Abstracts and Sources

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IEEE Std 1-1986 (R1992). *IEEE Standard General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation.* These principles are intended to serve as a guide in the preparation of IEEE and other standards that deal with the selection of temperature limits and the measurement of temperature for specific types of electric equipment. Fundamental considerations are outlined, and the elements to be considered in applying the principles to specific cases are reviewed. Guiding principles are included for the development of test procedures for thermal evaluation of electrical insulating materials, thermal evaluation of insulation systems, and thermal classification of insulation systems for use in rating electric equipment.

IEEE Std 4-1995. *IEEE Standard Techniques for High-Voltage Testing.* This standard establishes standard methods to measure high-voltage and basic testing techniques, so far as they are generally applicable, to all types of apparatus for alternating voltages, direct voltages, lightning impulse voltages, switching impulse voltages, and impulse currents. This revision implements many new procedures to improve accuracy, provide greater flexibility, and address practical problems associated with high-voltage measurements.

IEEE Std 7-4.3.2-1993. *IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations.* Additional computer specific requirements to supplement the criteria and requirements of IEEE Std 603-1991 are specified. Within the context of this standard, the term computer is a system that includes computer hardware, software, firmware, and interfaces. The criteria contained herein, in conjunction with criteria in IEEE Std 603-1991, establish minimum functional and design requirements for computers used as components of a safety system.

IEEE Std 11-1980 (R2000). *IEEE Standard for Rotating Electric Machinery for Rail and Road Vehicles.* Rotating electric machinery that forms part of the propulsion and major auxiliary equipment on internally and externally powered electrically propelled rail and road vehicles and similar large transport and haulage vehicles, and their trailers where specified in a contract, is covered. Major auxiliary equipment includes equipment such as blower and compressor motors, motor-generator and motor-alternator sets, auxiliary generators, and exciters, usually larger than 3 kW. Ratings, tests, and calculation procedures are defined to permit comparison among machines for similar use, and to enable suitability of machines for a given use to be evaluated. The following are covered: ratings, temperature rises and temperature-rise tests, temperature measurements, high-potential tests, commutation tests, overspeed requirements and tests, characteristic curves and tests, external power systems, terminal markings, mechanical measurements.

IEEE Std 18-1992. *IEEE Standard for Shunt Power Capacitors.* Capacitors rated 216 V or higher, 2.5 kvar or more, and designed for shunt connection to alternating-current transmission and distribution systems operating at a nominal frequency of 50 or 60 Hz are considered. Service conditions, ratings, manufacturing, and testing are covered. A guide to the application and operation of power capacitors is included.

IEEE Std 32-1972 (R1997). *IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.* Devices used for the purpose of controlling the ground current or the potentials to ground of an alternating-current system are covered. These devices can be grounding transformers, ground-fault neutralizers, resistors, reactors, capacitors, or combinations of these. Rating, insulation classes and dielectric-withstand levels, temperature limitations, testing, and construction are considered.

IEEE Std 43-2000. *IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.* This document describes the recommended procedure for measuring insulation resistance of armature and field windings in rotating machines rated 1 hp, 750 W or greater. It applies to synchronous machines, induction machines, dc machines, and synchronous condensers. Contained within this document is the general theory of insulation resistance (IR) and polarization index (P.I.), as well as factors affecting the results, test procedures, methods of interpretation, test limitations, and recommended minimum values.

IEEE Std 48-1996. *IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV Through 765 kV.* All indoor and outdoor cable terminations used on alternating-current cables having laminated or extruded insulation rated 2.5 kV through 765 kV are covered, except for separable insulated connectors, which are covered by IEEE Std 386-1995.

IEEE Std 62-1995. *IEEE Guide for Diagnostic Field Testing of Electric Power Apparatus—Part 1: Oil Filled Power Transformers, Regulators, and Reactors.* Diagnostic tests and measurements that are performed in the field on oil-immersed power transformers and regulators are described. Whenever possible, shunt reactors are treated in a similar manner to transformers. Tests are presented systematically in categories depending on the subsystem of the unit being examined. A diagnostic chart is included as an aid to identify the various subsystems. Additional information is provided regarding specialized test and measuring techniques.

IEEE Std 67-1990 (R1995). *IEEE Guide for Operation and Maintenance of Turbine Generators.* General recommendations for the operation, loading, and maintenance of turbine-driven synchronous generators having cylindrical rotors are provided. The manufacturer's and user's responsibility is discussed, and the classification of generators and the basis on which they are rated are covered. Mechanical considerations are also addressed.

IEEE Std 80-2000. *IEEE Guide for Safety in AC Substation Grounding.* Outdoor ac substations, either conventional or gas-insulated, are covered in this guide. Distribution, transmission, and generating plant substations are also included. With proper caution, the methods described herein are also applicable to indoor portions of such substations, or to substations that are wholly indoors. No attempt is made to cover the grounding problems peculiar to dc substations. A quantitative analysis of the effects of lightning surges is also beyond the scope of this guide.

IEEE Std 81-1983 (R1991). *IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.* The present state of the technique of measuring ground resistance and impedance, earth resistivity, and potential gradients from currents in the earth, and the prediction of the magnitude of ground resistance and potential gradients from scale-model tests are described and discussed. Factors influencing the choice of instruments and the techniques for various types of measurements are covered. These include the purpose of the measurement, the accuracy required, the type of instruments available, possible sources of error, and the nature of the ground or grounding system under test. The intent is to assist the engineer or technician in obtaining and interpreting accurate, reliable data. The test procedures described promote the safety of personnel and property and prevent interference with the operation of neighboring facilities.

IEEE Std 81.2-1991. *IEEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or*

Interconnected Grounding Systems. Practical instrumentation methods are presented for measuring the ac characteristics of large, extended, or interconnected grounding systems. Measurements of impedance to remote earth, step and touch potentials, and current distributions are covered for grounding systems ranging in complexity from small grids (less than 900 m^2) with only a few connected overhead or direct-burial bare concentric neutrals, to large grids (greater than 20 000 m^2) with many connected neutrals, overhead ground wires (sky wires), counterpoises, grid tie conductors, cable shields, and metallic pipes. This standard addresses measurement safety; earth-return mutual errors; low-current measurements; power-system staged faults; communication and control cable transfer impedance; current distribution (current splits) in the grounding system; step, touch, mesh, and profile measurements; the foot-equivalent electrode earth resistance; and instrumentation characteristics and limitations.

IEEE Std 82-1994. *IEEE Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors*. A test procedure for impulse testing of insulated conductors (cables) and cables with accessories installed (cable systems) is provided. This procedure can be used as a design or qualification test for cables or for cable systems. This test procedure is not intended to replace any existing or future standards covering cable or cable accessories, impulse generators, impulse testing or voltage measurements. It is intended to supplement such standards by indicating specific procedures for a specific type of cable system or cable system component.

IEEE Std 91-1984 (R1994). *IEEE Standard Graphic Symbols for Logic Functions (bound with IEEE Std 91a-1991)*. An international language by which it is possible to determine the functional behavior of a logic or circuit diagram with minimal reference to supporting documentation is defined; as such, it is designed to allow a single concept to be expressed in one of several different ways, according to the demands of a particular situation. Consequently, this standard does not attempt, nor intend, to establish single correct symbols for particular devices. The symbols for representing logic functions or devices enable users to understand the logic characteristics of these functions or devices without specific knowledge of their internal characteristics. Definitions and an explanation of symbol construction are provided. Information is presented on: qualifying symbols associated with inputs, outputs, and other connections; dependency notation; combinational and sequential elements; and symbols for highly complex functions. The symbols and representation techniques are compatible with IEC Pub. 617, Part 12.

IEEE Std 91a-1991 (R1994). *Supplement to IEEE Standard Graphic Symbols for Logic Functions (bound with IEEE Std 91-1984)*. Graphic symbols for representing logic functions or physical devices capable of carrying out logic functions are presented. Descriptions of logic functions, the graphic representation of these functions, and examples of their applications are given. The symbols are presented in the center of electrical applications, but most may also be applied to nonelectrical systems (for example, pneumatic, hydraulic, or mechanical). This supplement provides additional internationally approved graphic symbols and makes corrections as needed to IEEE Std 91-1984.

IEEE Std 95-1977 (R1991). *IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage*. Recommendations are made to aid in the selection of metric units, so as to promote uniformity in the use of metric units and to limit the number of different metric units that will be used in electrical and electronics science and technology. The recommendations can cover units for space and time, periodic and related phenomena, mechanics, heat, electricity and magnetism, light and related electromagnetic radiations, and acoustics. This document does not cover how metric units are to be used nor does it offer guidance concerning correct metric practice.

IEEE Std 98-1984 (R1993). *IEEE Standard for the Preparation of Test Procedures for the Thermal Evaluation of Solid Electrical Insulating Materials*. Principles are given for the development of test procedures to evaluate the thermal endurance of solid electrical insulating materials and simple combinations of such materials. The results of accelerated thermal endurance tests, which are conducted according to prescribed procedures, may be used to establish temperature indexes for insulating materials. The test procedures apply to materials before they are fabricated into insulating structures identified with specific parts of electric equipment. Tests for specific insulating materials are not covered. The procedures may or may not apply to the aging characteristics of dielectric fluids or of porous materials impregnated with dielectric fluids.

IEEE Std 99-1980 (R1992). *IEEE Recommended Procedures for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electric Equipment*. A general form is provided for the preparation of test procedures. Points to be considered by technical committees in the preparation of specific instructions for the thermal evaluation of insulation systems for electric equipment are suggested. The test procedures involve accelerated thermal aging of insulation systems and specify tests that the committees deem pertinent, based on conditions of use. The objective of the procedures is to provide for the functional evaluation, by test, of insulation systems electric equipment

IEEE Std 101-1987 (R1995). *IEEE Guide for the Statistical Analysis of Thermal Life Test Data*. Statistical analyses of data from thermally accelerated aging tests are described. The basis and use of statistical calculations are explained. Data analysis, estimation of the relationship between life and temperature, and the comparison between two sets of data are covered.

IEEE Std 112-1996. *IEEE Standard Test Procedure for Polyphase Induction Motors and Generators*. Instructions are given for conducting and reporting the more generally applicable and acceptable tests to determine the performance characteristics of polyphase induction motors and generators. Electrical measurements, performance testing, temperature tests, and miscellaneous tests are covered.

IEEE Std 115-1995. *IEEE Guide: Test Procedures for Synchronous Machines*. Instructions are given for conducting the more generally applicable and accepted tests to determine the performance characteristics of synchronous machines. Although the tests described are applicable in general to synchronous generators, synchronous motors (larger than fractional horsepower), synchronous condensers, and synchronous frequency changers, the descriptions make reference primarily to synchronous generators and synchronous motors. Alternative methods of making many of the tests covered in this guide are described and are suitable for different sizes and types of machines under different conditions. This guide covers miscellaneous tests; saturation curves, segregated losses, and efficiency; load excitation and voltage regulation; temperature tests; torque tests; synchronous machine quantities; and sudden short-circuit tests.

IEEE Std 117-1974 (R1991). *IEEE Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery*. Useful methods for the evaluation of systems of insulation for random-wound stators of rotating electric machines are given. The chief purpose is to classify insulation systems in accordance with their temperature limits by test, rather than by chemical composition. The procedure is intended to evaluate insulation systems for use in usual service conditions with air cooling. It has also been a useful tool for evaluating systems for special requirements where machines are enclosed in gas atmospheres, subjected to strong chemicals, metal dusts, or submersion in liquids, although these special requirements are beyond the scope of this test procedure.

IEEE Std 118-1978 (R1992). *IEEE Standard Test Code for Resistance Measurements.* Methods of measuring electrical resistance that are commonly used to determine the characteristics of electric machinery and equipment are presented. The methods are limited to those using direct-current or commercial power frequencies of 60 Hz or below, and to those measurements required to determine performance characteristics. The choice of method in any given case depends on the degree of accuracy required and the nature of the circuit to be measured. A guide for selecting the appropriate method is given.

IEEE Std 120-1989 (R1997). *IEEE Master Test Guide for Electrical Measurements in Power Circuits.* Instructions are given for measuring electrical quantities that are commonly needed to determine the performance characteristics of electric machinery and equipment. Methods are given for measuring voltage, current, power, energy, power factor, frequency, impedance, and magnetic quantities, with either analog or digital indicating or integrating instruments, in dc or ac rotating machines; transformers; induction apparatus; arc and resistance heating equipment; and mercury arc, thermionic, or solid-state rectifiers and inverters. Ancillary instruments and equipment are discussed. Computer-based techniques and the use of optical fibers in instrumentation are considered.

IEEE Std 122-1991 (R1997). *IEEE Recommended Practice for Functional Performance Characteristics of Control Systems for Steam Turbine Generator Units.* Minimum functional and performance characteristics related to speed/load-control systems for steam turbine generator units that may be interconnected on a power system are recommended. The recommendations apply to the following types of steam turbines, rated at 500 kW and larger, intended to drive electric generators at constant speed: (1) condensing or noncondensing turbines without initial or exhaust steam-pressure control, or both, including turbines used with reheat or regenerative feed-water heaters, or both; (2) condensing or noncondensing turbines with initial or exhaust steam-pressure control, or both, including turbines used with reheat or regenerative feed-water heaters, or both; (3) automatic extraction, or induction, or both, and mixed-pressure turbines. Emergency governors, or other overspeed control devices, and, in general, devices that are not responsive to speed are excluded. This recommended practice can be included in prime-mover purchase specifications.

IEEE Std 125-1988 (R1996). *IEEE Recommended Practice for Preparation of Equipment Specifications for Speed-Governing of Hydraulic Turbines Intended to Drive Electric Generators.* Terms, functions, and characteristics as commonly used in North America for preparing equipment specifications for speed-governing of hydraulic turbine-driven generators are defined. Specific components that may be included in a governor system are described. The performance characteristics of a good governor system and adjustments and tests to obtain and confirm the desired performance are delineated. Information to be provided by the manufacturer, so that the purchaser can be assured that the governor equipment will interface properly with other equipment, is specified. The intent is also to provide adequate information for maintenance purposes. The criteria for acceptance tests are given, and the data that will be furnished by the purchaser are listed.

IEEE Std 139-1988 (R1999). *IEEE Recommended Practice for the Measurement of Radio Frequency Emission from Industrial, Scientific, and Medical (ISM) Equipment Installed on User's Premises.* Equipment inspection and RF electromagnetic field measurement procedures are described for equipment that generates RF energy for purposes other than radio communications, to cause physical, chemical, or biological changes. The procedures are designed to help ensure that the equipment does not interfere with radio communications, navigation, and other essential radio services. The reporting of RF field measurements is covered.

IEEE Std 140-1990 (R1995). *IEEE Recommended Practice for Minimization of Interference from Radio-Frequency Heating Equipment.* Procedures that may be applied in the design and construction of radio-frequency heating equipment used for heating in industrial settings and for other purposes are described. These procedures are intended to reduce the levels of radio-frequency energy leaks that can interfere with other equipment and broadcast services. They may also be used as remedial measures when harmful interference occurs. Applications in the field of telecommunication and information technology are excluded.

IEEE Std 141-1993 (R1999). *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book).* A thorough analysis of basic electric-systems considerations is present. 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. Recommendations are made regarding system planning; voltage considerations; urge voltage protection; system protective devices; fault calculations; grounding; power switching, transformation, and motor-control apparatus; instruments and meters; cable systems; busways; electrical energy conservation; and cost estimation.

IEEE Std 142-1991. *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book).* The problems of system grounding, that is, connection to ground of neutral, of the corner of the delta, or of the midtap of one phase are covered. The advantages and disadvantages of grounded versus ungrounded systems are discussed. Information is given on how to ground the system, where the system should be grounded, and how to select equipment for the grounding of the neutral circuits. Connecting the frames and enclosures of electric apparatus, such as motors, switchgear, transformers, buses, cables, conduits, building frames, and portable equipment, to a ground system is addressed. The fundamentals of making the interconnection or ground-conductor system between electric equipment and the ground rods, water pipes, etc., are outlined. The problems of static electricity—how it is generated, what processes may produce it, how it is measured, and what should be done to prevent its generation or to drain the static charges to earth to prevent sparking—are treated. Methods of protecting structures against the effects of lightning are also covered. Obtaining a low-resistance connection to the earth, using of ground rods, connections to water pipes, etc., is discussed.

IEEE Std 145-1993. *IEEE Standard Definitions of Terms for Antennas.* Definitions of terms in the field of antennas are provided.

IEEE Std 149-1979 (R1990). *IEEE Standard Test Procedures for Antennas.* Procedures for the measurement of antenna properties are presented. It is assumed that the antenna to be measured can be treated as a passive, linear, and reciprocal device, and that its radiation properties can therefore be measured in either the transmitting or the receiving mode. However, many of the procedures can be adapted for use in the measurement of antenna systems containing circuit elements that may be active, nonlinear, or nonreciprocal. The measurement of radiation patterns on an antenna range is addressed. The instrumentation required for the antenna range, directions for the evaluation of an existing range, and the operation of ranges are discussed. A variety of special measurement techniques are included.

IEEE Std 167A.1-1995. *IEEE Standard Facsimile Test Chart: Bi-level (Black & White).* A facsimile test chart for assessing performance of document facsimile systems, including any compatible combination of facsimile equipment, computers, transmission facilities, and image storage, is pro-

vided. The chart is composed solely of high-resolution, high contrast black-and-white patterns. Although the chart is designed for Group 3 and Group 4 facsimile, it is also expected to be useful in testing other imaging systems. The received image may be recorded or displayed. This standard offers a means of assessing various technical quality parameters, detecting defects produced in received images, and evaluating the readability of text when the original is black and white.

IEEE Std 167A.2-1996. *IEEE Standard Facsimile Test Chart: High Contrast (Gray Scale).* A means of assessing performance of document facsimile systems, including any compatible combination of facsimile equipment, computers, transmission facilities, and image storage, is provided.

IEEE Std 167A.3-1997. *IEEE Standard Facsimile Color Test Chart.* A facsimile test chart for assessing performance of document facsimile systems, including any compatible combination of facsimile equipment, computers, transmission facilities, and image storage, is provided.

IEEE Std 187-1990 (R1995). *IEEE Standard on Radio Receivers: Open Field Method of Measurement of Spurious Radiation from FM and Television Broadcast Receivers.* The potential sources of spurious radiation from frequency modulation (FM) and television broadcast receivers, and methods of measurement, are described. This standard is not intended to apply to equipment other than FM and television broadcast receivers.

IEEE Std 208-1995. *IEEE Standard on Video Techniques: Measurement of Resolution of Camera Systems, 1993 Techniques.* The methods for measuring the resolution of camera systems are described. The primary application is for users and manufacturers to quantify the limit where fine detail contained in the original image is no longer reproduced by the camera system. The techniques described may also be used for laboratory measurements and for proof-of-performance specifications for a camera.

IEEE Std 211-1997. *IEEE Standard Definitions of Terms for Radio Wave Propagation.* Terms and definitions used in the context of electromagnetic wave propagation relating to the fields of telecommunications, remote sensing, radio astronomy, optical waves, plasma waves, the ionosphere, the magnetosphere, and magnetohydrodynamic, acoustic, and electrostatic waves are supplied.

IEEE Std 213-1987 (R1998). *IEEE Standard Procedure for Measuring Conducted Emissions in the Range of 300 kHz to 25 MHz from Television and FM Broadcast Receivers to Power Lines.* Procedures for testing television and FM broadcast receivers are included. The user is cautioned that this method might not be appropriate for conducted emissions testing of systems or products other than televisions or FM receivers. Other more general methods exist and it is suggested that they be used for review. These include, but are not limited to, ANSI C63.4-1981, American National Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz. A method for measuring the emissions conducted by the power line from these receivers in the frequency range of 300 kHz to 25 MHz is defined. Standard input signals, the equipment setup, and measurement techniques are described.

IEEE Std 241-1990 (R1997). *IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (IEEE Gray Book).* This recommended practice is intended to promote the use of sound engineering principles in the design of electrical systems for commercial buildings. It covers load characteristics; voltage considerations; power sources and distribution systems; power distribution apparatus; controllers; services, vaults, and electrical equipment rooms; wiring systems; systems protection and coordination; lighting; electric space conditioning; transportation; communication systems planning; facility automation; expansion, modernization, and rehabilitation; special requirements by occupancy; and energy conservation. Although directed to the power-oriented engineer with limited commercial-building experience, it can be an aid to all engineers responsible for the electrical design of commercial buildings. This standard is not intended to be a complete handbook; however, it can direct the engineer to texts, periodicals, and references for commercial buildings and act as a guide through the myriad of codes, standards, and practices published by the IEEE and other professional associations and governmental bodies.

IEEE Std 242-1986 (R1991). *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).* The selection, application, and coordination of the components that constitute system protection for industrial plants and commercial buildings is presented. Complete information on protection and coordination principles designed to protect industrial and commercial power systems against any abnormalities that could reasonably be expected to occur in the course of system operation is presented. Design features are provided for: quick isolation of the affected portion of the system while maintaining normal operation elsewhere; reduction of the short-circuit current to minimize damages to the system, its components, and the utilization equipment it supplies; and provision of alternate circuits, automatic throwovers, and automatic reclosing devices. The following are covered: basic principles; calculation of short-circuit currents; instrument transformers; selection and application of protective relays; fuses; low-voltage circuit breakers; ground-fault protection; conductor protection; motor protection; transformer protection; generator protection; bus and switchgear protection; service supply line protection; overcurrent coordination; and maintenance, testing, and calibration.

IEEE Std 252-1995. *IEEE Standard Test Procedure for Polyphase Induction Motors Having Liquid in the Magnetic Gap.* Instructions for conducting and reporting the more generally applicable and acceptable tests to determine the performance characteristics of polyphase induction motors having liquid in the magnetic gap are given. Constants in several equations and forms apply to three-phase motors only and require modification for application to motors having another number of phases. It is not intended that the procedure cover all possible tests or tests of a research nature. The procedure shall not be interpreted as requiring the making of any or all of the tests described herein in any given transaction.

IEEE Std 259-1999. *IEEE Standard Test Procedure for Evaluation of Systems of Insulation for Dry-Type Specialty and General-Purpose Transformers.* A uniform method by which the thermal endurance of electrical insulation systems for dry-type specialty and general-purpose transformers can be compared is established. Covered are insulation systems intended for use in the types of transformers described in NEMA ST 1-1988 and NEMA ST 20-1992.

ANSI 260.1-1993. *American National Standard Letter Symbols for Units of Measurement (IS Units, Customary Inch-Pound Units, and Certain Other Units).* General principles of letter symbol standardization are discussed. Symbols are given for general use and for use with limited character sets. The symbols given are intended for all applications, including use in text and equations; in graphs and diagrams; and on panels, labels, and nameplates.

ANSI 260.3-1993 (R2000). *American National Standard Mathematical Signs and Symbols for Use in Physical Sciences and Technology.* Signs and symbols used in writing mathematical text are defined. Special symbols peculiar to certain branches of mathematics, such as non-Euclidean Geometry's, Abstract Algebra's, Topology, and Mathematics of Finance, which are not ordinarily applied to the physical sciences and engineering, are omitted.

ANSI 260.4-1996 (R2000). *American National Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics.* Letter symbols for physical quantities used in the science

and technology of acoustics are covered. Abbreviations for a number of acoustical levels and related measures that are in common use are also given. The symbols given in this standard are intended for all applications.

IEEE Std 267-1966. *IEEE Recommended Practice for the Preparation and Use of Symbols.* Guidelines to be used in developing and applying those symbols that are employed in the electrical and electronics fields are provided. These include abbreviations, functional designations, graphic symbols, letter combinations, mathematical symbols, reference designations, symbols for quantities, and symbols for units. The guidelines should be useful to any committee engaged in developing standards publications in the areas mentioned.

IEEE Std 269-1992. *IEEE Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets.* Practical methods for measuring the transmission characteristics of both digital and conventional to-wire analog telephone sets by means of objective measurements on a test connection are described. The test results thus obtained may be used as a means of evaluating or specifying the transmission performance of a telephone set on a standardized basis. The measurements are applicable to telephone sets incorporating carbon or linear transmitters. Measurements are over the frequency range most useful for speech: 100–5000 Hz. The test methods are not intended to be applicable to special devices, such as noise-exclusion transmitters, distant-talking transmitters, insert-type receivers, or noise-exclusion receivers equipped with large ear pads.

IEEE Std 275-1992 (R1998). *IEEE Recommended Practice for Thermal Evaluation of Insulation Systems for Alternating-Current Electric Machinery Employing Form-Wound Preinstalled Stator Coils for Machines Rated 6900 V and Below.* A test procedure for comparing two or more insulation systems in accordance with their expected life at rated temperature is described. The procedure is limited to insulation systems for ac electric machines using form-wound preinstalled stator coils and rated 6900 V and below. This procedure is intended to evaluate insulation systems for use in usual service conditions with air cooling. It does not cover such special requirements as machines that are enclosed in gas atmospheres, or that are subjected to strong chemicals, to metal dust, or to submersion in liquids, etc. The procedure includes instructions for testing candidate systems in comparison with known systems having a proven record of service experience and interpretation of the results.

IEEE Std 277-1994. *IEEE Recommended Practice For Cement Plant Power Distribution.* Electrical distribution systems in cement plants that would result in satisfactory equipment utilization, reliability, performance, safety, and low maintenance—all at a reasonable cost are recommended.

IEEE Std 280-1985 (R1997). *IEEE Standard Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.* Letter symbols used to represent physical quantities in the field of electrical science and electrical engineering are defined. The symbols are independent of the units employed or special values assigned. Also included are selected symbols for mathematics and for physical constants.

IEEE Std 290-1980 (R1986). *IEEE Standard for Electric Couplings: Part I—General, Rating, Performance Characteristics; Part II—Test Procedures.* The more generally applicable characteristics, and how to conduct and report on the tests for determining them, are covered. Service conditions, rating, temperature and temperature use, torque characteristics, speed, losses, and markings are discussed. Methods for electrical measurements, preliminary tests, performance determination, temperature tests, high-potential tests, and miscellaneous tests are given.

IEEE Std 291-1991. *IEEE Standards Methods for Measuring Electromagnetic Field Strength of Sinusoidal Continuous Wave, 30 Hz to 30 Hz.* Two standard methods for field-strength measurement are described. The standard-antenna method consists of measuring the voltage developed in a standard antenna by the field to be measured and computing the field strength from the measured voltage and the dimensions and form of the standard antenna. The standard-field method consists of comparing voltages produced in an antenna by the field to be measured and by a standard field, the magnitude of which is computed from the dimensions of the transmitting antenna, its current distribution, the distance of separation, and effect of the ground. The measurement procedures are outlined, including calibration of commercial field strength and extension of the methods to microwave frequencies. Methods for measuring power radiated from an antenna under several different conditions are briefly presented, and the important considerations for securing useful and accurate measurements are described.

IEEE Std 292-1969 (R2000). *IEEE Specification Format for Single-Degree-of-Freedom Spring-Restrained Rate Gyros.* A guide for the preparation of a single-degree-of-freedom spring-restrained rate gyro specification is given. The format used provides a common meeting ground of terminology and practice for manufacturers and users.

IEEE Std 293-1969 (R2000). *IEEE Test Procedure for Single-Degree-of-Freedom Spring-Restrained Rate Gyros.* Recommended rate gyro test procedures derived from those currently in use, including test conditions to be considered, are compiled. In some cases alternate methods for measuring a performance characteristic have been included. This standard is intended to be a guide in the preparation of Section 4 of a specification that follows the format of IEEE Std 292-1969, Specification Format for Single-Degree-of-Freedom Spring-Restrained Rate Gyros.

IEEE Std 295-1969 (R2000). *IEEE Standard for Electronics Power Transformers.* Application guidance and test procedures are given for power transformers and inductors that are used in electronic equipment and supplied by power lines or generators of essentially sine wave or polyphone voltage. Provision is made for relating the characteristics of transformers to the associated rectifiers and circuits. This Standard includes, but is not limited to, the following transformers and inductors: rectifier supply transformers for either high- or low-voltage supplies, filament and cathode heater transformers, transformers for alternating current resonant charging circuits, inductors used in rectifier filters, and autotransformers with fixed taps.

IEEE Std 299-1997. *IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures.* Uniform measurement procedures and techniques are provided for determining the effectiveness of electromagnetic shielding enclosures at frequencies from 9 kHz to 18 GHz (extendable to 50 Hz and 100 GHz, respectively) for enclosures having no dimension less than 2.0 m. The types of enclosures covered include, but are not limited to, single-shield or double-shield structures of various construction, such as bolted demountable, welded, or integral with a building; and made of materials such as steel plate, copper or aluminum sheet, screening, hardware cloth, metal foil, or shielding fabrics.

IEEE Std 300-1988 (R1999). *IEEE Standard Test Procedures for Semiconductor Charged-Particle Detectors.* Test procedures for semiconductor charged-particle detectors for ionizing radiation are provided. They apply to detectors that are used for the detection and high-resolution spectroscopy of charged particles. The measurement techniques were selected to be readily available to all manufacturers and users of charged-particle detectors. Some superior techniques are not included because the methods are too complex or require equipment (such as particle accelerators) that may not be readily available. The standard covers measurement of resolution, noise, sensitivity to ambient conditions, current-voltage characteristics, dead-layer energy loss, sensitive arc, detector thickness (for transmission detectors), and capacitance-voltage characteristics.

IEEE Std 301-1988 (R1999). *IEEE Standard Test Procedures for Amplifiers and Preamplifiers used with Detectors of Ionizing Radiation.*

IEEE Std 303-1991 (R1996). *IEEE Recommended Practice for Auxiliary Devices for Motors in Class 1, Groups A, B, C, and D, Division 2 Locations.* Installation procedures and wiring methods and materials are recommended. Termination boxes, motor surge protection, and power-factor-correction capacitors are discussed. The aim is to promote consistent application of the devices covered.

IEEE Std 304-1977 (R1991). *IEEE Test Procedure for Evaluation and Classification of Insulation Systems for Direct-Current Machines.* Insulation systems for direct-current machines are classified in accordance with their limiting temperatures as determined by test rather than by chemical composition. The intention is to classify according to the recognized A, B, F, and H categories by determining thermal capability in accordance with machine temperature-rise standards. This test procedure has been prepared to indicate accepted tests. It is applicable to insulation systems for use in usual service conditions. This standard does not cover special requirements such as for machines in gas atmospheres being subjected to strong chemicals, metal dusts, or submersion in liquids.

IEEE Std 308-1991. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.* Class 1E portions of ac and dc power systems and instrumentation and control power systems in single-unit and multiunit nuclear power generating stations are covered. Not included are the preferred power supply; unit generator(s) and their buses; generators breaker; step-up, auxiliary, and start-up transformers; connections to the station switchyard; switchyard; transmission lines; and the transmission network. The intent is to provide criteria for the determination of Class 1E power system design features, criteria for sharing Class 1E power systems in multiunit stations, and the requirements for their testing and surveillance.

IEEE Std 309-1999/ANSI N42.3-1999. *IEEE Standard Test Procedures and Bases for Geiger-Mueller Counters.* Test procedures for Geiger-Mueller counters that are used for the detection of ionizing radiation are presented so that they have the same meaning to both manufacturers and users. Also included is information on bases (i.e., connections) for the counters.

IEEE Std 315-1975 (R1993). *IEEE Standard Graphic Symbols for Electrical and Electronics Diagrams.* A list of graphic symbols and class designation letters for use on electrical and electronics diagrams is provided. All of the symbols are designed so that their connection points fall on a modular grid to help those who use a grid basis for the preparation of diagrams. A substantial effort has been made to make this standard compatible with approved International Electrotechnical Commission (IEC) Recommendations (IEC Publication 117, in various parts).

IEEE Std 315A-1986 (R1993). *IEEE Standard Supplement to Graphic Symbols for Electrical and Electronics Diagrams.* Symbols approved by the International Electrotechnical Commission since 1975, or for which there is now a greater need in the US arising from international commerce, are provided. Besides the addition of new symbols, some updating of the information in IEEE Std 315-1975 has been undertaken.

IEEE Std 317-1983 (R1996). *IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations.* Requirements for the design, construction, qualification, test, and installation of electric penetration assemblies in nuclear containment structures for stationary nuclear power generating stations are presented. Quality control and quality assurance requirements and requirements for purchaser's specification are included. The requirements for external circuits that connect to penetration assemblies and for operation, maintenance, or periodic testing after installation are not covered.

IEEE Std 323-1983 (R1996). *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.* The basic requirements for qualifying Class 1E equipment with interfaces that are to be used in nuclear power generating stations are described. The principles, procedures, and methods of qualification are covered. These qualification requirements, when met, will confirm the adequacy of the equipment design under normal, abnormal, design basis event, post design basis event, and in-service test conditions for the performance of safety functions. The methods are to be used for qualifying equipment, extending qualification, and updating qualification if the equipment is modified.

IEEE Std 325-1996. *IEEE Standard Test Procedures for Germanium Gamma-Ray Detectors.* Terminology and standard test procedures are established for germanium radiation detectors that are used for the detection and high-resolution spectrometry of gamma rays, X rays, and charged particles that produce hole-electron pairs in the crystal lattice so that these items have the same meaning to both manufacturers and users. Not all tests described in this standard are mandatory, but tests that are used to specify performance shall be performed in accordance with this standard. Detector endcap and reentrant (Marinelli) beaker standards are discussed; measurements that depend upon phonon production are not covered in this standard.

IEEE Std 334-1994 (R1999). *IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations.* Methods and requirements for qualifying continuous duty Class 1E motors for use in nuclear power generating stations are provided. The methods are used for qualifying motors, extending the qualification, and updating the qualification if the motor's design or specified service conditions are modified. The requirements include the principles, procedures, and methods of qualification as they relate to continuous duty Class 1E polyphase squirrel cage ac motors.

IEEE Std 336-1985 (R1991). *IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities.* Requirements for installation, inspection, and testing of power, instrumentation, and control equipment and systems during the construction phase of a nuclear facility are set forth. These requirements also cover modifications and those operating phase activities that are comparable in nature and extent to related initial construction activities of the facility. The intent is to establish requirements for safety systems equipment. However, this standard may also be applied to nonsafety systems equipment.

IEEE Std 337-1972 (R1992). *IEEE Standard Specification Format Guide and Test Procedure for Linear, Single-Axis, Pendulous, Analog Torque Balance Accelerometer.* A format guide for the preparation of an accelerometer specification that provides a common meeting ground of terminology and practice for manufacturers and users is given. It covers performance; mechanical, electrical, and environmental requirements; quality assurance, preparation for delivery, and use of notes. A compilation of recommended procedures for testing an accelerometer is presented. These procedures, including test conditions to be considered, are derived from those currently in use. Not all tests outlined in this document need be included, nor are additional tests precluded. In some cases, alternative methods for measuring performance characteristics have been included or indicated. The torque balance electronics are not considered to be part of the instrument.

IEEE Std 338-1987 (R2000). *IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems.* Design and operational criteria are provided for the performance of periodic testing as part of the surveillance program of nuclear power generating station

safety systems. Such testing consists of functional tests and checks, calibration verification and time response measurements, as required, to verify that the safety system performs to meet its defined safety function. The system status, associated system documentation, test intervals, and test procedures during operation are also addressed.

IEEE Std 344-1987 (1993). *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.* Recommended practices for establishing procedures that will yield data that verify that the Class 1E equipment can meet its performance requirements during and following one safe shutdown earthquake preceded by a number of operating basis earthquakes are provided. This recommended practice may be used to establish tests or analyses that will yield data to substantiate performance claims or to evaluate and verify performance of representative devices and assemblies as part of an overall qualification effort. Two approaches to seismic analysis are described, one based on dynamic analysis and the other on static coefficient analysis. Common methods currently in use for seismic qualification by test are presented.

IEEE Std 352-1987 (R1999). *IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Safety Systems.* The basic principles that are needed to conduct a reliability analysis of safety systems are provided for designers and operators of nuclear power plant safety systems and the concerned regulatory groups. By applying the principles given, systems may be analyzed, results may be compared with reliability objectives, and the basis for decisions may be suitably documented. The quantitative principles are applicable to the analysis of the effects of component failures on safety system reliability. Although they have their greatest value during the design phase, the principles are applicable during any phase of the system's lifetime. They may also be applied during the preoperational phase or at any time during the normal lifetime of a system.

IEEE Std 367-1996. *IEEE Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage From a Power Fault.* Guidance for the calculation of power station ground potential rise (GPR) and longitudinal induction (LI) voltages is provided, as well as guidance for their appropriate reduction from worst-case values, for use in metallic telecommunication protection design.

IEEE Std 376-1975 (R1998). *IEEE Standard for the Measurement of Impulse Strength and Impulse Bandwidth.* The use of the impulse generator for calibration purposes in electromagnetic compatibility measurements is addressed. In particular, basic information relating to the use of this device is provided, and interpretation of measurements made using instruments based on it is considered. Two methods of measurement of spectrum amplitude and impulse bandwidth are described in detail. The first method uses a video pulse technique. The second uses a substitution method in which the reference is a pulse-modulated sine wave generator whose parameters are measured. Both techniques are capable of about equal accuracy.

IEEE Std 377-1980 (R1997). *IEEE Recommended Practice for Measurement of Spurious Emission from Land-Mobile Communication Transmitters.* Controlled test conditions, test apparatus, test methods, and data presentation, all of which form the basis for establishing the energy levels of spurious emissions of mobile communication transmitters designed to generate FM signals in the frequency range of 25 to 1000 MHz, are covered. The purpose is to enable design and system engineers engaged in a variety of development projects to achieve uniform results in recognizing the sources and nature of RF spurious emissions emanating from vehicular communications transmitters. Procedures for measuring both broadband and narrowband spectra are provided for both conducted and radiated emissions. Specified limits are not included. However, reference values that are not limited by the state of the art are provided. Transmitter test conditions, apparatus, and method are based on standard instrumentation and measuring techniques and do not require any special apparatus other than necessary terminal simulators. The procedures do not cover the associated antenna and transmission lines.

IEEE Std 379-1994 (R1997). *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems.* The application of the single-failure criterion to the electrical power, instrumentation, and control portions of nuclear power generating station safety systems is covered. Conformance with the requirements of IEEE Std 603-1991 and the single-failure criterion as stated in that document is established. Interpretation and guidance in the application of the single-failure criterion, a discussion of the failures, and an acceptable method of single-failure analysis are presented.

IEEE Std 382-1996. *IEEE Standard for Qualification of Actuators for Power-Operated Valve Assemblies With Safety-Related Functions for Nuclear Power Plants.* The qualification of all types of power-driven valve actuators, including damper actuators, for safety-related functions in nuclear power generating stations, is described. This standard may also be used to separately qualify actuator components. The minimum requirements for, and guidance regarding, the methods and procedures for qualification of power-driven valve actuators with safety-related functions are provided.

IEEE Std 383-1974 (R1992). *IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.* Directions for establishing type tests that may be used in qualifying Class 1E electric cables, field splices, and other connections for service in nuclear power generating stations are provided. Though intended primarily for cable for field installation, this guide may also be used for the qualification of internal wiring of manufactured devices. It does not cover cables for service within the reactor vessel.

IEEE Std 384-1992 (R1998). *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits.* The independence requirements of the circuits and equipment comprising or associated with Class 1E systems are described. Criteria for the independence that can be achieved by physical separation and electrical isolation of circuits and equipment that are redundant are set forth. The determination of what is to be considered redundant is not addressed.

IEEE Std 386-1995. *IEEE Standard for Separable Insulated Connectors System for Power Distribution Systems Above 600 V.* Definitions, service conditions, ratings, interchangeable construction features, and tests are established for load-break and dead-break separable insulated connector systems rated 601 V and above, 600 A or less, for use on power distribution systems.

IEEE Std 387-1995. *IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations.* The criteria for the application and testing of diesel-generator units as Class 1E standby power supplies in nuclear power generating stations is described.

IEEE Std 388-1992 (R1998). *IEEE Standard for Transformers and Inductors in Electronic Power Conversion Equipment.* Transformers and inductors of both the saturating and nonsaturating type are covered. The power-transfer capability of the transformers and inductors covered ranges from less than 1 W to the multikilowatt level. The purpose is to provide a common basis between the engineers designing power-conversion circuits and the engineers designing the transformers and inductors used in those circuits. Apparatus used in equipment for high-voltage power conversion for distribution by electric utilities is not covered.

IEEE Std 389-1996. *IEEE Recommended Practice for Testing Electronics Transformers and Inductors.* A number of tests

are presented for use in determining the significant parameters and performance characteristics of electronics transformers and inductors. These tests are designed primarily for transformers and inductors used in all types of electronics applications, but they may apply to the other types of transformers of large apparent-power rating used in the electric power utility industry.

IEEE Std 390-1987 (R1998). *IEEE Standard for Pulse Transformers.* Pulse transformers for use in electronic equipment are considered. This standard applies to the following transformer types: power output (drivers), impedance matching, interstage coupling, current sensing, and blocking-oscillator transformers. For these transformers, the peak power transmitted ranges from a few milliwatts to kilowatts, and the peak voltage transmitted ranges from a few volts to many kilovolts. Symbols, performance tests, equivalent circuits, preferred test methods, marking, and service conditions are covered.

IEEE Std 393-1991 (R1998). *IEEE Standard Test Procedures for Magnetic Cores.* Test methods useful in the design, analysis, and operation of magnetic cores in many types of applications are presented. Tests for specifying and/or measuring permeability, core loss, apparent core loss, induction, hysteresis, thermal characteristics, and other properties are given. Most of the test methods described include specific parameter ranges, instrument accuracies, core sizes, etc., and may be used in the specification of magnetic cores for industrial and military applications. More generalized test procedures are included for the benefit of the R & D engineer and university student. Although the primary concern is with cores of the type used in electronic transformers, magnetic amplifiers, inductors, and related devices, many of the tests are adaptable to cores used in many other applications.

IEEE Std 399-1997. *IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (IEEE Brown Book).* This Recommended Practice is a reference source for engineers involved in industrial and commercial power systems analysis. It contains a thorough analysis of the power system data required, and the techniques most commonly used in computer-aided analysis, in order to perform specific power system studies of the following: short-circuit, load flow, motor-starting, cable ampacity, stability, harmonic analysis, switching transient, reliability, ground mat, protective coordination, dc auxiliary power system, and power system modeling.

IEEE Std 400-1991. *IEEE Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.* Procedures and test-voltage values for acceptance and maintenance high-direct-voltage testing of power cable systems are presented. The procedures apply to all types of insulated cable systems rated between 2000 V and 69 kV and intended primarily for the transmission or distribution of power. They are not intended to apply to communication cables, control cables, high-frequency or other special-purpose cables, although information of some value may be obtained thereby. The aim of this standard is to provide uniform procedures and to provide guidelines for evaluation of the test results.

IEEE Std 404-1993. *IEEE Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5000 to 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500–500 000 V.* This standard establishes electrical ratings and test requirements for cable joints for use with extruded dielectric shielded cable rated in preferred voltage steps from 5000–138 000 V and cable joints for use with laminated dielectric cable rated in preferred voltage steps from 2500–500 000 V. It also defines a variety of common joint constructions. This standard is designed to provide uniform testing procedures that can be used by manufacturers and users to evaluate the ability of underground power cable splices to perform reliably in service.

IEEE Std 420-1982 (R1999). *IEEE Standard for the Design and Qualification of Class 1E Control Boards, Panels, and Racks Used in Nuclear Power Generating Stations.* Design requirements that are unique to Class 1E control boards, panels, and racks are specified. Standards for qualification tests to verify that these design requirements have been satisfied are provided. This standard is not intended to define the selection, design, or qualification of piping, modules, or other equipment mounted on the Class 1E control boards, panels, or racks. It is concerned, however, with the effect such mounted equipment has on the design and qualifications. Qualification and testing of individual Class 1E control board components and modules and external field-run cables are not covered.

IEEE Std 421.1-1986 (R1996). *IEEE Standard Definitions for Excitation Systems for Synchronous Machines.* Elements and commonly used components in excitation control systems and for excitation systems as applied to synchronous machines are defined. The primary purpose of the standard is to provide a vocabulary for writing excitation systems specifications, evaluating excitation system performance, specifying methods for excitation system tests, and preparing excitation system standards. It is also intended to serve as an educational aid for those becoming acquainted with excitation systems.

IEEE Std 421.2-1990 (R1996). *IEEE Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems.* Criteria, definitions, and test procedures for evaluating the dynamic performance of excitation control systems as applied by electric utilities are provided. Since an excitation control system, including the synchronous machine and its excitation system, is a feedback control system, many definitions and performance criteria that are common to all feedback control systems have been adopted. Others specifically related to excitation control systems have been derived. The primary purposes of this guide are to provide a basis for evaluating closed-loop performance of excitation control systems (including both the synchronous machine and its excitation system) for both large and small signal disturbances; to confirm the adequacy of mathematical models of excitation systems for use in analytical studies of power systems; to specify methods for performing tests of excitation control systems and their components; and to prepare excitation system specifications and additional standards. Portions of this standard can also serve as a tutorial for people becoming acquainted with excitation control systems.

IEEE Std 421.3-1997. *IEEE Standard for High-Potential Test Requirements for Excitation Systems for Synchronous Machines.* High-potential test voltages for excitation systems used with synchronous machines are established. Test voltages are established based on whether equipment is connected to the exciter power circuit or is electrically isolated from the exciter power circuit.

IEEE Std 421.4-1990 (R1999). *IEEE Guide for the Preparation of Excitation System Specifications.* This guide is intended to provide to the specification writer the necessary material to prepare a specification for the procurement of an excitation system for a synchronous machine. The information is given in narrative form, with descriptions and functions of particular items that should be examined in preparing the specifications. Excitation systems for synchronous machines rated 5000 kVA or larger are covered.

IEEE Std 421.5-1992 (R1996). *IEEE Recommended Practice for Excitation System Models for Power System Stability Studies.* Excitation system models suitable for use in large-scale system stability studies are presented. With these models, most of the excitation systems currently in widespread use on large, system-connected synchronous machines in North America can be represented. They include updates of models published in the Transactions on Power Apparatus and Systems in 1981, as well as models for additional control features, such as discontinuous excitation controls.

IEEE Std 429-1994. *IEEE Recommended Practice for Thermal Evaluation of Sealed Insulation Systems for AC Electric*

Machinery Employing Form-Wound Preinsulated Stator Coils for Machines Rated 6900 V and Below. A test procedure for comparing two or more sealed insulation systems in accordance with their expected life at rated temperature is outlined. The procedure is limited to insulation systems for alternating-current (ac) electrical machines using form-wound preinsulated stator coils rated 6900 V and below.

IEEE Std 432-1992 (R1998). *IEEE Guide for Insulation Maintenance for Rotating Electric Machinery (5 hp to less than 10 000 hp)*. Information necessary to permit an effective evaluation of the insulation systems of medium and small rotating electrical machines is presented. The guide is intended to apply in general to industrial air-cooled machines rated from 5 hp to less than 10 000 hp. However, the procedures may be found useful for other types of machines.

IEEE Std 433-1974 (R1991). *IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Voltage at Very Low Frequency*. Terms that have a specific meaning in VLF testing are defined, and VLF test equipment and wave shape are described. A uniform procedure for testing the armature insulation of large ac machines with VLF voltage is provided. Constants for relating VLF tests to power-frequency and direct-voltage tests to obtain equally effective test levels are recommended.

IEEE Std 434-1973 (R1991). *IEEE Guide for Functional Evaluation of Insulation Systems for Large High-Voltage Machines*. Classification test methods that may be used to compare insulation systems in use, or proposed for use, in large high-voltage rotating machines are described. Thermal aging, voltage endurance, thermomechanical forces, and electromechanical forces are addressed.

IEEE Std 442-1981 (R1991). *IEEE Guide for Soil Thermal Resistivity Measurement*. A method for measurement of soil thermal resistivity that is based on the theory that the rate of temperature rise of a line heat source is dependent upon the thermal constants of the medium in which it is placed is given. This information will enable the user to properly install and load underground cables. The aim is to provide sufficient information to enable the user to select useful commercial test equipment, or to manufacture equipment that is not readily available on the market, and to make meaningful resistivity measurements with this equipment in the field or on soil samples in the laboratory. Designs for both laboratory and field thermal needles are described.

IEEE Std 446-1995 (R2000). *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book)*. This Recommended Practice addresses the uses, power sources, design, and maintenance of emergency and standby power systems. Chapter 3 is a general discussion of needs for and the configuration of emergency and standby systems. Chapter 9 lists the power needs for specific industries. Chapters 4 and 5 deal with the selection of power sources. Chapter 6 provides recommendations for protecting both power sources and switching equipment during fault conditions. Chapter 7 provides recommendations for design of system grounding, and Chapter 10 provides recommendations for designing to reliability objectives. Chapter 8 provides recommended maintenance practices.

IEEE Std 449-1998. *IEEE Standard for Ferroresonant Voltage Regulators*. Ferroresonant transformers used as regulators in electronic power supplies and in other equipment are covered. Guides to application and test procedures are included.

IEEE Std 450-1995 (R2000). *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*. Maintenance, test schedules, and testing procedures that can be used to optimize the life and performance of permanently installed, vented lead-acid storage batteries used for standby power applications are provided. This recommended practice also provides guidance to determine when batteries should be replaced. This recommended practice is applicable to all stationary applications. However, specific applications, such as emergency lighting units and semiportable equipment, may have other appropriate practices and are beyond the scope of this recommended practice.

IEEE Std 473-1985 (R1997). *IEEE Recommended Practice for an Electromagnetic Site Survey (10 kHz to 10 GHz)*. Guidelines for the systematic, documented investigation of the amplitudes of RF electromagnetic fields found at one or more locations with respect to frequency, time, and position are provided. Periodic and random radiated electric and magnetic fields and conducted interference within the frequency range of 10 kHz to 10 GHz are considered. Although several aspects of radio-emission investigation are not addressed directly, including signal identification and discrimination; field emissions from regularly occurring, low-frequency, pulsed sources; and test enclosure fields, much information pertinent to these areas is provided.

IEEE Std 475-2000. *IEEE Standard Measurement Procedure for Field Disturbance Sensors 300 MHz to 40 GHz*. Test procedures for microwave field disturbance sensors to measure radio frequency (RF) radiated field strength of the fundamental frequency, harmonic frequencies, near field power flux density, and nonharmonic spurious emissions of sensors operating within the frequency range of 300 MHz to 40 GHz are defined.

IEEE Std 484-1996. *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*. Recommended design practices and procedures for storage, location, mounting, ventilation, instrumentation, preassembly, assembly, and charging of vented lead-acid batteries are provided. Required safety practices are also included. These recommended practices are applicable to all stationary applications. However, specific applications, such as emergency lighting units and semiportable equipment, and alternate energy applications, may have other appropriate practices and are beyond the scope of this recommended practice.

IEEE Std 485-1997. *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications*. Methods for defining the dc load and for sizing a lead-acid battery to supply that load for stationary battery applications in full float operations are described. Some factors relating to cell selection are provided for consideration. Installation, maintenance, qualification, testing procedures, and consideration of battery types other than lead-acid are beyond the scope of this recommended practice. Design of the dc system and sizing of the battery charger(s) are also beyond the scope of this recommended practice.

IEEE Std 487-1992 (R1994). *IEEE Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Power Stations*. Workable methods for protecting wire-line communication circuits entering power stations are presented. This standard covers: the electric power station environment; protection apparatus; service types, reliability, service performance objective classifications, and transmission considerations; protection theory and philosophy; protection configurations; installation and inspection; and safety.

IEEE Std 488.1-1987 (R1994). *IEEE Standard Digital Interface for Programmable Instrumentation*. Interface systems used to interconnect both programmable and nonprogrammable electronic measuring apparatus with other apparatus and accessories necessary to assemble instrumentation systems are considered. The standard applies to the interface of instrumentation systems, or portions of them, in which the data exchanged among the interconnected apparatus is digital, the number of devices that may be interconnected by one contiguous bus does not exceed 15, total transmission path lengths over the interconnecting cables do not exceed 20 m, and the data rate across the interface on any signal line does not ex-

ceed 1 Mb/s. The basic functional specifications of this standard may also be used in digital interface applications that require longer distances, more devices, increased noise immunity, or combinations of these.

IEEE Std 488.2-1992 (R1998). *IEEE Standard Codes, Formats, Protocols, and Common Commands for Use With IEEE Std 488.1-1987, IEEE Standard Digital Interface for Programmable Instruction.* A set of codes and formats to be used by devices connected via the IEEE 488.1 bus is specified. This standard also defines communication protocols necessary to effect application-independent and device-dependent message exchanges, and further defines common commands and characteristics useful in instrument system applications. It is intended to apply to small- to medium-scale instrument systems comprised mainly of measurement, stimulus, and interconnect devices with an instrumentation controller. The standard may also apply to certain devices outside the scope of the instrument system environment. IEEE 488.1 subsets, standard message-handling protocols including error handling, unambiguous program and response-message syntactic structures, common commands useful in a wide range of instrument system applications, standard status reporting structures, and system configuration and synchronization protocols are covered.

IEEE Std 492-1999. *IEEE Guide for Operation and Maintenance of Hydro-Generators.* General recommendations for the operation, loading, and maintenance of synchronous hydro-generators and generator/motors are covered. This guide does not apply to synchronous machines having cylindrical rotors. In this guide, the term hydro-generator is used to describe a synchronous machine coupled to a hydraulic turbine or pump-turbine. This guide is not intended to apply in any way to the prime mover.

IEEE Std 493-1997. *IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (IEEE 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. The presentation is self-contained and should enable trade-off studies during the design of industrial and commercial power systems 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 are presented.

IEEE Std 499-1997. *IEEE Recommended Practice for Cement Plant Electric Drives and Related Electrical Equipment.* All electric drives, including motors and control wiring associated with machinery or equipment commonly used in the manufacturing areas of cement plants are covered. Recommendations are not intended to apply to power distribution circuits. These recommendations apply to electrical equipment having a supply voltage of 13 800 V or less.

IEEE Std 502-1985 (R1998). *IEEE Guide for Protection, Interlocking, and Control of Fossil-Fuel Unit-Connected Steam Stations.* Information regarding the essential subsystems that make up a fossil-fueled unit-connected boiler-turbine-generator (BTG) station is presented. Typical interlocking, control, and protection for operating the subsystems in a coordinated order to ensure proper start-up and safe shutdown are described. The primary purpose is to provide a basis for qualitative evaluation of overall design of a unit-connected fossil-fuel plant, and for writing general operating guides of an educational nature to aid in acquainting personnel with boiler-turbine-generator systems.

IEEE Std 505-1977 (R1996). *IEEE Standard Nomenclature for Generating Station Electric Power Systems.* Electric power systems in stationary generating stations that provide electric power to the power system are covered. Nomenclature is included for the following interrelated systems: generating unit power system, generating unit auxiliaries power system, station auxiliaries power system, generating unit dc auxiliaries power system, and station dc auxiliaries power system. Nomenclature for instrumentation, controls, or auxiliaries is not included.

IEEE Std 510-1983 (R1992). *IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing.* Safety practices for those who are involved with making measurements on high-voltage sources or with high-power sources of various types, including power-system lines, 60-Hz test transformers, direct-voltage supplies, lightning-impulse generators, and switching-impulse generators are recommended. Electrical hazards involved in temporary measurements, as opposed to metering, relaying, or routine line work, are considered. Safety is considered in connection with testing in laboratories, in the field, in substations, and on lines, and with the test equipment utilized. Cable-fault location, large-capacitance-load testing, high-current testing, and direct connection to power lines are treated separately.

IEEE Std 515-1997. *IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.* The specific test requirements for qualifying electrical resistance heating cables for industrial service are provided, as well as the basis for electrical and thermal design. Heating device characteristics are addressed, and installation and maintenance requirements are detailed. Heating cable and surface heating device application recommendations and requirements are made for ordinary (unclassified) and hazardous (classified) potentially flammable atmospheres and locations.

IEEE Std 515.1-1995. *IEEE Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.* This standard provides the specific test requirements for qualifying electrical resistance heating cables for industrial service, and provides the basis for electrical and thermal design. Heater characteristics are addressed, and installation and maintenance requirements are detailed. Recommendations and requirements are made for unclassed, Class I, Division 2, and Class I, Division 1 heating cable applications.

IEEE Std 516-1995. *IEEE Guide for Maintenance Methods on Energized Power Lines.* General recommendations for performing maintenance work on energized power lines are provided. Technical explanations as required to cover certain laboratory testing of tools and equipment, field maintenance and care of tools and equipment, and work methods for the maintenance of energized lines and for persons working in the vicinity of energized lines are included.

IEEE Std 517-1974 (R2000). *IEEE Standard Specification Format Guide and Test Procedure for Single-Degree-of-Freedom Rate-Integrating Gyros.* A specification format guide for the preparation of a rate-integrating gyro specification that provides a common meeting ground of terminology and practice for manufacturers and users is presented. A compilation of recommended procedures for testing a rate-integrating gyro is given.

IEEE Std 518-1982 (R1996). *IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.* Techniques for the installation and operation of industrial controllers, so as to minimize the disturbing effects of electrical noise on these controllers, are addressed. The identification of noise in control circuits and the classification of noise are discussed. A systems approach to noise reduction is presented. Installation recommendations and wiring practices are covered.

IEEE Std 519-1992 (R1996). *IEEE Recommended Practices And Requirements For Harmonic Control In Electric 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 Std 522-1992 (R1998). *IEEE Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating-Current Rotating Electric Machines*. Suggestions are made for testing the dielectric strength of the insulation separating the various turns from each other within multiturn form-wound coils to determine their acceptability. Typical ratings of machines employing such coils normally lie within the range of 200 kW to 100 MW. The test-voltage levels described do not evaluate the ability of the turn insulation to withstand abnormal voltage surges, as contrasted to surges associated with normal operation. The suggestions apply to: (1) individual stator coils after manufacture; (2) coils in completely wound stators of original manufacture; (3) coils and windings for rewinds of used machinery; and (4) windings of machines in service to determine their suitability for further service (preventive-maintenance testing). Coil service conditions, test devices, and test sequence are discussed. High-frequency test levels for new coils, as well as procedures for maintenance tests or tests after installation of machines, are proposed. Specific test procedures for wound machines, for coils during winding, and for applying surge tests to complete windings are given in the appendixes.

IEEE Std 524-1992 (R1997). *IEEE Guide to the Installation of Overhead Transmission Line Conductors*. General recommendations for the selection of methods, equipment, and tools that have been found practical for the stringing of overhead transmission line conductors and overhead ground wires are provided. The aim is to present in one document sufficient details of present-day methods, materials, and equipment to outline the basic considerations necessary to maintain safe and adequate control of conductors during stringing operations.

IEEE Std 524a-1993 (R1998). *IEEE Guide to Grounding During the Installation of Overhead Transmission Line Conductors—Supplement to IEEE Guide to the Installation of Overhead Transmission Line Conductors*. General recommendations for the selection of methods and equipment found to be effective and practical for grounding during the stringing of overhead transmission line conductors and overhead ground wires are provided. The guide is directed to transmission voltages only. The aim is to present in one document sufficient details of present day grounding practices and equipment used in effective grounding and to provide electrical theory and considerations necessary to safeguard personnel during the stringing operations of transmission lines.

IEEE Std 525-1992 (R1999). *IEEE Guide for the Design and Installation of Cable Systems in Substations*. Guidance for the design, installation, and protection of wire and cable systems in substations with the objective of minimizing cable failures and their consequences is provided. The design of wire and cable systems in generating stations is not covered.

IEEE Std 528-1994. *IEEE Standard for Inertial Sensor Terminology*. Terms and definitions relating to inertial sensors are presented. Usage as understood by the inertial sensor community is given preference over general technical usage of the terms herein. The criterion for inclusion of a term and its definition in this document is usefulness as related to inertial sensor technology.

IEEE Std 529-1980 (R2000). *IEEE Supplement for Strapdown Applications to IEEE Standard Specification Format Guide and Test Procedure for Single-Degree-of-Freedom Rate-Integrating Gyros*. A specification format guide for the preparation of a rate-integrating gyroscope specification is presented. Recommended procedures for testing a rate-integrating gyroscope are compiled. This standard, when combined with IEEE Std 517-1974 (R1994), defines the requirements and test procedures in terms of characteristics unique to the gyroscope or those applications in which the dynamic angular inputs are significantly greater than the limitations identified in IEEE Std 517-1974.

IEEE Std 530-1978 (R1992). *IEEE Standard Specification Format Guide and Test Procedure for Linear, Single-Axis, Digital, Torque Balance Accelerometer*. A guide for the preparation of a digital accelerometer specification and test procedure is provided. It is intended to provide common terminology and practice for manufacturers and users. The accelerometer considered utilizes a linear, single-axis, nongyroscopic accelerometer sensor with a permanent magnet torquer. The torquing electronics are considered part of the accelerometer. General design, performance, environmental, and reliability requirements are covered. Information on classification of tests, acceptance tests, qualification tests, reliability tests, standard test conditions, test equipment, test methods, and data submittal is given.

IEEE Std 532-1993. *IEEE Guide for Selecting and Testing Jackets for Underground Cables*. This guide covers corrosion protection, properties of commonly used jackets, electrical characteristics of jackets, physical requirements for jackets referenced in industry standards, and selection and testing of jackets. It is written for those responsible for optimizing underground cable installations. The purpose is to present a reasonably complete picture of the role of jackets so that the subject can be approached in an orderly and organized manner. An effort has been made to shun the highly technical language and theory commonly used by electrical engineers, corrosion engineers, and chemists to discuss the more detailed application of jackets.

IEEE Std 535-1986 (R1994). *IEEE Standard Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations*. Qualification methods for Class 1E lead storage batteries and racks to be used in nuclear power generating stations outside of primary containment are described. Principles and methods of qualification, qualification information, qualification by type testing, type tests and analysis procedures, and documentation are covered. Battery sizing, maintenance, capacity testing, installation, charging equipment, and other types of batteries that are beyond the scope of this standard are not considered.

IEEE Std 539-1990 (R1994). *IEEE Standard Definitions of Terms Relating to Corona and Field Effects of Overhead Power Lines*. The most widely used terms specific to or associated with overhead power-line corona and electromagnetic fields are defined. This includes terms related to electric and magnetic fields, ions, radio frequency propagation, electromagnetic signals and noise, audible noise, coupled voltages and current, shock and perception, weather and related statistical terms, and measurements and measuring devices.

IEEE Std 563-1978 (R1996). *IEEE Guide on Conductor Self-Damping Measurements*. Methods for measuring the inherent vibration damping characteristics of overhead conductors are presented. The intent is to obtain information in a compatible and consistent form that will provide a reliable basis for studying the vibration and damping of conductors in the future, and for comparing data of various investigators. The methods and procedures recommended are not intended for quality-control test purposes.

IEEE Std 572-1985 (R1992). *IEEE Standard for Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations*. General requirements, direction, and methods for qualifying Class 1E connection assemblies for service in nuclear power generating stations are provided. Connectors, terminations, and environmental seals in combination with related cables or wires as assemblies are covered. Emphasis is placed on multipin, quick, disconnect-type

connection assemblies primarily utilized for instrumentation, control, and power. This standard does not apply to containment electric penetrations, fire stops, in-line splices, or components for service within the reactor vessel.

IEEE Std 576-1989 (R1992). *IEEE Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in the Petroleum and Chemical Industry*. A guide to installation, splicing, termination, and field-proof testing of cable systems is provided. The aim is to avoid premature cable failure due to improper installation and mechanical damage during installation, and to provide a reference that can be specified for cable installations. This standard is not intended to be a design document; many of the problems of installation can be avoided by designing cable layouts with the installation limits of this recommended practice.

IEEE Std 577-1976 (R1992). *IEEE Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations*. Uniform minimum acceptable requirements for the performance of reliability analyses for safety-related systems found in nuclear power generating stations are provided. The requirements can be applied during design, fabrication, testing, maintenance, and repair of systems and components in nuclear power plants. The timing of the analysis depends upon the purpose for which it is performed.

IEEE Std 583-1982 (R1999). *IEEE Standard Modular Instrumentation and Digital Interface System (CAMAC)*. This standard is intended to serve as a basis for a range of modular instrumentation capable of interfacing transducers and other devices to digital controllers for data and control. It consists of mechanical standards and signal standards that are sufficient to ensure physical and operational compatibility between units regardless of source. The standard fully specifies a data bus (Dataway) by means of which instruments and other functional modules can communicate with each other, with peripherals, with computers, and with other external controllers.

IEEE Std 592-1990 (R1996). *IEEE Standard for Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Insulated Connectors*. Design tests for shield resistance and a simulated fault-current initiation are provided for exposed semiconducting shields used on cable accessories, specifically joints and separable insulated connectors rated 15 kV through 35 kV. The shield is intended to protect the insulation, provide voltage stress relief, maintain the accessory surface at or near ground potential under normal operating conditions, and initiate fault-current arcing if the accessory insulation should fail. A maximum shield-resistance performance is specified to ensure that the accessory shield provides stress relief, and that the shield surface is maintained at or near ground potential. The shield fault-current initiation test demonstrates the ability of the accessory shield to initiate fault-current arcs to ground that will cause overcurrent protective devices to operate should the accessory insulation fail. In this test, special connections and procedures are specified to ensure that full-circuit voltage will be applied to the shield during the test. The test specifications do not, however, attempt to simulate all service conditions or field assembly.

IEEE Std 595-1982 (R1999). *IEEE Standard Serial Highway Interface System (CAMAC)*. A serial highway (SH) system using byte-organized messages and configured as a unidirectional loop, to which are connected a system controller and up to sixty-two CAMAC crate assemblies, is defined. In the primary application, the controlled devices are CAMAC crate assemblies with serial crate controllers that conform to a defined message structure. In other applications, some or all of the controlled devices connected to the SH can be equipment that conforms to a subset of the full specification and is not necessarily constructed in CAMAC format or controlled by CAMAC commands.

IEEE Std 596-1982 (R1999). *IEEE Standard Parallel Highway Interface System (CAMAC)*. The CAMAC parallel highway interface system for interconnecting up to seven CAMAC crates (or other devices) and a system controller is defined. In particular, the signals, timing, and logical organization of the connections from crate controllers and parallel highway drivers to the parallel highway through a standard connector are defined. The internal structures of crate controllers and parallel highway drivers, and the physical construction of the parallel highway system, are defined only as they affect compatibility between parts of the system.

IEEE Std 602-1996. *IEEE Recommended Practice for Electric Systems in Health Care Facilities (IEEE White Book)*. A recommended practice for the design and operation of electric systems in health care facilities is provided. The term "health care facility," as used here, encompasses buildings or parts of buildings that contain hospitals, nursing homes, residential custodial care facilities, clinics, ambulatory health care centers, and medical and dental offices. Buildings or parts of buildings within an industrial or commercial complex, used as medical facilities, logically fall within the scope of this book.

IEEE Std 603-1998. *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. Minimum functional and design criteria for the power, instrumentation, and control portions of nuclear power generating station safety systems are established. The criteria are to be applied to those systems required to protect the public health and safety by functioning to mitigate the consequences of design basis events. The intent is to promote safe practices for design and evaluation of safety system performance and reliability. Although the standard is limited to safety systems, many of the principles may have applicability to equipment provided for safe shutdown, post-accident monitoring display instrumentation, preventative interlock features, or any other systems, structures, or equipment related to safety.

IEEE Std 605-1998. *IEEE Guide for Design of Substation Rigid-Bus Structures*. Rigid-bus structures for outdoor and indoor, air-insulated, and alternating-current substations are covered. Portions of this guide are also applicable to strain-bus structures or direct-current substations, or both. Ampacity, radio influence, vibration, and forces due to gravity, wind, fault current, and thermal expansion are considered. Design criteria for conductor and insulator strength calculations are included.

IEEE Std 610-1990 (R1992). *IEEE Standard Computer Dictionary—A Compilation of IEEE Standard Computer Glossaries*. This dictionary is a compilation of IEEE standard glossaries covering the fields of mathematics of computing, computer applications, modeling and simulation, image processing and pattern recognition, data management, and software engineering. Every effort has been made to include all terms within the designated subject areas. Terms were excluded if they were considered to be parochial to one group or organization; company-proprietary or trademarked; multiword terms whose meaning could be inferred from the definitions of the component words; or terms whose meaning in the computer field could be directly inferred from their standard English meaning.

IEEE Std 610.7-1995. *IEEE Standard Glossary of Computer Networking Terminology*. Terms that pertain to data communications and networking, from the following areas, are defined: Data transmission, general communications, general networks, local area networks, network communications security, network errors, networking hardware, network management, network nodes, network signaling, open system architecture, packet, protocols, standards, and standards organizations, telephony. The glossary is primarily a compilation of terms defined in individual IEEE standards, but also includes a number of common terms.

IEEE Std 610.12-1990. *IEEE Standard Glossary of Software Engineering Terminology*. Terms currently in use in the computer field are identified, and standard definitions are estab-

lished for them. Topics covered include: addressing; assembling, compiling, linking, and loading; computer performance evaluation; configuration management; data types; errors, faults, and failures; evaluation techniques; instruction types; language types; libraries; microprogramming; operating systems; quality attributes; software documentation; software and system testing; software architecture; software development processes; software development techniques; and software tools. This glossary is intended to serve as a useful reference both for those in the computer field and for those who come into contact with computers either through their work or in their everyday lives.

IEEE Std 620-1996. *IEEE Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.* Thermal limit curves for induction machines are defined. A procedure is established for the presentation of these curves, and guidance for the interpretation and use of these curves for machine thermal protection is provided.

IEEE Std 622-1987 (R1994). *IEEE Recommended Practice for the Design and Installation of Electric Heat Tracing Systems for Nuclear Power Generating Stations.* Recommended practices for designing, installing, and maintaining electric heat tracing systems are provided. These electric heat tracing systems are applied, both for critical process temperature control and for process temperature control, on mechanical piping systems that carry borated water, caustic soda, and other solutions. Electric heat tracing systems are also applied on water piping systems to prevent them from freezing in cold weather. The recommendations include identification of requirements, heater design considerations, power systems design considerations, temperature control considerations, alarm considerations, finished drawings and documents, installation of materials, start-up testing, temperature tests, and maintenance of electric pipe heating systems.

IEEE Std 622A-1984 (R1999). *IEEE Recommended Practice for the Design and Installation of Electric Pipe Heating Control and Alarm Systems for Power Generating Stations.* Recommended practices for designing and installing electric pipe heating control and alarm systems, as applied to mechanical piping systems that require heat, are provided. The recommendations include selection of control and alarm systems, accuracy considerations, local control usage, centralized control usage, qualification criteria of controls and alarms, and calibration and testing of controls and alarms. The intent is to ensure design consistency and reliable operation of electric pipe heating control and alarm systems, which in turn will ensure that piping system fluids will be available for use not only during station operation but also during normal shutdown.

IEEE Std 622B-1988 (R2000). *IEEE Recommended Practice for Testing and Start-up Procedures for Electric Heat Tracing Systems for Power Generating Stations.* Recommendations that may be used to ensure that an electric heat tracing system is installed correctly, is properly tested and commissioned, and is functioning correctly are provided. The recommendations cover the sequence for testing materials and components of the electric heat tracing system, installation, preoperational testing of the system, verification of system performance, and the necessary records to be filed. Although this standard is written for power generating stations, the techniques presented can be used on electric heat tracing systems in any application.

IEEE Std 625-1990. *IEEE Recommended Practice to Improve Electrical Maintenance and Safety in the Cement Industry.* Assists in the effective application of relays and other devices for the protection of shunt capacitors used in substations. It covers the protective considerations, along with recommended and alternate methods of protection for the most commonly used capacitor bank configurations. Capacitor bank design trade-offs are also discussed. This guide covers protection of filter tanks and very large EHV capacitor banks, but does not include a discussion of pole-mounted capacitor banks on distribution circuits or application of capacitors connected to rotating apparatus.

IEEE Std 627-1980 (R1996). *IEEE Standard for Design Qualification of Safety Systems Equipment Used in Nuclear Power Generating Stations.* Basic principles for design qualification of safety systems equipment used in nuclear power generating stations are provided. Specification criteria, the development of a qualification program, and documentation are addressed. All types of safety systems equipment—mechanical and instrumentation as well as electrical—are covered. Principles and procedures for preparing specific safety systems equipment standards are established.

IEEE Std 628-1987 (R1992). *IEEE Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations.* Criteria for the minimum requirements in the selection, design, installation, and qualification of raceway systems for Class 1E circuits for nuclear power generating stations are provided. Methods for the structural qualification of such raceway systems are prescribed. Since aging and radiation have no known detrimental effect upon metallic raceway systems, and since nonmetallic raceway systems are limited to underground or embedded applications, these two environmental conditions are not considered, nor are the embedments or structural members to which a support is attached.

IEEE Std 635-1989 (R1994). *IEEE Guide for Selection and Design of Aluminum Sheaths for Power Cables.* Requirements are outlined and design guidelines are established for the selection of aluminum sheaths for extra-high, high-, medium-, and low-voltage cables. Basic installation parameters for aluminum-sheathed cables are also established. In addition, references to industry standards and codes incorporating design and installation requirements of aluminum-sheathed cables and a comprehensive bibliography on the subject are provided.

IEEE Std 637-1985 (R1992). *IEEE Guide for the Reclamation of Insulating Oil and Criteria for Its Use.* Detailed procedures are provided for reclaiming used mineral insulating oils (transformer oils) by chemical and mechanical means to make them suitable for reuse as insulating fluids. Reclamation procedures are described, as are the test methods used to evaluate the progress and end point of the reclamation process, and the essential properties required for reuse in each class of equipment. Suitable criteria for the use of reclaimed oils are identified. The use of oil in new apparatus under warranty is not covered.

IEEE Std 638-1992 (R1999). *IEEE Standard for Qualification of Class 1E Transformers for Nuclear Power Generating Stations.* Procedures for demonstrating the adequacy of new Class 1E transformers, located in a mild environment of a nuclear power generating station, to perform their required safety functions under postulated service conditions are presented. Single- and three-phase transformers rated 601 V to 15 000 V for the highest voltage winding, and up to 2500 kVA (self-cooled rating), are covered. Because of the conservative approach used in the development of this standard for new transformers, the end-point criteria cannot be used for in-service transformers.

IEEE Std 643-1980 (R1992). *IEEE Guide for Power-Line Carrier Applications.* Application information is provided to users of carrier equipment as applied on power-transmission lines. Material on power line carrier channel characteristics is presented, along with discussions on intrabundle conductor systems and insulated shield wire systems. Procedures for the calculation of channel performance are given. Data for the calculations are drawn from various sections of the guide. Coupling components are discussed, covering line traps, coupling capacitors, line tuners, coaxial cables, hybrids, and filters. Frequency selection practices are discussed. Future trends are examined with respect to electronic equipment, system improvements, and applications.

IEEE Std 644-1994. *IEEE Standard Procedures for Measurement Frequency Electric and Magnetic Fields from AC Power Lines.* Uniform procedures for the measurement of power frequency electric and magnetic fields from alternating current (ac) overhead power lines and for the calibration of the meters used in these measurements are established. The procedures apply to the measurement of electric and magnetic fields close to ground level. The procedures can also be tentatively applied (with limitations, as specified in the standard) to electric fields near an energized conductor or structure.

IEEE Std 647-1995. *IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Laser Gyros.* The specification and test requirements for a single-axis laser gyro for use as a sensor in attitude control systems, angular displacement measuring systems, and angular rate measuring systems is defined. A standard specification format guide for the preparation of a single-axis laser gyro is provided. A complication of recommended procedures for testing a laser gyro, derived from those presently used in the industry, is also provided.

IEEE Std 649-1991 (R1999). *IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations.* The basic principles, requirements, and methods for qualifying Class 1E motor control centers for outside containment applications in nuclear power generating stations are described. In addition to defining specific qualification requirements that are in accordance with the more general qualification requirements of IEEE Std 323-1974, this standard is intended to provide guidance in establishing a quantification program for demonstrating the design adequacy of Class 1E motor control centers.

IEEE Std 650-1990 (R1998). *IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations.* Methods for qualifying static battery chargers and inverters for Class 1E installations for mild-environment outside containment in nuclear power generating stations are described. The qualification methods set forth employ a combination of type testing and analysis, the latter including a justification of methods, theories, and assumptions used. These procedures meet the requirements of IEEE Std 323-1983 (R1990), IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

IEEE Std 656-1992 (R2000). *IEEE Standard for the Measurement of Audible Noise From Overhead Transmission Lines.* Uniform procedures are established for manual and automatic measurement of audible noise from overhead transmission lines. Their purpose is to allow valid evaluation and comparisons of the audible noise performance of various overhead lines. Definitions are provided, and instruments are specified. Measurement procedures are set forth, and precautions are given. Supporting data that should accompany the measurement data are specified, and methods for presenting the latter are described.

IEEE Std 662-1992 (R1998). *IEEE Standard Terminology for Semiconductor Memory.* Guidelines under which data sheets for new semiconductor memories are to be generated are provided. Adherence to these guidelines is intended to produce data sheets that are concise and that consistently define the operation and characteristics of semiconductor memory devices. Terminology relevant to product description, product specification, and user information is covered.

IEEE Std 664-1993 (R2000). *IEEE Guide for Laboratory Measurement of the Power Dissipation Characteristics of Aeolian Vibration Dampers for Single Conductors.* The current methodologies, including apparatus, procedures, and measurement accuracies, for determining the dynamic characteristics of vibration dampers and damping systems are described. Some basic guidance is provided regarding a given method's strengths and weaknesses. The methodologies and procedures described are applicable to indoor testing only.

IEEE Std 665-1995. *IEEE Guide for Generating Station Grounding.* Grounding practices that have generally been accepted by the electric utility industry as contributing to effective grounding systems for personnel safety and equipment protection in generating stations are identified. A guide for the design of generating station grounding systems and for grounding practices applied to generating station indoor and outdoor structures and equipment, including the interconnection of the station and substation grounding systems, is provided.

IEEE Std 666-1991 (R1996). *IEEE Design Guide for Electric Power Service Systems for Generating Stations.* A listing of typical power plant auxiliaries and criteria for their power service are given, as well as examples of one-line diagrams for a typical plant. Tables of typical power service parameters are included to illustrate the range of typical values for each parameter, and the approximate effect of the minimum and maximum value of each parameter on the load is identified. This guide applies to all types of power generating stations, but it is particularly applicable where the electric power service system is required to perform continuously.

IEEE Std 671-1985 (R1997). *IEEE Standard Specification Format Guide and Test Procedure for Nongyroscopic Inertial Angular Sensors: Jerk, Acceleration, Velocity, and Displacement.* A guide is presented for the preparation of a specification and test procedure for an inertial angular sensor that provides a common meeting ground of terminology and practice for manufacturers and users of an array of sensors that have been developed to meet needs not easily met by traditional spinning rotor gyroscopes. A test procedure for verifying that the specifications have been met is given. The standard is not intended to compete with existing standards for specific devices with highly specific models and error sources, such as spring restrained rate gyros, but to provide a uniform guide for those inertial angular sensors that have not been covered elsewhere.

IEEE Std 675-1982 (R1999). *IEEE Standard Multiple Controllers in a CAMAC Crate.* A method for incorporating more than one source of control into a CAMAC crate is defined. The aim is to provide for the use of auxiliary controllers in order to extend the capabilities and fields of application of the CAMAC modular instrumentation and interface system of IEEE Std 583-1982 (R1994).

IEEE Std 683-1976 (R1999). *IEEE Recommended Practice for Block Transfers in CAMAC Systems.* The recommended block-transfer algorithms are discussed, and those given in the basic CAMAC specification are described. These algorithms are well established and are supported by existing hardware. Some new algorithms are then discussed. Compatibility, hardware design, and software considerations are addressed.

IEEE Std 686-1997. *IEEE Standard Radar Definitions.* Definitions for the purpose of promoting clarity and consistency in the use of radar terminology are provided. The definitions represent the consensus of a panel of radar experts.

IEEE Std 692-1997. *IEEE Standard Criteria for Security Systems for Nuclear Power Generating Stations.* Criteria are provided for the design of an integrated security system for nuclear power generating stations. Requirements are included for the overall system, interfaces, subsystems, and individual electrical and electronic equipment. This standard addresses equipment for security-related detection, surveillance, access control, communication, and data acquisition.

IEEE Std 693-1997. *IEEE Recommended Practice for Seismic Design of Substations.* Recommendations for seismic design of substations, including qualification of each equipment type, are discussed. Design recommendations consist of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation.

IEEE Std 694-1985 (R1994). *IEEE Standard for Microprocessor Assembly Language.* A common set of instructions used

by most general-purpose microprocessors is presented. Rules for the naming of new instructions and the derivation of new mnemonics are provided. Assembly language conventions are established. This standard does not prescribe programming style, specify or restrict the number of instructions or directives, prescribe or restrict the type of instructions or directives, specify or restrict machine architectures, or specify source or object file formats.

IEEE Std 716-1995. *IEEE Standard C/ATLAS Test Language for All Systems—Common/Abbreviated Test Language for All Systems (C/ATLAS).* A high order language for testing is defined. This language is designed to describe tests in terms that are independent of any specific test system, and has been constrained to ensure that it can be implemented on automatic test equipment.

IEEE Std 726-1982 (R1999). *IEEE Standard, Real-Time BASIC for CAMAC.* This standard defines ANSI Standard Real-Time BASIC, in which the declarations and real-time statements are defined for use with CAMAC hardware. It covers real-time capabilities, declarations, parallel activities, CAMAC input and output, the CAMAC Q and X signals, CAMAC LAM handling, message passing, shared data, and bit manipulation. The aim is to achieve maximum compatibility between different implementations of ANSI BASIC for use with CAMAC.

IEEE Std 730-1998. *IEEE Standard for Software Quality Assurance Plans.* Uniform, minimum acceptable requirements for preparation and content of Software Quality Assurance Plans (SQAPs) are provided. This standard applies to the development and maintenance of critical software. For noncritical software, or for software already developed, a subset of the requirements of this standard may be applied.

IEEE Std 730.1-1995 (Redesignation of IEEE Std 938). *IEEE Guide for Software Quality Assurance Planning.* Approaches to good Software Quality Assurance practices in support of IEEE Std 730-1989, IEEE Standard for Software Quality Assurance Plans, are identified. These practices are directed toward the development and maintenance of critical software, that is, where failure could impair safety or cause large financial losses.

IEEE Std 738-1993. *IEEE Standard for Calculating the Current-Temperature Relationship of Bare Overhead Conductors.* A simplified method of calculating the current–temperature relationship of bare overhead lines, given the weather conditions, is presented. Along with a mathematical method, sources of the values to be used in the calculation are indicated. This standard does not undertake to list actual temperature–ampacity relationships for a large number of conductors in a large number of conditions.

IEEE Std 739-1995 (R2000). *IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities (IEEE Bronze Book).* This recommended practice serves as an engineering guide for use in electrical design for energy conservation. It provides a standard design practice to assist engineers in evaluating electrical options from an energy standpoint. It establishes engineering techniques and procedures to allow efficiency optimization in the design and operation of an electrical system considering all aspects (safety, costs, environment, those occupying the facility, management needs, etc.).

IEEE Std 741-1997. *IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations.* Criteria that establish protection requirements for Class 1E power systems and equipment are prescribed. The purpose of and the means for obtaining protection from electrical and mechanical damage or failures that can occur within a time period that is shorter than that required for operator action are described. Testing and surveillance requirements are included. Plant physical design requirements to protect against certain events are not included.

IEEE Std 743-1995. *IEEE Standard Equipment Requirements and Measurement Techniques for Analog Transmission Parameters for Telecommunications.* Performance requirements for test equipment that measures the analog transmission parameters of subscriber loops, message trunks, PBX trunks, and ties lines are specified. Requirements for these measurements with DS1 bit stream access are also provided. The measurement of loss, noise, and impulse noise on non-loaded cable pairs used for digital subscriber lines is addressed.

IEEE Std 751-1990 (R1992). *IEEE Trial-Use Design Guide for Wood Transmission Structures.* This standard discusses the structural design and application of wood transmission structures. The guide includes definitions, application of loads, structure application, characteristics of natural wood and laminated wood members, design stresses, fabrication of laminated wood members, connections, nonwood members, erection and framing, and quality assurance.

IEEE Std 754-1985 (R1990). *IEEE Standard for Binary Floating-Point Arithmetic.* A family of commercially feasible ways for new systems to perform binary floating-point arithmetic is defined. This standard specifies basic and extended floating-point number formats; add, subtract, multiply, divide, square root, remainder, and compare operations; conversions between integer and floating-point formats; conversions between different floating-point formats; conversions between basic-format floating-point numbers and decimal strings; and floating-point exceptions and their handling, including nonnumbers.

IEEE Std 758-1979 (R1999). *IEEE Standard, Subroutines for CAMAC.* A set of standard subroutines that provide access to CAMAC facilities in a variety of computer programming languages is described. The subroutines are specifically intended to be suitable for use with FORTRAN, although they are not restricted to that language. The subroutines have been grouped into three subsets in order to provide different standard levels of implementation. The lowest level requires only two subroutines, but, nevertheless, gives access to most of the facilities that can be found in CAMAC. In higher levels of implementation, subroutines are added that permit procedures to be written in more mnemonic terminology, provide better handling of LAMs, permit procedures to be independent of the type of CAMAC highway used, and provide efficient block-transfer capability.

IEEE Std 759-1984 (R1999). *IEEE Test Procedures for Semiconductor X-Ray Energy Spectrometers.* Test procedures for X-ray spectrometers consisting of a semiconductor radiation detector assembly and signal processing electronics interfaced to a pulse-height analyzer/computer are presented. Energy resolution, spectral distortion, pulse-height linearity, counting rate effects, overload effects, pulse-height stability, and efficiency are covered. Test procedures for pulse-height analyzers and computers are not covered.

IEEE Std 765-1995. *IEEE Standard for Preferred Power Supply (PPS) for Nuclear Power Generating Stations.* The design criteria of the preferred power supply (PPS) and its interfaces with the Class 1E power system, switchyard, transmission system, and alternate ac (AAC) source are described. This standard provides PPS requirements for nuclear power plants and guidance in the areas of AAC power source interfaces with PPS, physical independence of the PPS power and control circuits, and expanded PPS criteria for multiunit stations.

IEEE Std 771-1998. *IEEE Guide to the Use of the ATLAS Specification.* Guidance in the use of ATLAS test languages is provided. ATLAS may be used to describe test requirements independent of any specific test equipment, and examples of best practice.

IEEE Std 776-1992 (R1998). *IEEE Recommended Practice for Inductive Coordination of Electric Supply and Communication Lines.* The inductive environment that exists in the vicinity of electric power and wire-line telecommunications

systems and the interfering effects that may be produced are addressed. An interface that permits either party, without need to involve the other, to verify the induction at the interface by use of a probe wire is presented. This recommended practice does not apply to railway signal circuits.

IEEE Std 790-1989 (R1996). *IEEE Guide for Medical Ultrasound Field Parameter Measurements.* Information is provided to assist in selecting measurement procedures and implementing 'cookbook' descriptions for building and using devices that measure medical ultrasound field parameters such as pressure, power, and intensity. It is intended for use by persons involved in measurement of acoustic fields produced by medical ultrasound instruments and is divided into three parts. Hydrophones are discussed, with regard to types, calibration and evaluation techniques, and measurement techniques using hydrophones. Fifteen radiation force techniques that are commercially available for purchase or are currently in routine use in established research laboratories are described. Three thermal techniques that utilize acoustic absorption and the measurement of temperature and an acousto-optical approach are presented.

IEEE Std 792-1995. *IEEE Recommended Practice for the Evaluation of the Impulse Voltage Capability of Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils.* A test procedure for the evaluation of the impulse voltage capability of insulation systems of form-wound ac rotating electrical machinery is outlined. The procedure is primarily directed toward providing a qualification test for the turn insulation in regard to its ability to withstand impulses that might be impressed on the terminals of a machine and that result from switching surges, lightning, or other disturbances. The standard also presents information on the ability of the ground insulation to withstand impulses. The procedure provides a basis for the accumulation, analysis, and reporting of information concerning impulse-voltage withstand strength of ground and turn insulation, both new and aged. The use of multifactor aging tests, combining thermal and electrical aging in order to address the withstand capability of micaceous insulation, is recommended.

IEEE Std 802-1990 (R1992). *IEEE Standards for Local and Metropolitan Area Networks—Overview and Architecture.* This document serves as the foundation for the family of IEEE 802® standards for local area networks (LANs) and metropolitan area networks (MANs) that deals with the physical and data link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model. Descriptions of the networks considered as well as a reference model for protocol standards are provided. Compliance with the family of IEEE 802® standards is defined, and a standard for the identification of public, private, and standard protocols is included. Universal addresses and protocol identifiers are considered.

IEEE Std 802.1F-1993 (R1998). *IEEE Standard* for *Local and Metropolitan Area Networks—Common Definitions and Procedures for IEEE 802® Management Information.* Management information and procedures applicable across the entire family of IEEE 802® LAN/MAN standards within the architectural framework for LAN/MAN Management specified in IEEE Std 802-1990 are identified. Common management information, such as attributes to represent MAC address and managed objects to represent configurable gauges, are specified. The need of developers of LAN/MAN management specifications for common procedures to develop, describe, and register management information is addressed.

IEEE Std 802.1Q-1998. *IEEE Standard for Virtual Bridged Local Area Networks.* This standard defines an architecture for Virtual Bridged LANs, the services provided in Virtual Bridged LANs, and the protocols and algorithms involved in the provision of those services.

IEEE Std 802.3, 1998 Edition. (Incorporating ANSI/IEEE Std 802.3, 1996 Edition, IEEE Std 802.3r-1996, IEEE Std 802.3u-1995, IEEE Std 802.3x&y-1997, IEEE Std 802.3z-1998, and IEEE Std 802.3aa-1998). *IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan areas networks—Specific requirements—Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.* The media access control characteristics for the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method for shared medium local area networks are described. The control characteristics for full duplex dedicated channel use are also described. Specifications are provided for MAU types 1BASE5 at 1 Mb/s; Attachment Unit Interface (AUI) and MAU types 10BASE5, 10BASE2, FOIRL (fiber optic interrepeater link), 10BROAD36, 10BASE-T, 10BASE-FL, 10BASE-FB, and 10BASE-FP at 10 Mb/s; Media Independent Interface (MII) and PHY types 100BASE-T4, 100BASE-TX, 100BASE-FX, and 100BASE-T2 at 100 Mb/s; and the Gigabit MII (GMII) and 1000BASE-X PHY types, 1000BASE-SX, 1000BASE-LX, and 1000BASE-CX, which operate at 1000 Mb/s (Gigabit Ethernet). Repeater specifications are provided at each speed. Full duplex specifications are provided at the Physical Layer for 10BASE-T, 10BASE-FL, 100BASE-TX, 100BASE-FX, 100BASE-T2, and Gigabit Ethernet. System considerations for multisegment networks at each speed and management information base (MIB) specifications are also provided.

IEEE Std 802.3ab-1999. (Supplement to IEEE Std 802.3, 1998 Edition). *IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Supplement to Carrier Sense Mulitple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications—Physical Layer Parameters and Specifications for 1000 Mb/s Operation Over 4-Pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T.* Type 1000BASE-T PCS, type 1000BASE-T PMA sublayer, and type 1000BASE-T Medium Dependent Interface (MDI) are defined. This supplement provides fully functional, electrical and mechanical specifications for the type 1000BASE-T PCS, PMA, and MDI. This supplement also specifies the baseband medium used with 1000BASE-T.

IEEE Std 802.3ac-1998. (Supplement to IEEE Std 802.3, 1998 Edition). *IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications—Frame Extensions for Virtual Bridged Local Area Network (VLAN) Tagging on 802.3 Networks.* Changes and additions to IEEE Std 802.3, 1998 Edition, to support Virtual Bridged Local Area Networks (VLANs) as specified in IEEE P802.1Q, Draft Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks, are provided.

IEEE Std 802.3ad-2000. (Amendment to IEEE Std 802.3, 1998 Edition). *IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Amendment to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications—Aggregation of Multiple Link Segments.* An optional Link Aggregation sublayer for use with CSMA/CD MACs is defined. Link Aggregation allows one or more links to be aggregated together to form a Link Aggregation Group, such that a MAC Client can treat the Link Aggregation Group as if it were a single link. To this end, it specifies the establishment of DTE to DTE logical links, consisting of N parallel instances of full duplex point-to-point links operating at the same data rate.

IEEE Std 802.4h-1997. (Supplement to ISO/IEC 8802-4: 1990 [ANSI/IEEE Std 802.4-1990]). *IEEE Standards for*

Local and Metropolitan Area Networks: Supplement to Token-Passing Bus Access Method and Physical Layer Specifications Alternative Use of BNC Connectors and Manchester-Encoded Signaling Methods for Single-Channel Bus Physical Layer Entities. This supplement to ISO/IEC 8802-4:1990 [ANSI/IEEE Std 802.4-1990] provides the functional, electrical, and mechanical characteristics of single-channel differential and Manchester-data-encoded bus Physical Layer Entities (PLEs).

IEEE Std 802.5c-1991 (R1997). *IEEE Standards for Local and Metropolitan Area Networks: Supplement to Token Ring Access Method and Physical Layer Specifications: Recommended Practice for Dual Ring Operation with Wrapback Configuration*. Extensions to the IEEE 802.5 Token-Passing Ring standard are defined. These extensions implement a Dual Ring local area network (LAN) topology that provides full interoperability between stations conforming to IEEE Std 802.5, including coexistence on the same ring, and recovery from all single media failures with full capability restored. The Dual Ring Topology and operation described are intended for applications that require very high availability and recovery from media and station failures.

IEEE Std 802.5t-2000. (Amendment to ANSI/IEEE Std 802.5, 1998 Edition; ANSI/IEEE Std 802.5r, 1998 Edition; and ANSI/IEEE Std 802.5j, 1998 Edition). *IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements: Amendment to Part 5: Token Ring Access Method and Physical Layer Specifications*. This supplement specifies the changes required to ANSI/IEEE Std 802.5, 1998 Edition, (Base standard) and ANSI/IEEE 802.5r, 1998 Edition, and ANSI/IEEE Std 802.5j, 1998 Edition, (Amendment 1 standard) to support 100 Mbit/s Dedicated Token Ring (DTR) operation. The Base standard, together with the Amendment 1 standard, specifies shared and dedicated (point-to-point) Token Ring operation at both 4 Mbit/s and 16 Mbit/s using either the TKP Access Protocol or the TXI Access Protocol. This supplement extends Token Ring operation to 100 Mbit/s for the DTR C-Port and Station using the TXI Access Protocol. Extensions to the medium access control (MAC) have been made to accommodate the requirements for high media rates (100 Mbit/s and above).

IEEE Std 802.6-1994 (R1997). *IEEE Standard for Information Technology Telecommunications and information exchange between systems—Local And Metropolitan Area Networks Specific Requirements—Part 6: Distributed Queue Dual Bus (DQDB) Access Method And Physical Layer Specifications*. This standard is part of a family of standards for local area networks (LANs) and metropolitan area networks (MANs) that deals with the Physical and Data Link Layers as defined by the ISO Open Systems Interconnection Reference Model. It defines a high-speed shared medium access protocol for use over a dual, counterflowing, unidirectional bus subnetwork. The Physical Layer and Distributed Queue Dual Bus (DQDB) Layer are required to support a Logical Link Control (LLC) Sublayer by means of a connectionless Medium Access Control (MAC) Sublayer service in a manner consistent with other IEEE 802® networks. Additional DQDB Layer functions are specified as a framework for other services. These additional functions will support Isochronous Service Users and Connection-Oriented Data Service Users, but their implementation is not required for conformance.

IEEE Std 802.6j-1995 (R1997). *IEEE Standard for Local and Metropolitan Area Networks: Supplement to 802.6: Connection-Oriented Service on a Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)*. Enhanced Queued Arbitrated (QA) Functions, which can support applications requiring bandwidth guarantees and delay limits on a DQDB subnetwork, are specified. Connection-Oriented Convergence Functions (COCFs) using the enhanced QA Functions, which are necessary to support connection-oriented service, are also specified

IEEE Std 802.7-1989 (R1997). *IEEE Recommended Practices for Broadband Local Area Networks*. The physical, electrical, and mechanical characteristics of a properly designed IEEE 802.7 broadband cable medium are specified. The medium supports the communication of IEEE 802.3b, IEEE 802.4, video, and narrow-band radio frequency (RF) modem devices. The broadband bus topology consists of amplifiers, coaxial cable, and directional couplers that create a full duplex directional medium. The characteristics described are intended as the minimum acceptable parameters for the design, installation, and test of an IEEE 802.7 cable plant. Single and dual cable systems are specified for the support of existing ISO 8802-3 and IEEE 802.4 broadband devices.

IEEE Std 802.10-1998. *IEEE Standards for Local and Metropolitan Area Networks: Standard for Interoperable LAN/MAN Security (SILS)*. IEEE Std 802.10 provides specifications for an interoperable data link layer security protocol and associated security services. The Secure Data Exchange (SDE) protocol is supported by an application layer Key Management Protocol (KMP) that establishes security associations for SDE and other security protocols. A security label option is specified that enables rule-based access control to be implemented using the SDE protocol. A method to allow interoperability with type-encoded Medium Access Control (MAC) clients is also provided, as well as a set of managed object classes to be used in the management of the SDE sublayer and its protocol exchanges.

IEEE Std 802.10a-1999. (Supplement to IEEE Std 802.10-1998). *IEEE Standards for Local and Metropolitan Area Networks: Supplement to Standard for Interoperable LAN/MAN Security (SILS)—Security Architecture Framework*. An architectural description of the functions and location of SILS components is provided. The SILS components and their relationships to applications, communications protocols, system management, and security management are described.

IEEE Std 802.10c-1998. *IEEE Standards for Local and Metropolitan Area Networks: Supplement to Standard for Interoperable LAN/MAN Security (SILS)—Key Management (Clause 3)*. A cryptographic key management model and a key management OSI Basic Reference Model Application Layer protocol are specified.

IEEE Std 802.10h-1997. *IEEE Standards for Local and Metropolitan Area Networks: Supplement to Interoperable LAN/MAN Security (SILS)—Secure Data Exchange (SDE): Protocol Implementation Conformance Statement (PICS) Proforma (Annex 2L)*. The secure data exchange (SDE) protocol implementation conformance statement (PICS) proforma is provided. The SDE PICS proforma defines the information to be supplied by protocol implementors claiming conformance with IEEE Std 802.10, Clause 2, Secure Data Exchange (SDE).

IEEE Std 802.11a-1999. (Supplement to IEEE Std 802.11-1999). *IEEE Supplement to IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific Requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: High-speed Physical Layer in the 5 GHZ Band*. Changes and additions to IEEE Std. 802.11-1999 are provided to support the new high-rate physical layer (PHY) for operation in the 5 GHz band.

IEEE Std 802.11b-1999. (Supplement to ANSI/IEEE Std 802.11, 1999 Edition). *Supplement to IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band*. Changes and additions to IEEE Std

802.11, 1999 Edition are provided to support the higher rate physical layer (PHY) for operation in the 2.4 GHz band.

IEEE Std 802.12-1995. *IEEE Standards for Local and Metropolitan Area Networks: Demand Priority Access Method, Physical Layer and Repeater Specification for 100 Mb/s Operation.* The media access control characteristics for the Demand Priority access method are specified. The layer management, physical layers, and media that support this access method are also specified. Layer and sublayer interface specifications are aligned to the ISO Open Systems Interconnection Basic Reference Model and ISO/IEC 8802 models. Specifications for 100 Mb/s operation over 100 Ω balanced cable (twisted-pair) category 3 through 5, 150 Ω shielded balanced cable, and fibre optic media are included.

IEEE Std 802.12c-1998. *Supplement to Information technology—Local and metropolitan area networks—Specific requirements—Part 12: Demand-priority access method, physical layer and repeater specifications: Full-Duplex Operation.* Optional MAC capabilities are defined to allow direct link connection between two end nodes with provision for both half-duplex and full-duplex operation; burst-mode packet transmission from an end node to a repeater where the end node may send one or more packets each time it is granted permission to transmit; and implementation of the MAC Control sublayer to allow the exchange of control requests between peer MAC entities across the network when in 8802-3 compatibility mode. Full interoperability is maintained with existing ISO/IEC 8802-12 products.

IEEE Std 803-1983 (R1999). *IEEE Recommended Practice for Unique Identification in Power Plants and Related Facilities—Principles and Definitions.* This recommended practice provides unique identification principles and definitions that, when used with related recommended practices concerning component function identifiers, implementation instructions, and system descriptions, provides a basis for uniquely identifying systems, structures, and components of nuclear and fossil fueled power plant projects (electric power generating stations) and related facilities. Hydro and other types of power plant projects are not included. The standard is part of a series of recommended practices, entitled the Energy Industry Identification System (EIIS), the purpose of which is to present a common language that will permit a user to correlate a system, structure, or component with that of another organization for the purposes of reporting, comparison, or general communication. A significant feature of the concept is that the unique identification code identifies the function at the component level and not the hardware itself.

IEEE Std 803.1-1992 (R2000). *IEEE Recommended Practice for Unique Identification in Power Plants and Related Facilities—Component Function Identifiers.* This recommended practice provides component function identifiers that, when used with related recommended practices concerning unique identification principles and definitions, implementation instructions, and system descriptions, provide a basis for uniquely identifying systems, structures, and components of nuclear and fossil-fueled power plant projects (electric power generating stations) and related facilities. Hydro and other types of power plant projects are not included. The standard is part of a series of recommended practices, entitled the Energy Industry Identification System (EIIS), the purpose of which is to present a common language of communication that will permit a user to correlate a system, structure, or component with that of another organization for the purpose of reporting, comparison, or general communication. A significant feature of this concept is that the unique identification code identifies the function at the component level and not the hardware itself.

IEEE Std 805-1984 (R2000). *IEEE Recommended Practice for System Identification in Nuclear Power Plants and Related Facilities.* This recommended practice provides a single source of nuclear power plant system descriptions which, along with related recommended practices concerning unique identification principles and definitions, component function identifiers, and implementation instructions, provides a basis for uniquely identifying systems, structures, and components of light water nuclear power plant projects (electric power generating stations) and related facilities. The system descriptions concentrate on system function and include such internal details as is necessary to clearly support the system function description. They are not intended to serve as design input. Fossil, hydro, and other types of power plants are not included. This standard is part of a series of recommended practices, entitled the Energy Industry Identification Systems (EIIS), the purpose of which is to present a common language of communication that will permit a user to correlate a system, structure, or component with that of another organization for the purposes of reporting, comparison, or general communication. A significant feature of this concept is that the unique identification code identifies the function at the component level and not the hardware itself.

IEEE Std 810-1987. (R1994) *IEEE Standard for Hydraulic Turbine and Generator Integrally Forged Shaft Couplings and Shaft Runlet Tolerances.* The dimensions of integrally forged shaft couplings and the shaft runlet tolerances are specified. The shafts and couplings covered are used for both horizontal and vertical connections between generators and turbines in hydroelectric installations. Data on fabricated shafts, shaft stresses, and bolt tensioning are not given.

IEEE Std 813-1988 (R2000). *IEEE Specification Format Guide and Test Procedure for Two-Degree-of-Freedom Dynamically Tuned Gyros.* A format guide for the preparation of a two-degree-of-freedom dynamically tuned gyro (DTG) specification is given that provides a common ground of terminology and practice for manufacturers and users. A compilation of recommended procedures for testing a DTG is also given. The requirements and test procedures are defined in terms unique to the DTG. They cover applications of the gyro as an angular motion sensor in navigation and control systems. They apply to two modes of use: (1) as a strapdown sensor in operating environments typical of aircraft and missile applications, and (2) as a sensor in gimballed platform applications in which the dynamic angular inputs to which the gyro is subjected are benign relative to the accuracy required. In the case of the strapdown DTG, the characteristics of the external capture loops are considered to the extent necessary to define the gyro performance.

IEEE Std 824-1994. *IEEE Standard for Series Capacitors in Power Systems.* Capacitors and assemblies of capacitors, insulation means, switching, protective equipment, and control accessories that form a complete bank for inserting in series with a transmission line are applied. Included are requirements for safety, rating, and protective device levels. Functional requirements for alarm devices, maintenance, design and production tests, and a guide for operation are included. Functional requirements for protective devices are addressed, including varistors and bypass gaps.

IEEE Std 828-1998. *IEEE Standard for Software Configuration Management Plans.* The minimum required contents of a Software Configuration Management Plan (SCMP) are established, and the specific activities to be addressed and their requirements for any portion of a software product's life cycle are defined.

IEEE Std 829-1998. *IEEE Standard for Software Test Documentation.* A set of basic software test documents is described. This standard specifies the form and content of individual test documents. It does not specify the required set of test documents.

IEEE Std 830-1998. *IEEE Recommended Practice for Software Requirements Specifications.* The content and qualities of a good software requirements specification (SRS) are described and several sample SRS outlines are presented. This recommended practice is aimed at specifying requirements of

software to be developed but also can be applied to assist in the selection of in-house and commercial software products. Guidelines for compliance with IEEE/EIA 12207.1-1997 are also provided.

IEEE Std 833-1988 (1994). *IEEE Recommended Practice for the Protection of Electric Equipment in Nuclear Power Generating Stations from Water Hazards.* This document recommends methods and design features that, if implemented, would provide water-hazard protection to class-1E and non-class-1E systems and equipment from direct sources of water (for example, water spray from decontamination activities) and indirect sources of water (for example, water running along cables and raceways). It does not classify water-hazard protection features as nuclear-safety-related or non-nuclear-safety-related. Protection of equipment by choice of location, equipment design, and sealing are shielding are considered. The following are covered: design and construction features for electric equipment rooms; protection of electric equipment located in open areas subject to water hazards; electric equipment enclosures; electric equipment installation practices; sealing methods; and maintenance, surveillance, and testing activities.

IEEE Std 835-1994 (R2000). *IEEE Standard Power Cable Ampacity Tables.* Over 3000 ampacity tables for extruded dielectric power cables rated through 138 kV and laminar dielectric power cables rated through 500 kV are provided.

IEEE Std 836-1991 (R1997). *IEEE Recommended Practice for Precision Centrifuge Testing of Linear Accelerometers.* A guide to the conduct and analysis of precision centrifuge tests of linear accelerometers is provided, covering each phase of the tests beginning with the planning. Possible error sources and typical methods of data analysis are addressed. The intent is to provide those involved in centrifuge testing with a detailed understanding of the various factors affecting accuracy of measurement, both those factors associated with the centrifuge and those in the data collection process. Model equations are discussed, both for the centrifuge and for a typical linear accelerometer, with each equation having the complexity needed to accommodate the various identified characteristics and error sources in both. A new iterative matrix equation solution for deriving from the centrifuge test data the various model equation coefficients for the accelerometer under test is presented.

IEEE Std 837-1989 (R1996). *IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.* Directions and methods for qualifying permanent connections used for substation grounding are provided. Particular attention is given to the connectors used within the grid system, connectors used to join ground leads to the grid system, and connectors used to join the ground leads to equipment and structures. The purpose is to give assurance to the user that connectors meeting the requirements of this standard will perform in a satisfactory manner over the lifetime of the installation provided, that the proper connectors are selected for the application, and that they are installed correctly. Parameters for testing grounding connections on aluminum, copper, steel, copper-clad steel, galvanized steel, stainless steel, and stainless-clad steel are addressed. Performance criteria are established, test procedures are provided, and mechanical, current-temperature cycling, freeze-thaw, corrosion, and fault-current tests are specified.

IEEE Std 841-1994 (R1996). *IEEE Standard for Petroleum and Chemical Industry—Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 500 hp.* This standard applies to high-efficiency TEFC, horizontal and vertical, single-speed, squirrel cage polyphase induction motors, up to and including 500 hp, in NEMA frame sizes 143T and larger, for petroleum, chemical, and other severe duty applications (commonly referred to as severe duty motors). Excluded from the scope of this standard are motors with sleeve bearings and additional specific features required for explosion-proof motors.

IEEE Std 844-1991 (R1996). *IEEE Recommended Practice for Electrical Impedance, Induction, and Skin Effect Heating of Pipelines and Vessels.* Recommended practices are provided for the design, installation, testing, operation and maintenance impedance, induction, and skin-effect heating systems. Thermal insulation and control and monitoring are addressed. General considerations for heating systems are discussed, covering selection criteria, design guidelines and considerations, power systems, receiving and storage, installation, testing, operations, and maintenance. These aspects are then discussed for each of the above types of systems, along with special considerations particular to each. These recommended practices are intended to apply to the use of these heating systems in general industry.

IEEE Std 845-1999. *IEEE Guide for the Evaluation of Human-System Performance in Nuclear Power Generating Stations.* Guidance for evaluating human-system performance related to systems, equipment, and facilities in nuclear power generating stations is provided. Specific evaluation techniques and rationale for their application within the integrated systems approach to plant design, operations, and maintenance described in IEEE Std 1023-1988 are summarized.

IEEE Std 848-1996. *IEEE Standard Procedure for the Determination of the Ampacity Derating of Fire-Protected Cables.* A detailed test procedure is provided for determining the ampacity or derating factor in the following cable installation configurations: block-out or sleeve type cable penetration fire stops; conduits covered with a protective material; tray covered with a protective material; cable directly covered or coated with a fire-retardant material; and free-air drops enclosed with a protective material.

IEEE Std 854-1987 (R1994). *IEEE Standard for Radix-Independent Floating-Point Arithmetic.* A family of commercially feasible ways for new systems to perform floating-point arithmetic is defined. This standard specifies constrains on parameters defining values of basic and extended floating-point numbers; add, subtract, multiply, divide, square root, remainder and compare operations; conversions between integers and floating-point numbers; conversions between different floating-point precisions; conversion between basic precision floating-point numbers and decimal strings; and floating-point exceptions and their handling, including non-numbers. It is intended that an implementation of a floating-point system conforming to this standard can be realized entirely in software, entirely in hardware, or in any combination of software and hardware. Retrofitting issues are not considered.

IEEE Std 857-1996. *IEEE Recommended Practice for Test Procedures for High-Voltage Direct-Current Thyristor Valves.* Information and recommendations for the type testing of thyristor valves for high-voltage direct-current (HVDC) power transmission systems are provided. These tests cover only the principal tests on the valves and do not include tests of auxiliary equipment associated with the valves.

IEEE Std 896.10-1997. *IEEE Standard for Futurebus+® Spaceborne Systems—Profile S.* In the Futurebus+ series of standards, tools with which high-performance bus-based systems may be developed are provided. This architecture provides a wide range of performance scalability over both cost and time for multiple generations of single- and multiple-bus multiprocessor systems. This document, a companion standard to the ISO/IEC 10857:1994 (896.1, 1994 Edition) Futurebus+ Logical Layer Specification, builds on the logical layer by adding requirements for a spaceborne profile. It is to this profile that products will claim conformance. Other specifications may be required in conjunction with this standard.

IEEE Std 902-1998. *IEEE Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems (IEEE Yellow Book).* Guidelines for the numerous personnel who are responsible for safely operating and maintaining industrial and commercial electric power facilities are provided.

This guide provides plant engineers with a reference source for the fundamentals of safe and reliable maintenance and operation of industrial and commercial electric power distribution systems.

IEEE Std 928-1986 (R1991). *IEEE Recommended Criteria for Terrestrial Photovoltaic Power Systems.* General performance criteria for terrestrial photovoltaic (PV) systems are established, and an overall framework for all detailed terrestrial photovoltaic power system performance standards is provided. Criteria for subsystem performance and standard test methods to be used for performance measurements are recommended. System installation, operation, and maintenance are covered. Since thermal conditioning elements may be part of the system design, some consideration is given to the thermal subsystem. The criteria apply to all terrestrial photovoltaic power systems.

IEEE Std 929-2000. *IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems.* This recommended practice contains guidance regarding equipment and functions necessary to ensure compatible operation of photovoltaic (PV) systems that are connected in parallel with the electric utility. This includes factors relating to personnel safety, equipment protection, power quality, and utility system operation. This recommended practice also contains information regarding islanding of PV systems when the utility is not connected to control voltage and frequency, as well as techniques to avoid islanding of distributed resources.

IEEE Std 930-1987 (R1995). *IEEE Guide for the Statistical Analysis of Voltage Endurance Data for Electrical Insulation.* A description is given, with examples of statistical methods for analyzing the data, for time-to-failure from constant-stress voltage endurance tests or breakdown voltage from progressive-stress tests on specimens or systems of electrical insulation. Methods to compare test data are also given. The methods are principally applied to data from tests on solid insulation, but they may also apply to the analysis of data from tests on gas, liquid, and composite systems. The statistical methods discussed do not take into consideration the physical mechanism of voltage aging. They assume that the only aging stress is alternating voltage of constant frequency. The methods may not apply if there is more than one aging stress. Methods to ascertain the short-time withstand voltage or operating voltage of an insulation system are not included, and the mathematical techniques may not directly apply to the estimation of equipment life.

IEEE Std 933-1999. *IEEE Guide for the Definition of Reliability Program Plans for Nuclear Power Generating.* Guidelines for the definition of a reliability program at nuclear power generating stations are developed. Reliability programs during the operating phase of such stations are emphasized; however, the general approach applies to all phases of the nuclear power generating station life cycle (e.g., design, construction, start-up, operating, and decommissioning).

IEEE Std 935-1989 (R1995). *IEEE Guide on Terminology for Tools and Equipment to Be Used in Live Line Working.* Terminology for tools and equipment used in live line working is given to permit identification of the tools and equipment and to standardize their names. Detailed definitions are not given for all the terms used in live line working; only the necessary details, without indications of their components and their methods of use, are provided. The following are covered: insulating sticks; universal tool fittings; insulating covers and similar assemblies; bypassing equipment; small individual hand tools; personal equipment; equipment for positioning a worker; handling and anchoring equipment; measuring and testing equipment, and hydraulic and miscellaneous equipment.

IEEE Std 937-2000. *IEEE Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems.* Design considerations and procedures for storage, location, mounting, ventilation, assembly, and maintenance of lead-acid storage batteries for photovoltaic power systems are provided. Safety precautions and instrumentation considerations are also included. Even though general recommended practices are covered, battery manufacturers may provide specific instructions for battery installation and maintenance.

IEEE Std 943-1986 (R1992). *IEEE Guide for Aging Mechanisms and Diagnostic Procedures in Evaluating Electrical Insulation Systems.* Background information necessary for proper construction of aging mechanisms and selection of diagnostic procedures when designing tests for functional evaluation of insulation systems for electrical equipment is presented. Aging mechanisms of insulation systems and methods for ascertaining correlation of aging during testing and aging during actual service are described. Diagnostic techniques for use in functional tests are also listed. The intent is primarily to aid committees in standardizing tests within the scope of their responsibilities.

IEEE Std 944-1986 (R1996). *IEEE Application and Testing of Uninterruptible Power Supplies for Power Generating Stations.* The application and performance requirements for a low-voltage uninterruptible power supply (UPS) system used for service in power generating stations are defined. Service conditions and requirements for design application, procurement documents, and testing are covered. The recommendations apply only to semiconductor ac-to-ac converter systems (static) with dc electric energy storage capability. Equipment or component design requirements, safety-related design criteria, or requirements for equipment qualification and preoperational/surveillance testing are not addressed.

IEEE Std 945-1984 (R1997). *IEEE Standard Preferred Metric Units for Use in Electrical and Electronics Science and Technology.* Recommendations are made to aid in the selection of metric units, so as to promote uniformity in the use of metric units and to limit the number of different metric units that will be used in electrical and electronics science and technology. The recommendations can cover units for space and time, periodic and related phenomena, mechanics, heat, electricity and magnetism, light and related electromagnetic radiations, and acoustics. This document does not cover how metric units are to be used, nor does it offer guidance concerning correct metric practice.

IEEE Std 946-1992 (R1997). *IEEE Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations.* Guidance for the design of the dc auxiliary power systems for nuclear and large fossil-fueled power generating stations is provided. The components of the dc auxiliary power system, including lead storage batteries, static battery chargers, and distribution equipment, are addressed. Guidance for selecting the quantity and types of equipment, the equipment ratings, interconnections, instrumentation, control and protection is also provided.

IEEE Std 951-1996. *IEEE Guide to the Assembly and Erection of Metal Transmission Structures.* Various good practices that will enable users to improve their ability to assemble and erect self-supporting and guyed steel or aluminum lattice and tubular steel structures are presented. Construction considerations after foundation installation, and up to the conductor stringing operation, are also covered. The guide focuses on the design and construction considerations for material delivery, assembly and erection of metal transmission structures, and the installation of insulators and hardware. This guide is intended to be used as a reference source for parties involved in the ownership, design, and construction of transmission structures.

IEEE Std 952-1997. *IEEE Standard Specification Format Guide and Test Procedure for Single-Axis Interferometric Fiber Optic Gyros.* Specification and test requirements for a single-axis interferometric fiber optic gyro (IFOG) for use as a sensor in attitude control systems, angular displacement measuring systems, and angular rate measuring systems are

defined. A standard specification format guide for the preparation of a single-axis IFOG is provided. A compilation of recommended procedures for testing a fiber optic gyro, derived from those presently used in the industry, is also provided.

IEEE Std 957-1995. *IEEE Guide for Cleaning Insulators.* Procedures for cleaning contaminated electrical insulators (excluding nuclear, toxic, and hazardous chemical contaminants) of all types, using various equipment and techniques, are provided.

IEEE Std 959-1988 (R1995). *IEEE Specifications for an I/O Expansion Bus: SBX Bus.* An I/O expansion bus for microcomputers that is independent of processor or board type is specified. Each expansion interface supports up to 16 8-bit I/O ports directly. Enhanced addressing capability is available using slave processors or FIFO devices. In addition, each expansion interface may optionally support a DMA channel capable of data rates up to 2 16-bit Mwords/sec. These features are supported for both 8- and 16-bit data paths. The specification has been prepared for those users who intend to design or evaluate products that will be compatible with the bus. For this purpose, functional, electrical, and mechanical specification is covered in detail. The intent of the specification is to guarantee compatibility between baseboards and expansion modules while not restricting the actual designs any more than necessary.

IEEE Std 960-1993 (R1999). *IEEE Standard FASTBUS Modular High-Speed Data Acquisition and Control System and IEEE FASTBUS Standard Routines.* Mechanical, signal, electrical, and protocol specifications are given for a modular data bus system, which, while allowing equipment designers a wide choice of solutions, ensure compatibility of all designs that obey the mandatory parts of the specification. This standard applies to systems consisting of modular electronic instrument units that process or transfer data or signals, normally in association with computers or other automatic data processors. Standard software routines for use with the system in IEEE Std 960-1993 are defined.

IEEE Std 961-1987 (R1994). *IEEE Standard for an 8-Bit Microcomputer Bus System: STD Bus.* An 8-bit microcomputer bus system derived from the industry bus known as the STD bus is described. The STD bus is a modular packaging and interconnect scheme for 8-bit microprocessor card systems. The bus size and bus organization were selected to serve the interface between any 8-bit microprocessor and a variety of memory and I/O functions. Logical, timing, electrical, and mechanical specifications are provided. The body of the standard provides a core specification for the device-independent parameters. Appendixes provide device-dependent parameters for various processors. This document also contains IEEE Std 1101-1987, IEEE Standard for Mechanical Core Specifications for Microcomputers.

IEEE Std 977-1991 (R1997). *IEEE Guide to Installation of Foundations for Transmission Line Structures.* Various approaches to good construction practices, which could improve the installation of transmission-line structure foundations, are presented. Spread foundations, drilled shaft foundations, pile foundations, and anchors are treated. This guide is intended to be used as a reference for those involved in the ownership, design, and construction of transmission structures.

IEEE Std 979-1994. *IEEE Guide for Substation Fire Protection.* Guidance is provided to substation engineers in determining the design, equipment, and practices deemed necessary for the fire protection of substations. A list of publications that can be used to acquire more detailed information for specific substations or substation components is presented.

IEEE Std 980-1994. *IEEE Guide for Containment and Control of Oil Spills in Substations.* The significance of oil-spillage regulations and their applicability to electric supply substations are discussed; the sources of oil spills are identified; typical designs and methods for dealing with oil containment and control of oil spills are discussed; and guidelines for preparation of a typical Spill Prevention Control and Countermeasures (SPCC) plan are provided. This guide excludes polychlorinated biphenyl (PCB) handling and disposal considerations.

IEEE Std 982.1-1988. *IEEE Standard Dictionary of Measures to Produce Reliable Software.* A set of measures indicative of software reliability that can be applied to the software product as well as to the development and support processes is provided. The measures can be applied early in the development process to indicate the reliability of the delivered product. The aim is to provide a common set of definitions that allows a meaningful exchange of data and evaluations to occur, and that serves as the foundation on which researchers and practitioners can build consistent methods. The standard is designed to assist management in directing product development and support toward specific reliability goals.

IEEE Std 982.2-1988. *IEEE Guide for the Use of IEEE Standard Dictionary of Measures to Produce Reliable Software.* This guide provides the underlying concepts and motivation for establishing a measurement process for reliable software, utilizing IEEE Std 982.1-1988, IEEE Standard Dictionary of Measures to Produce Reliable Software. The guide contains information necessary for application of measures to a project. It includes guidance for the following: applying product and process measures throughout the software life cycle, providing the means for continual self-assessment and reliability improvement; optimizing the development of reliable software, beginning at the early development stages with respect to constraints such as cost and schedule; maximizing the reliability of software in its actual use environment during the operation and maintenance phases; and developing the means to manage reliability in the same manner that cost and schedule are managed. The guide is intended for design, development, evaluation (e.g., auditing or procuring agency), and maintenance personnel; software quality and software reliability personnel; and operations and acquisition support managers. It is organized to provide input to the planning process for reliability management.

IEEE Std 991-1986 (R1994). *IEEE Standard for Logic Circuit Diagrams.* Guidelines for preparation of diagrams depicting logic functions are provided. Definitions, requirements for assignment of logic levels, application of logic symbols, presentation techniques, and labeling requirements are included, with typical examples where appropriate. The techniques are presented in the context of electrical and electronic systems, but they also may be applied to nonelectrical systems (e.g., pneumatic, hydraulic, or mechanical).

IEEE Std 993-1997. *IEEE Standard for Test Equipment Description Language (TEDL).* A language useful for describing Automatic Test Equipment (ATE) instrumentation and configurations, as well as Interface Test Adapters (ITA), is defined. Principally intended for testing environments using the ATLAS test language, TEDL can also be used to describe instrumentation in non-ATLAS environments.

IEEE Std 998-1996. *IEEE Guide for Direct Lightning Stroke Shielding of Substations.* Design information for the methods historically and typically applied by substation designers to minimize direct lightning strokes to equipment and buswork within substations is provided. Two approaches, the classical empirical method and the electrogeometric model, are presented in detail. A third approach involving the use of active lightning terminals is also briefly reviewed.

IEEE Std 1000-1987 (R1994). *IEEE Standard Specification for a Standard 8-Bit Backplane Interface: STEbus.* A bus that can be used to implement general-purpose, high-performance, 8-bit microcomputer systems is defined. Such a system may be used in a stand-alone configuration or in larger multiple-bus architectures as a private (or secondary) bus or a high-speed I/O channel. The standard is applicable to systems and

system elements with the common commercial designation STE Bus and is intended for users who plan to evaluate, implement, or design various system elements that are compatible with the IEEE 1000 Std Bus system structure. It provides a functional description and covers signal lines, arbitration, the data transfer protocol, interboard signaling, and electrical specifications. The physical attributes and method of interconnect utilized by boards and modules conforming to this standard are derived from several IEC standards, which, when implemented jointly in a systems environment, result in a mechanical configuration commonly referred to as Eurocard. This document also contains IEEE Std 1101-1987, IEEE Standard for Mechanical Core Specifications for Microcomputers.

IEEE Std 1003.0-1995. *IEEE Guide to the POSIX® Open System Environment (OSE).* This guide presents an overview of open system concepts and their applications. Information is provided to persons evaluating systems based on the existence of, and interrelationships among, application software standards, with the objective of enabling application portability and system interoperability. A framework is presented that identifies key information system interfaces involved in application portability and system interoperability and describes the services offered across these interfaces. Standards or standards activities associated with the services are identified where they exist or are in progress. Gaps are identified where POSIX Open System Environment services are not currently being addressed by formal standards. Finally, the concept of a profile is discussed with examples from several application domains.

IEEE Std 1003.1/2003.1/INT (March 1994 Edition). *IEEE Standards Interpretations for IEEE Std 1003.1-1990 and IEEE Std 2003.1-1992 (March 1994 Edition).* The Portable Applications Standards Committee of the IEEE Computer Society carried out a series of analyses of various problems encountered by users of IEEE Std 1003.1-1990, IEEE Standard for Information Technology—Portable Operating System Interface (POSIX®)—Part 1: System Application Program Interface (API) and IEEE Std 2003.1-1992, IEEE Standard for Information Technology—Test Methods for Measuring Conformance to POSIX—Part 1: System Interfaces. The results of its deliberations are presented in this document. The intent is to give the POSIX community reasonable ways of interpreting unclear portions of these standards.

IEEE Std 1003.1d-1999. *IEEE Standard for Information Technology—Portable Operating System Interface (POSIX®)—Part 1: System Application Program Interface (API)—Amendment d: Additional Realtime Extensions [C Language].* This standard is part of the POSIX series of standards for applications and user interfaces to open systems. It defines the applications interface to system services for spawning a process, timeouts for blocking services, sporadic server scheduling, execution time clocks and timers, and advisory information for file management. This standard is stated in terms of its C binding.

IEEE Std 1003.5, 1999 Edition. *IEEE Standard for Information Technology—POSIX® Ada Language Interfaces—Part 1: Binding for System Application Program Interface (API) Includes Amendment 1: Realtime Extensions and Amendment 2: Protocol-Independent.* This standard is part of the POSIX® series of standards for applications and user interfaces to open systems. It defines the Ada language bindings as package specifications and accompanying textual descriptions of the application program interface (API). This standard supports application portability at the source code level through the binding between ISO 8652:1995 (Ada) and ISO/IEC 9945-1:1996 (IEEE Std 1003.1-1996) (POSIX) as amended by IEEE P1003.1g/D6.6.Terminology and general requirements, process primitives, the process environment, files and directories, input and output primaries, device- and class-specific functions, language-specific services for Ada, system databases, synchronization, memory management, execution scheduling, clocks and timers, message passing, task management, the XTI and socket detailed network inter-faces, event management, network support functions, and protocol-specific mappings are covered. It also specifies behavior to support the binding that must be proviced by the Ada.

IEEE Std 1003.9-1992 (R1997). *IEEE Standard for Information Technology—POSIX® FORTRAN 77 Language Interfaces—Part 1: Binding for System Application Program Interface (API).* This standard provides a standardized interface for accessing the system services of ISO/IEC 9945:1990 (IEEE Std 1003.1-1990, also known as POSIX.1), and support routines to access constructs not directly accessible with FORTRAN 77. This standard supports application portability at the source level through the binding between ANSI X3.9-1978 and POSIX.1, and a standardized definition of language-specific services. The goal is to provide standardized interfaces to the POSIX.1 system services via a FORTRAN 77 language interface. Terminology and general requirements, process primitives, the process environment, files and directories, input and output primitives, device- and class-specific functions, the FORTRAN 77 language library, and system databases are covered.

IEEE Std 1003.10-1995 (R1997). *IEEE Standard for Information Technology POSIX®—Based Supercomputing Application Environment Profile.* This standard is related to the POSIX series of standards for applications and user interfaces to open systems. It specifies the set of standards and the requirements needed for portability of supercomputing applications, users, and system administrators.

IEEE Std 1005-1998. *IEEE Standard Definitions and Characterization of Floating Gate Semiconductor Arrays.* This standard describes the underlying physics and the operation of floating gate memory arrays, specifically, UV erasable EPROM, byte rewritable E2PROMs, and block rewritable flash EEPROMs. In addition, reliability hazards are covered with focus on retention, endurance, and disturb. There are also clauses on the issues of testing floating gate arrays and their hardness to ionizing radiation.

IEEE Std 1007-1991 (R1997). *IEEE Standard Methods and Equipment for Measuring the Transmission Characteristics of Pulse-Code Modulation (PCM) Telecommunications Circuits and Systems.* Test equipment requirements and methods for testing the transmission characteristics of PCM telecommunications equipment, circuits, and systems are set forth. The requirements are intended for certification, installation, preservice, out-of-service operational, and in-service operational tests of the PCM transmission facilities. The PCM equipment that may be tested includes primary multiplex equipment containing analog–digital conversion devices, digital multiplex equipment, digital links, and digital sections. This standard is limited to testing at the analog interfaces of the primary multiplex equipment and the digital interfaces at DS1, DS1C, DS2, and DS3 levels of the North American digital hierarchy. Synchronous multiplex equipment and equipment offering other than 64 kbps coded voiceband channels are not covered in this standard, nor is signaling parameter measurement.

IEEE Std 1008-1987 (R1993). *IEEE Standard for Software Unit Testing.* An integrated approach to systematic and documented unit testing is defined. The approach uses unit design and unit implementation information, in addition to unit requirements, to determine the completeness of the testing. The testing process described is composed of a hierarchy of phases, activities, and tasks and defines a minimum set of tasks for each activity. The standard can be applied to the unit testing of any digital computer software or firmware and to the testing of both newly developed and modified units. The software engineering concepts and testing assumptions on which this standard approach is based, and guidance and resource information to assist with the implementation and usage of the standard unit testing approach, are provided in appendixes.

IEEE Std 1010-1987 (R1992). *IEEE Guide for Control of Hydroelectric Power Plants.* The control and monitoring requirements for equipment and systems associated with conventional and pumped-storage hydroelectric plants are described. Typical methods of local and remote control, details of the control interfaces for plant equipment, requirements for centralized and off-site control, and trends in control systems are included. The various categories that affect the levels of control for a plant, namely, location, mode, and supervision, are described. Block diagrams and descriptions of the control and monitoring requirements for major plant systems and equipment are given. Control sequencing of generating and pumped storage units, centralized control, and off-site control are covered. The information is directed toward practicing engineers in the field of power plant design who have a basic knowledge of hydroelectric facilities.

IEEE Std 1012-1998. *IEEE Standard for Software Verification and Validation.* Software verification and validation (V&V) processes, which determine whether development products of a given activity conform to the requirements of that activity, and whether the software satisfies its intended use and user needs, are described. This determination may include analysis, evaluation, review, inspection, assessment, and testing of software products and processes. V&V processes assess the software in the context of the system, including the operational environment, hardware, interfacing software, operators, and users.

IEEE Std 1012a-1998. *IEEE Standard for Software Verification and Validation: Content Map to IEEE/EIA 12207.1-1997.* The relationship between the two sets of requirements on plans for verification and validation of software, found in IEEE Std 1012-1998 and IEEE/EIA Std 12207.1-1997, is explained so that users may produce documents that comply with both standards.

IEEE Std 1013-1990. *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Photovoltaic (PV) Systems.* Methods for sizing both vented and valve-regulated lead-acid batteries used with terrestrial photovoltaic (PV) systems, regardless of size, are described. The purpose is to assist system designers in sizing batteries for residential, commercial, and industrial PV systems. Sizing examples are given for various representative system applications. Iterative techniques to optimize battery costs, which include consideration of the interrelationship between battery size, PV array size, and weather, are not covered. A worksheet with examples of its use is included to facilitate the battery sizing process.

IEEE Std 1014-1987 (R1992). *IEEE Standard for a Versatile Backplane Bus: VMEbus.* A high-performance backplane bus for use in microcomputer systems that employ single or multiple microprocessors is specified. This interfacing system, which is used to interconnect data processing, data storage, and peripheral control devices in a tightly coupled hardware configuration, is based on the VMEbus specification. The bus includes four subbuses: data transfer bus, priority interrupt bus, arbitration bus, and utility bus. Specifications are given for each of these, and overall electrical and mechanical specifications are given as well. Signal line description, use of the SERCIK and SERDAT lines, metastability and synchronization, and permissible capability subsets are covered in the appendixes.

IEEE Std 1015-1997. *IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems. (IEEE Blue Book).* Information is provided for selecting the proper circuit breaker for a particular application. This recommended practice helps the application engineer specify the type of circuit breaker, ratings, trip functions, accessories, acceptance tests, and maintenance requirements. It also discusses circuit breakers for special applications, e.g., instantaneous only and switches. In addition, it provides information for applying circuit breakers at different locations in the power system, and for protecting specific components. Guidelines are also given for coordinating combinations of line-side and load-side devices.

IEEE Std 1016-1998. *IEEE Recommended Practice for Software Design Descriptions.* The necessary information content and recommendations for an organization for Software Design Descriptions (SDDs) are described. An SDD is a representation of a software system that is used as a medium for communicating software design information. This recommended practice is applicable to paper documents, automated databases, design description languages, or other means of description.

IEEE Std 1020-1988 (R1994). *IEEE Guide for Control of Small Hydroelectric Power Plants.*

IEEE Std 1023-1988 (R1995). *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations.* Guidance is provided to management and engineers who wish to develop an integrated program for the application of human factors engineering (HFE) in the design, operation, and maintenance of nuclear power generating stations. The standard covers the program organization and applicability, the plant design aspects to consider, the HFE methodologies that may be used, and a typical program plan for the application of HFE. It is applicable to new facilities or modifications to existing facilities.

IEEE Std 1025-1993 (R1999). *IEEE Guide to the Assembly and Erection of Concrete Pole Structures.* Good practice that will improve the ability to assemble and erect self-supporting and guyed concrete pole structures for overhead transmission lines is presented. Construction aspects after foundation installation and up to the conductor stringing operation are covered. Some aspects of construction related to other materials use in concrete pole structures are covered, but the treatment is not complete. The guide is intended to be used as a reference source for parties involved in the ownership, design, and construction of transmission structures.

IEEE Std 1026-1995. *IEEE Recommended Practice for Test Methods for Determination of Compatibility of Materials with Conductive Polymeric Insulation Shields and Jackets.* A test method is provided to qualify various essentially nonvolatile, highly viscous fluids or solid materials at 90 °C, for use with high-voltage cable shields and jackets. A suggested alternative test method for more fluid and more volatile materials is also provided.

IEEE Std 1027-1996. *IEEE Standard for Measurement of the Magnetic Field in the Vicinity of a Telephone Receiver.* The methodology for measuring the magnetic field strength in the vicinity of a telephone receiver is discussed.

IEEE Std 1028-1997. *IEEE Standard for Software Reviews.* This standard defines five types of software reviews, together with procedures required for the execution of each review type. This standard is concerned only with the reviews; it does not define procedures for determining the necessity of a review, nor does it specify the disposition of the results of the review. Review types include management reviews, technical reviews, inspections, walk-throughs, and audits.

IEEE Std 1029.1-1998. *IEEE Standard for VHDL Waveform and Vector Exchange to Support Design and Test Verification (WAVES) Language Reference Manual.* This standard is a formal notation intended for use in all phases of the development of electronic systems. Because it is both machine-readable and human-readable, it supports the verification and testing of hardware designs; the communication of hardware design and test verification data; and the maintenance, modification, and procurement of hardware systems. This standard provides the syntactic and semantic framework for the unambiguous expression and aggregation of digital test data and timing information necessary to completely describe a test or set of tests for a digital system. WAVES digital test data (stimulus and expected responses) is described at the logic

level. Voltage and current values are not described by WAVES and are beyond the scope of this standard.

IEEE Std 1031-2000. *IEEE Guide for the Functional Specification of Transmission Static Var Compensators.* This guide documents an approach to preparing a specification for a transmission static var compensator. The document is intended to serve as a base specification with an informative annex provided to allow users to modify or develop specific clauses to meet a particular application.

IEEE Std 1036-1992. *IEEE Guide for Application of Shunt Power Capacitors.* Guidelines for the application protection, and ratings of equipment for the safe and reliable utilization of shunt power capacitors are provided. This guide applies to the use of 50 and 60 Hz shunt power capacitors rated 2400 V ac and above, and assemblies of capacitors. Applications that range from simple unit utilization to complex bank situations are covered.

IEEE Std 1043-1996. *IEEE Recommended Practice for Voltage-Endurance Testing of Form-Wound Bars and Coils.* The voltage endurance testing of form-wound bars and coils for use in large rotating machines is covered. Such testing is defined for machines with a nominal voltage rating up to 30 000 V.

IEEE Std 1044-1993. *IEEE Standard Classification for Software Anomalies.* A uniform approach to the classification of anomalies found in software and its documentation is provided. The processing of anomalies discovered during any software life cycle phase are described, and comprehensive lists of software anomaly classifications and related data items that are helpful to identify and track anomalies are provided. This standard is not intended to define procedural or format requirements for using the classification scheme. It does identify some classification measures and does not attempt to define all the data supporting the analysis of an anomaly.

IEEE Std 1044.1-1995. *IEEE Guide to Classification of Software Anomalies.* This guide provides supporting information to assist users who are applying IEEE Std 1044-1993, IEEE Standard Classification for Software Anomalies, to decide whether to conform completely to or just extract ideas from IEEE Std 1044-1993. This guide will enable users of IEEE Std 1044-1993 to implement and customize that standard for their organization in an effective and efficient manner.

IEEE Std 1045-1992. *IEEE Standard for Software Productivity Metrics.* A consistent way to measure the elements that go into computing software productivity is defined. Software productivity metrics terminology are given to ensure an understanding of measurement data for both source code and document production. Although this standard prescribes measurements to characterize the software process, it does not establish software productivity norms, nor does it recommend productivity measurements as a method to evaluate software projects or software developers. This standard does not measure the quality of software. This standard does not claim to improve productivity, only to measure it. The goal of this standard is for a better understanding of the software process, which may lend insight to improving it.

IEEE Std 1046-1991 (R1996). *IEEE Application Guide for Distributed Digital Control and Monitoring for Power Plants.* Alternate approaches to applying a digital control system, for both new construction and existing plant modernization projects, are described, and their advantages and disadvantages are compared. Criteria to be used to judge the suitability of commercially available systems for use in the power generation industry are provided. Terminology is defined, and the objectives of distributed control and monitoring systems are described. The following system application issues are addressed: integrated versus segregated systems functional and geographic distribution, hierarchical architecture and automation, control and protection functions, input/output systems, environmental considerations, and documentation. The data communications structure and the functions that support it are considered. Data acquisition and monitoring (the man/machine interfaces) are discussed. Reliability, availability, and fault tolerance of distributed control and monitoring systems are addressed.

IEEE Std 1048-1990 (R1996). *IEEE Guide for Protective Grounding of Power Lines.* Guidelines are provided for safe protective grounding methods for persons engaged in de-energized overhead transmission and distribution line maintenance. They comprise state-of-the-art information on protective grounding as currently practiced by power utilities in North America. The principles of protective grounding are discussed. Grounding practices and equipment, power-line construction, and ground electrodes are covered.

IEEE Std 1050-1996 (R1998). *IEEE Guide for Instrumentation and Control Equipment grounding in Generating Stations.* Information about grounding methods for generating station instrumentation and control (I & C) equipment is provided. The identification of I & C equipment grounding methods to achieve both a suitable level of protection for personnel and equipment is included, as well as suitable noise immunity for signal ground references in generating stations. Both ideal theoretical methods and accepted practices in the electric utility industry are presented.

IEEE Std 1058-1998. *IEEE Standard for Software Project Management Plans.* The format and contents of software project management plans, applicable to any type or size of software project, are described. The elements that should appear in all software project management plans are identified.

IEEE Std 1061-1998. *IEEE Standard for a Software Quality Metrics.* A methodology for establishing quality requirements and identifying, implementing, analyzing, and validating the process and product software quality metrics is defined. The methodology spans the entire software life cycle.

IEEE Std 1062, 1998 Edition. *IEEE Recommended Practice for Software Acquisition.* A set of useful quality practices that can be selected and applied during one or more steps in a software acquisition process is described. This recommended practice can be applied to software that runs on any computer system regardless of the size, complexity, or criticality of the software, but is more suited for use on modified-off-the-shelf software and fully developed software.

IEEE Std 1063-1987 (R1993). *IEEE Standard for Software User Documentation.* Minimum requirements for the structure and information content of user documentation are provided. The requirements apply primarily to technical substance rather than to style. Editorial and stylistic considerations are addressed only when they impact structure and content. Only traditional documentation, either printed on paper or stored in some other medium in the format of a printed document and used in a manner analogous to the way a printed document is used, is addressed.

IEEE Std 1067-1996. *IEEE Guide for In-Service Use, Care, Maintenance, and Testing of Conductive Clothing for Use on Voltages up to 765 kV ac and ± 750 kV dc.* Recommendations are provided for the in-service use, care, maintenance, and electrical testing of conductive clothing, including suits, gloves, socks, and boots, for use on voltages up to 765 kV ac and ± 750 kV dc.

IEEE Std 1068-1996. *IEEE Recommended Practice for the Repair and Rewinding of Motors for the Petroleum and Chemical Industry.* General recommendations are provided for owners (users?) of motors that need repair as well as owners and operators of establishments that offer motor repair services. The use of this recommended practice is expected to result in higher quality, more cost-effective, and timely repairs. Guidelines are also provided for evaluating repairs and facilities.

IEEE Std 1069-1991 (R1996). *IEEE Recommended Practice for Precipitator and Baghouse Hopper Heating Systems.* Recommendations on hopper heating system performance and

equipment requirements necessary to provide an economical and effective hopper heating system are presented. System characteristics are described, and heat transfer analysis is covered. Heating module design considerations are presented. Control, monitoring, and alarm systems are discussed. Insulation, installation, operation, and maintenance are addressed.

IEEE Std 1070-1995. *IEEE Guide for the Design and Testing of Transmission Modular Restoration Structure Components.* A generic specification, including design and testing, for transmission modular restoration structure components used by electric utilities is provided.

IEEE Std 1073-1996. *IEEE Standard for Medical Device Communications—Overview and Framework.* An overall definition of the IEEE 1073 family of standards is provided, describing the interconnection and interoperation of medical devices with computerized healthcare information systems in a manner suitable for the clinical environment.

IEEE Std 1073.3.1-1994. *IEEE Standard for Medical Device Communications—Transport Profile—Connection Mode.* A local area network (LAN) for the interconnection of computers and medical devices is defined by the specifications and guidelines set forth in this standard. The functions, features, and protocols of the intra-room communications subnet of a bedside communications network known as the Medical Information Bus (MIB) are defined. This communications subnet is the functional equivalent for the MIB of the Transport, Network, Data Link, and Physical layers of the Organization for International Standards (ISO) Reference Model for Open Systems Interconnection (OSI). This standard defines the services and protocols for the MIB Transport, Network, and Data Link layers.

IEEE Std 1073.3.2-2000. *IEEE Standard for Medical Device Communications—Transport Profile—IrDA Based—Cable Connected.* A connection-oriented transport profile and physical layer suitable for medical device communications in legacy devices is established. Communications services and protocols consistent with specifications of the Infrared Data Association are defined. These communication services and protocols are optimized for use in patient-connected bedside medical devices.

IEEE Std 1073.4.1, 2000 Edition. *IEEE Standard for Medical Device Communications—Physical Layer Interface—Cable Connected.* A physical interface for the interconnection of computers and medical devices in the IEEE 1073 family of standards is defined. This interface is intended to be highly robust in an environment where devices are frequently connected to and disconnected from the network. The physical and electrical characteristics of the connector and signals necessary to exchange digital information between cable-connected medical devices and host computer systems are specified.

IEEE Std 1073.4.1a-2000. *IEEE Standard for Medical Device Communications—Physical Layer Interface—Cable Connected.* A physical interface for the interconnection of computers and medical devices in the IEEE 1073 family of standards is defined. This interface is intended to be highly robust in an environment where devices are frequently connected to and disconnected from the network. The physical and electrical characteristics of the connector and signals necessary to exchange digital information between cable-connected medical devices and host computer systems are specified.

IEEE Std 1074-1997. *IEEE Standard for Developing Software Life Cycle Processes.* A process for creating a software life cycle process is provided. Although this standard is directed primarily at the process architect, it is useful to any organization that is responsible for managing and performing software projects.

IEEE Std 1076-1993. *VHDL Interactive Tutorial—A CD-ROM Learning Tool for IEEE Std 1076 (VHDL).* Aiding in the comprehension and use of IEEE VHDL, this unique product offers a comprehensive & reliable tutorial on VHDL not available anywhere else. An enhancement to IEEE Std 1076-1993, the interactive tutorial is organized into four modules designed to incrementally add to the user's understanding of VHDL and it's applications. This hands-on tutorial shows clear links between the many levels and layers of VHDL and provides actual examples of VHDL implementation, making it an indispensable tool for VHDL product development and users.

IEEE Std 1076a-2000. *IEEE Standard VHDL Language Reference Manual.* VHSIC Hardware Description Language (VHDL) is defined. VHDL is a formal notation intended for use in all phases of the creation of electronic systems. Because it is both machine readable and human readable, it supports the development, verification, synthesis, and testing of hardware designs; the communication of hardware design data; and the maintenance, modification, and procurement of hardware. Its primary audiences are the implementors of tools supporting the language and the advanced users of the language.

IEEE Std 1076.1-1999. *IEEE Standard VHDL Analog and Mixed-Signal Extensions.* This standard defines the IEEE 1076.1 language, a hardware description language for the description and the simulation of analog, digital, and mixed-signal systems. The language, also informally known as VHDL-AMS, is built on IEEE Std 1076-1993 (VHDL) and extends it with additions and changes to provide capabilities of writing and simulating analog and mixed-signal models.

IEEE Std 1076.2-1996. *IEEE Standard VHDL Language Math Package.* The MATH_REAL package declaration, the MATH_COMPLEX package declaration, and the semantics of the standard mathematical definition and conventional meaning of the functions that are part of this standard are provided. Ways for users to implement this standard are given in an informative annex. Samples of the MATH_REAL and MATH_COMPLEX package bodies are provided in an informative annex as guidelines for implementors to verify their implementation of this standard. Implementors may choose to implement the package bodies in the most efficient manner available to them.

IEEE Std 1076.3-1997. *IEEE Standard VHDL Synthesis Packages.* The current interpretation of common logic values and the association of numeric values to specific VHDL array types is described. This standard provides semantic for the VHDL synthesis domain, and enables formal verification and simulation acceleration in the VHDL based design. The standard interpretations are provided for values of standard logic types defined by IEEE Std 1164-1993, and of the BIT and BOOLEAN types defined in IEEE Std 1076-1993. The numeric types SIGNED and UNSIGNED and their associated operators define integer and natural number arithmetic for arrays of common logic values. Two's compliment and binary encoding techniques are used. The numeric semantic is conveyed by two VHDL packages. This standard also contains any allowable modifications.

IEEE Std 1076.4-1995. *IEEE Standard VITAL Application-Specific Integrated Circuit (ASIC) Modeling Specification.* The VITAL (VHDL Initiative Towards ASIC Libraries) ASIC Modeling Specification is defined. It creates a methodology that promotes the development of highly accurate, efficient simulation models for ASIC (Application-Specific Integrated Circuit) components in VHDL.

IEEE Std 1076.6-1999. *IEEE Standard for VHDL Register Transfer Level (RTL) Synthesis.* A standard syntax and semantics for VHDL register transfer level (RTL) synthesis is de-fined. The subset of IEEE 1076 (VHDL) that is suitable for RTL synthesis is defined, along with the semantics of that subset for the synthesis domain.

IEEE Std 1082-1997. *IEEE Guide for Incorporating Human Action Reliability Analysis for Nuclear Power Generating*

Stations. A structured framework for the incorporation of human/system interactions into probabilistic risk assessments is provided.

IEEE Std 1095-1989 (R1994). *IEEE Guide for Installation of Vertical Generators and Generator/Motors for Hydroelectric Applications*. Installation procedures are given for all types of synchronous generators and generator/motors rated 5000 kVA and above to be coupled to hydraulic turbines or hydraulic pump/turbines having vertical shafts. The standard covers tools and facilities; personnel; generator construction; preparation of generator and turbine shafts in the factory; installation precautions; receiving, storing, and unpacking; erection procedures; mechanical run; balancing; insulation testing and drying out; initial operation; and field tests.

IEEE Std 1100-1999. *IEEE Recommended Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)*. 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 are presented. The main objective is to provide a consensus of recommended practices in an area where conflicting information and confusion, stemming primarily from different viewpoints of the same problem, have dominated. Practices herein address electronic equipment performance issues while maintaining a safe installation. A brief description is given of the nature of power quality problems, possible solutions, and the resources available for assistance in dealing with problems. Fundamental concepts are reviewed. Instrumentation and procedures for conducting a survey of the power distribution system are described. Site surveys and site power analyses are considered. Case histories are given to illustrate typical problems.

IEEE Std 1101.1-1998. *IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 60603-2 Connectors*. The basic dimensions of a range of modular subracks conforming to 60297-3 (1984-01) and 60297-4 (1995-03) for mounting in equipment according to 60297-1 (1986-09) and 310-D-1992, together with the basic dimensions of a compatible range of plug-in units, printed boards, and backplanes, are covered. The dimensions and tolerances necessary to ensure mechanical function compatibility are provided. This standard offers total system integration guidelines with attendant advantages, such as reduction in design and development time, manufacturing cost savings, and distinct marketing advantages.

IEEE Std 1101.2-1992 (R1994). *IEEE Standard for Mechanical Core Specifications for Conduction-Cooled Eurocards*. Mechanical characteristics of conduction-cooled versions of Eurocard-based circuit card assemblers are described. This specification is applicable to, but not limited to, the VMEbus standard, an internal interconnect (backplane) bus intended for connecting processing elements to their immediate fundamental resources. The aim is to ensure mechanical interchangeability of conduction-cooled circuit card assemblers in a format suitable for military and rugged applications, and to ensure their compatibility with commercial, double-height 160-mm Eurocard chassis.

IEEE Std 1101.3-1993. *IEEE Mechanical Standard for Conduction-Cooled and Air-Cooled 10 SU Modules*. The mechanical design requirements for conduction-cooled and air-cooled modules of the 10SU by 6.375 in (161.9 mm) format are established. The specification of dimensions and tolerances is intended to ensure the mechanical intermateability of modules within associated subracks. The basic dimension, frames, PWBs, materials, assembly, and chassis interface of single-sided and double-sided modules are covered.

IEEE Std 1101.4-1993. *IEEE Standard for Futurebus+®, Profile M (Military)*. Futurebus+ standards provide systems developers with a set of tools with which high performance bus-based systems may be developed. This architecture provides a wide range of performance scalability over both cost and time for multiple generations of single- and multiple-bus multiprocessor systems. This document, a companion standard to IEEE Std 896.1-1991, builds on the logical layer by adding requirements for three military profiles. It is to these profiles that products will claim conformance. Other specifications that may be required in conjunction with this standard are IEEE Std 896.1-1991, IEEE Std 896.2-1991, IEEE Std 896.3-1993, IEEE Std 896.4-1993, IEEE Std 1101.3-1993, IEEE Std 1101.4-1993, IEEE Std 1212-1991, IEEE Std 1194.1-1991, IEEE P1394, IEEE Std 1301-1991, and IEEE Std 1301.1-1991.

IEEE Std 1101.7-1995. *IEEE Standard for Space Applications Module, Extended Height Format E Form Factor*. The design requirements for a module designated for use in spacecraft, boosters, and other highly rugged, conductively cooled environments are established in this standard. The requirements herein serve to specify the mechanical design of the module. Dimensions and tolerances for racks, modules, printed wiring boards, backplanes, and other connector-related dimensions that are specific to the use of 300-pin and 396-pin connectors are given. These dimensions and tolerances are designed to ensure mechanical function and interoperability.

IEEE Std 1101.10-1996. *IEEE Standard for Additional Mechanical Specifications for Microcomputers Using the IEEE Std 1101.1-1991 Equipment Practice*. A generic standard that may be applied in all fields of electronics where equipment and installations are required to conform to the 482.6 mm (19 in) equipment practice based on IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995). Dimensions are provided that will ensure mechanical interchangeability of subracks and plug-in units.

IEEE Std 1101.11-1998. *IEEE Standard for Mechanical Rear Plug-in Units Specifications for Microcomputers Using IEEE Std 1101.1 and IEEE Std 1101.10 Equipment Practice*. Additional dimensions that will ensure mechanical interchangeability of subracks and plug-in units based on IEEE P1101.1 (D1.0, 1997), 1101.10-1996, and the environmental requirements of IEC 61587-1 (May 1998-Draft) and IEC 61587-3 (May 1998-Draft) are specified.

IEEE Std 1106-1995. *IEEE Recommended Practice for Maintenance, testing and Replacement of Nickel-Cadmium Storage Batteries for Generating Stations and Substations*. Installation design, installation, maintenance and testing procedures, and test schedules that can be used to optimize the life and performance of vented nickel-cadmium batteries used for continuous-float operations are provided. Guidance for determining when these batteries should be replaced is also provided. This recommended practice is applicable to all stationary applications. However, specific applications, such as alternative energy, emergency lighting units, and semiportable equipment, may have other appropriate practices and are beyond the scope of this recommended practice. Sizing, qualification, other battery types, and battery application are beyond the scope of this recommended practice.

IEEE Std 1107-1996. *IEEE Recommended Practice For Thermal Evaluation Of Sealed Insulation Systems for AC Electric Machinery Employing Random-Wound Stator Cells*. A test procedure for comparing expected life, at rated temperature, of two or more sealed insulation systems is outlined. The procedure is limited to insulation systems for ac electric machines using random-wound stator coils. It is the intent of this procedure to evaluate insulation systems for use with air cooling under severe environmental conditions where the insulation is exposed to conducting contaminants. It does not cover special requirements such as those for machines enclosed in gas atmospheres, subjected to strong chemicals, or to submersion in liquids.

IEEE Std 1110-1991 (R1994). *IEEE Guide for Synchronous Generator Modeling Practices In Stability Analyses*. Three

direct-axis and four quadrature-axis models are categorized, along with the basic transient reactance model. Some of the assumptions made in using various models and presents the fundamental equations and concepts involved in generator/system interfacing are discussed. The various attributes of power system stability are generally covered, recognizing two basic approaches. The first is categorized under large-disturbance nonlinear analysis; the second approach considers small disturbances, where the corresponding dynamic equations are linearized. Applications of a range of generator models are discussed and treated. The manner in which generator saturation is treated in stability studies, both in the initialization process, as well as during large or small disturbance stability analysis procedures, is addressed. Saturation functions that are derived, whether from test data or by the methods of finite elements are developed. Different saturation algorithms for calculating values of excitation and internal power angle, depending upon generator terminal conditions, are compared. The question of parameter determination is covered. Two approaches in accounting for generator field and excitation system base quantities are identified. Conversion factors are given for transferring field parameters from one base to another for correct generator/excitation system interface modeling. Suggestions for modeling of negative field currents and other field circuit discontinuities are included.

IEEE Std 1115-1992 (R1994). *IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications.* Methods for defining the dc load and for sizing a nickel-cadmium battery to supply that load are described. Installation, maintenance, qualification, testing procedures, and consideration of battery types other than nickel-cadmium batteries are not included. Design of the dc system and sizing of the battery charger(s) are also not included.

IEEE Std 1120-1990 (R1995). *IEEE Guide to the Factors to Be Considered in the Planning, Design, and Installation of Submarine Power and Communications Cables.* A checklist of factors relating to power and communications cables installed in a submarine environment, including the shore ends of such cables, is presented. These factors should be considered in the planning, design, and installation of submarine cable systems in a safe and environmentally acceptable manner. Special requirements of communications cables such as repeaters, etc., are not covered.

IEEE Std 1122-1998. *IEEE Standard for Digital Recorders for Measurements in High-Voltage Impulse Tests.* This standard defines the terms specifically related to the digital recorders used for monitoring high-voltage and high-current impulse tests, specifies the necessary performance characteristics for such digital recorders to ensure their compliance with the requirements for high-voltage and high-current impulse tests, and describes the tests and procedures that are necessary to show that these performance characteristics are within the specified limits.

IEEE Std 1125-1993 (R2000). *IEEE Guide for Measurement and Control in SF6 Gas-Insulated Equipment.* Guidelines for moisture level measurement, moisture data interpretation, and moisture control in gas-insulated transmission class equipment (GIE) are provided.

IEEE Std 1127-1998. *IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility.* Significant community acceptance and environmental compatibility items to be considered during the planning and design phases, the construction period, and the operation of electric supply substations are identified, and ways to address these concerns to obtain community acceptance and environmental compatibility are documented. On-site generation and telecommunication facilities are not considered.

IEEE Std 1128-1998. *IEEE Recommended Practice for Radio-Frequency (RF) Absorber Evaluation in the Range of 30 MHz to 5 GHz.* Realistic and repeatable criteria, as well as recommended test methods, for characterizing the absorption properties of typical anechoic chamber linings applied to a metallic surface are described. Parameters and test procedures are described for the evaluation of RF absorbers to be used for radiated emissions and radiated susceptibility testing of electronic products, in the absorber manufacturer and/or absorber user environment, over the frequency range of 30 MHz to 5 GHz.

IEEE Std 1129-1992 (R1998). *IEEE Recommended Practice for Monitoring and Instrumentation of Turbine Generators.* A basic philosophy and guidelines are established for the design and implementation of monitoring systems for cylindrical-rotor, synchronous turbine generators. Monitoring systems are used to display the status of the generator and auxiliary systems while these systems are operating online. The basic information needed to choose monitoring schemes best suited for each application is provided. This standard does not specify actual equipment or instrumentation, but it does indicate some critical areas where it is important to provide monitoring capability.

IEEE Std 1137-1991 (R1998). *IEEE Guide for the Implementation of Inductive Coordination Mitigation Techniques and Application.* Guidance is provided for controlling or modifying the inductive environment and the susceptibility of affected wire-line telecommunications facilities in order to operate within the acceptable levels of steady-state or surge-induced voltages of the environmental interface (probe wire) defined by IEEE Std 776-1987. Procedures for determining the source of the problem are given. Mitigation theory and philosophy are discussed, and mitigation devices are described. The application of typical mitigation apparatus and techniques and installation, maintenance, and inspection of mitigation apparatus are addressed. Advice for determining the best engineering solution is offered, and general safety considerations are discussed.

IEEE Std 1138-1994. *IEEE Standard Construction of Composite Fiber Optic Groundwire (OPGW) for Use on Electric Utility Power Lines.* The construction, mechanical and electrical performance, installation guidelines, acceptance criteria, and test requirements for a composite overhead ground wire with optical fibers, commonly known as OPGW, are discussed.

IEEE Std 1139-1999. *IEEE Standard Definitions of Physical Quantities for Fundamental Frequency and Time Metrology-Random Instabilities.* Methods of describing random instabilities of importance to frequency and time metrology is covered in this standard. Quantities covered include frequency, amplitude, and phase instabilities; spectral densities of frequency, amplitude, and phase fluctuations; and time-domain variances of frequency fluctuations. In addition, recommendations are made for the reporting of measurements of frequency, amplitude and phase instabilities, especially as regards the recording of experimental parameters, experimental conditions, and calculation techniques.

IEEE Std 1140-1994 (R1999). *IEEE Standard Test procedures for the Measurement of Electric and Magnetic Fields from Video Display Terminals (VDTs) from 5 Hz to 400 kHz.* Procedures for the measurement of electric and magnetic fields in close proximity to video display terminals (VDTs) in the frequency range of 5 Hz to 400 kHz are provided. Existing international measurement technologies and practices are adapted to achieve a consistent and harmonious VDT measurement standard for testing in a laboratory controlled environment.

IEEE Std 1142-1995. *IEEE Guide for the Design, Testing, and Application of Moisture-Impervious, Solid Dielectric 5-35 kV Power Cable Using Metal-Plastic Laminates.* The user of underground cables is provided with information on the design, testing, and application of moisture-impervious, medium-voltage, solid dielectric power cable using metal-

plastic laminates as moisture barriers. Information is also provided on selection of jacketing materials and installation practices. Other types of moisture barriers, such as extruded metal sheaths and bare metallic tapes with sealed seams, are beyond the scope of this guide.

IEEE Std 1143-1994 (R1999). *IEEE Guide on Shielding Practice for Low Voltage Cables.* A concise overview of shielding options for various types of interference and recommendations on shielding practices, including suggestions on terminating and grounding methods, are provided.

IEEE Std 1144-1996. *IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Photovoltaic (PV) Systems.* Methods for sizing nickel-cadmium batteries used in residential, commercial, and industrial photovoltaic (PV) systems are described.

IEEE Std 1145-1990 (R1999). *IEEE Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems.* Safety precautions, installation design considerations, and procedures for receiving, storing, commissioning, and maintaining pocket and fiber-plate nickel-cadmium storage batteries for photovoltaic power systems are provided. Disposal and recycling recommendations are also discussed. This recommended practice applies to all terrestrial photovoltaic power systems, regardless of size or application, that contain nickel-cadmium battery storage subsystems.

IEEE Std 1147-1991 (R1996). *IEEE Guide for the Rehabilitation of Hydroelectric Power Plants.* This guide is directed to the practicing engineer in the field of hydroelectric power plant design for the purpose of providing guidance in the decision-making processes and design for rehabilitation of hydroelectric power plants. It covers general assessment considerations, rehabilitation of waterways, and rehabilitation of equipment. An extensive bibliography is included.

IEEE Std 1149.1-1990 (R1996). *IEEE Standard Test Access Port and Boundary-Scan Architecture.* A test access port and boundary-scan architecture for digital integrated circuits and for the digital portions of mixed analog/digital integrated circuits are discussed. These facilities seek to provide a solution to the problem of testing assembled printed circuit boards and other products based on highly complex digital integrated circuits and high-density, surface-mounting assembly techniques. The facilities also provide a means of accessing and controlling design-for-test features built into the digital integrated circuits themselves. The circuitry includes a standard interface through which instructions and test data are communicated. A set of test features is defined, including a boundary-scan register, so that the component is able to respond to a minimum set of instructions designed to assist with testing of assembled printed circuit boards.

IEEE Std 1149.1a-1993 (R1996). *IEEE Supplement to Standard Test Access Port and Boundary-Scan Architecture.* A test access port and boundary-scan architecture for digital integrated circuits and for the digital portions of mixed analog/digital integrated circuits are discussed. These facilities seek to provide a solution to the problem of testing assembled printed circuit boards and other products based on highly complex digital integrated circuits and high-density, surface-mounting assembly techniques. The facilities also provide a means of accessing and controlling design-for-test features built into the digital integrated circuits themselves. The circuitry includes a standard interface through which instructions and test data are communicated. A set of test features is defined, including a boundary-scan register, so that the component is able to respond to a minimum set of instructions designed to assist with testing of assembled printed circuit boards. (This publication includes IEEE 1149.1a-1993.)

IEEE Std. 1149.1b-1994 (R1996). *IEEE Supplement to Standard Test Access Port and Boundary-Scan Architecture.* A language to describe components that conform to IEEE Std 1149.1-1990 is described in this supplement. The language is based on the VHSIC Hardware Description Language (VHDL). General characteristics, the overall structure of a boundary-scan description language (BSDL) description, special cases, and example packages are included.

IEEE Std 1149.4-1999. *IEEE Standard for a Mixed-Signal Test Bus.* The testability structure for digital circuits described in IEEE Std 1149.1-1990 has been extended to provide similar facilities for mixed-signal circuits. The architecture is described, together with the means of control of and access to both analog and digital test data. Sample implementation and application details (which are not part of the standard) are included for illustration.

IEEE Std 1149.5-1995. *IEEE Standard for Module Test and Maintenance Bus (MTM-Bus) Protocol.* This Standard specifies a serial, backplane, test and maintenance bus (MTM-Bus) that can be used to integrate modules from different design teams or vendors into testable and maintainable subsystems. Physical, link, and command layers are specified. Standard interface protocol and commands can be used to provide the basic test and maintenance features needed for a module as well as access to on-module assets (memory, peripherals, etc.) and IEEE Std 1149.1 boundary-scan. Standard commands and functions support fault isolation to individual modules and test of backplane interconnect between modules.

IEEE Std 1150-1991 (R1998). *IEEE Trial-Use Recommended Practice for Integrating Power Plant Computer-Aided Engineering (CAE) Applications.* A data model, called the plant information network, that standardizes categories of generating plant data and data relationships is presented. Guidelines are provided for using the model to integrate computer-aided engineering (CAE) applications across the spectrum of plant work activities during the complete cycle of the plant from site selection through decommissioning. Instructions are given to aid the utility's engineering, construction, and operating groups in specifying integrated CAE applications. The information engineering concepts that are the basis for integrated CAE development are covered.

IEEE Std 1155-1992 (R1998). *IEEE Standard for VMEbus Extensions for Instrumentation: VXIbus.* A technically sound modular instrument standard based on IEEE Std 1014-1987, IEEE Standard for a Versatile Backplane Bus: VMEbus, which is open to all manufacturers and is compatible with present industry standards, is defined. The VXIbus specification details the technical requirements of VXIbus compatible components, such as mainframes, backplanes, power supplies, and modules.

IEEE Std 1156.1-1993 (R1998). *IEEE Standard Microcomputer Environmental Specifications for Computer Modules.* Fundamental information on minimum environmental withstand conditions is provided. The information is intended to be used in those cases in which a generic or detail specification for a certain module has been prepared. The intent is to achieve uniformity and reproducibility in the test conditions for all modules that may make up larger systems and are purported to have a rated environmental performance level. The specifications pertain to both the natural and artificial environments to which modules may be exposed. These conditions include, but are not limited to, thermal, mechanical, electrical, and atmospheric stresses

IEEE Std 1156.2-1996. *IEEE Standard for Environmental Specifications for Computer Systems.* This standard is designed for use in conjunction with other documents such as the IEEE 1101 group of standards, the IEEE 896 group of standards, the IEEE 1596 group of standards, the IEEE 1014 group of standards, and ISO/IEC 10861:1994. This standard is one of the IEEE P1156.x series for environmental specifications. It is intended to be used as a core specification. It contains minimum environmental withstand conditions applicable to computer systems and all of their associated components. It has been created to provide general environmental withstand conditions for one or more of the above listed com-

puter busses or interconnect standards, and electronic equipment in general.

IEEE Std 1156.4-1997. *IEEE Standard for Environmental Specifications for Spaceborne Computer Modules.* Fundamental information on minimum environmental withstand conditions for space electronics is provided. The intent is to achieve uniformity and reproducibility in the test conditions for all spaceborne computer modules that may make up larger systems and are purported to have a rated environmental performance level. The specifications pertain to both the natural and artificial environments to which spaceborne computer modules may be exposed. These conditions include, but are not limited to, thermal, mechanical, electrical, and radiation stresses.

IEEE Std 1158-1991 (R1996). *IEEE Recommended Practice for Determination of Power Losses in High-Voltage Direct-Current (HVDC) Converter Stations.* A set of standard procedures for determining and verifying the total losses of a high-voltage direct-current (HVDC) converter station is recommended. The procedures are applicable to all parts of the converter station and cover standby, partial load, and full load losses and methods of calculation and measurement. All line commutated converter stations used for power exchange in utility systems are covered. Loss determination procedures for synchronous compensators or static VAR compensators are not included.

IEEE Std 1159-1995. *IEEE Recommended Practice on Monitoring Electrical Power Quality.* The 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.

IEEE Std 1160-1993 (R1999). *IEEE Standard Test Procedures for High-Purity Germanium Crystals for Radiation Detectors.* This standard applies to the measurement of bulk properties of high-purity germanium as they relate to the fabrication and performance of germanium detectors for gamma rays and x rays. Such germanium is monocrystalline and has a net concentration of fewer than 1011 electrically active impurity center per cm3, usually on the order of 1010 cm^{-3}.

IEEE Std 1164-1993 (R1999). *IEEE Standard Multivalue Logic System for VHDL Model Interoperability (Std_logic_1164).* This standard is embodied in the Std_logic_1164 package declaration and the semantics of the Std_logic_1164 body. An annex is provided to suggest ways in which one might use this package.

IEEE Std 1175-1992 (R1999). *IEEE Trial-Use Standard Reference Model for Computing System Tool Interconnections.* Reference models for tool-to-organization interconnections, tool-to-platform interconnections, and information transfer among tools are provided. The purpose is to establish agreements for information transfer among tools in the contexts of human organization, a computer system platform, and a software development application. To make the transfer of semantic information among tools easier, a semantic transfer language (STL) is also provided. Interconnections that must be considered when buying, building, testing, or using computing system tools for specifying behavioral descriptions or requirements of system and software products are described.

IEEE Std 1177-1993 (R1997). *IEEE Standard FASTBUS Modular High-Speed Data Acquisition and Control System and IEEE FASTBUS Standard Routines.* Mechanical, signal, electrical, and protocol specifications are given for a modular data bus system, which, while allowing equipment designers a wide choice of solutions, ensure compatibility of all designs that obey the mandatory parts of the specification. This standard applies to systems consisting of modular electronic instrument units that process or transfer data or signals, normally in association with computers or other automatic data processors. Standard software routines for use with the system in IEEE Std 960-1993 are defined.

IEEE Std 1178-1990 (R1995). *IEEE Standard for the Scheme Programming Language.* The form and meaning of programs written in the Scheme programming language, in particular, their syntax, the semantic rules for interpreting them, and the representation of data to be input or output by them, are specified. The fundamental ideas of the language and the notational conventions used for describing and writing programs in the language are presented. The syntax and semantics of expressions, programs, and definitions are specified. Scheme's built-in procedures, which include all of the language's data manipulation and input/output primitives, are described, and a formal syntax for Scheme written in extended Backus-Naur form is provided. Formal denotational semantics for Scheme and some issues in the implementation of Scheme's arithmetic are covered in the appendixes.

IEEE Std 1184-1994 (R1997). *IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems.* The characteristics of the various battery energy systems available are described so that users can select the system best suited to their requirements. This guide also describes how the rectifier and the inverter components of the uninterruptible power system (UPS) can relate to the selection of the battery system.

IEEE Std 1185-1994 (R2000). *IEEE Guide for Installation Methods for Generating Station Cables.* Installation methods to improve cable installation practices in generating stations are provided. These include cable lubrication methods, conduit-cable pulling charts, pull rope selection criteria, pulling attachment methods, and alternative methods to traditional cable pulling tension monitoring. This guide supplements IEEE Std 422-1986 and IEEE Std 690-1984, which provide specific cable installation limits. This guide may also be of benefit to cable pulling crews in commercial and industrial facilities when similar cable types and raceways are used.

IEEE Std 1187-1996. *IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Storage Batteries for Stationary Applications.* Recommended design practices and procedures for storage, location, mounting, ventilation, instrumentation, preassembly, assembly, and charging of valve-regulated lead-acid (VRLA) storage batteries are provided. Recommended safety practices are also included. This recommended practice applies to all VRLA battery stationary installations.

IEEE Std 1188-1996. *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.* Maintenance, test schedules and testing procedures that can be used to optimize the life and performance of valve-regulated lead-acid (VRLA) batteries for stationary applications are covered. Guidance to determine when batteries should be replaced is also provided.

IEEE Std 1189-1996. *IEEE Guide for Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.* Methods for selecting the appropriate type of valve-regulated, immobilized-electrolyte, recombinant lead-acid battery for any of a variety of potential stationary float applications are described.

IEEE Std 1193-1994. *IEEE Guide for Measurement of Environmental Sensitivities of Standard Frequency Generators.* Standard frequency generators that include all atomic frequency standards and precision quartz crystal oscillators are addressed.

IEEE Std 1194.1-1991 (R2000). *IEEE Standard for Electrical Characteristics of Backplane Transceiver Logic (BTL) Interface Circuits.* The electrical characteristics of digital interface circuits (drivers, receivers, or transceivers), used to drive a backplane bus that appears as a transmission line to the interface circuit, are specified in order to ensure proper electrical functioning with respect to timing and noise constraints. The performance requirements of buses using these interface circuits make it necessary to impose constraints beyond those

normally encountered in a specification for backplane buses. These constraints are imposed to: (1) optimize the system to accommodate the physical behavior of high-speed signals traveling between boards in a transmission-line environment; (2) minimize backplane propagation delay and backplane propagation skew between these signals to attain the required performance; and (3) minimize cross talk to attain the required reliability of information transfer.

IEEE Std 1202-1991 (R1996). *IEEE Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.* A test protocol and the performance criteria used to determine the flame propagation tendency of cables in a vertical cable tray are established. The standard applies to single-insulated and multiconductor cables. The test consists of exposing cable samples to a theoretical 20 kW (70 000 Btu/h) flaming ignition source for a 20 min duration. The test facility, test sample requirements, test procedure, and evaluation of results are covered.

IEEE Std 1204-1997. *IEEE Guide for Planning DC Links Terminating at AC Locations Having Low Short-Circuit Capacities.* Guidance on the planning and design of dc links terminating at ac system locations having low short-circuit capacities relative to the dc power infeed is provided in this guide. This guide is limited to the aspects of interactions between ac and dc systems that result from the fact that the ac system is weak compared to the power of the dc link (i.e., ac system appears as a high impedance at the ac/dc interface bus). This guide contains two parts: Part I, AC/DC Interaction Phenomena, classifies the strength of the ac/dc system, provides information about interactions between ac and dc systems, and gives guidance on design and performance; and Part II, Planning Guidelines, considers the impact of ac/dc system interactions and their mitigation on economics and overall system performance and discusses the studies that need to be performed.

IEEE Std 1205-1993. *IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations.* The guidelines are provided for assessing, monitoring, and mitigating degradation of Class 1E equipment used in nuclear power generating stations due to aging. The methods described can be used to identify the performance capability of Class 1E equipment beyond its qualified life. A discussion of stressors and aging mechanisms is included. If aging considerations have been satisfactorily addressed through other means (e.g., equipment qualification), then use of this guide may not be warranted. For some equipment, only partial application of this guide may be warranted.

IEEE Std 1206-1994. *IEEE Standard Methods for Measuring Transmission Performance of Telephone Handsets and Headsets.* Practical methods for measuring the transmission characteristics of a telephone handset or headset by means of using a test connection to obtain objective measurements are provided. The obtained test results may be used as a means of evaluating or specifying the transmission performance of a handset or headset on a standardized basis.

IEEE Std 1210-1996. *IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.* Criteria and test methods for determining the compatibility of cable-pulling lubricants (compounds) with cable jacket or other exterior cable covering are described in this standard. Cable-pulling lubricants are used to lower the tension on cable as it is pulled into conduit, duct, or directionally bored holes. Compatibility is important because lubricants should not negatively interact with the cables they lubricate. Compatibility of lubricants with a variety of common cable coverings is considered.

IEEE Std 1212.1-1993 (R1996). *IEEE Standard for Communicating Among Processors and Peripherals Using Shared Memory (Direct Memory Access—DMA).* Primitive yet high-performance means are defined for passing messages across the bus between the Processor and some form of intelligence in the I/O Unit's Function. This message-passing scheme makes minimal demands on the instruction set and hardware required. In addition, several simple conventions are defined for the structure of the messages passed. The intent is to provide a standard architectural framework that supports the detailed definition of application-dependent I/O Unit and Function interface standards. The algorithms and definitions themselves are useful in the design of integrated circuits for I/O.

IEEE Std 1214-1992 (R1999). *IEEE Standard Multichannel Analyzer (MCA) Histogram Data Interchange Format for Nuclear Spectroscopy.* A standard format for data interchange used to transfer pulse height data on magnetic media between laboratories is provided. The terms used in file records are defined. The contents consist only of ASCII characters and can be transmitted over networks and other direct links. Example programs to read data in FORTRAN, BASIC and C are provided.

IEEE Std 1219-1998. *IEEE Standard for Software Maintenance.* The process for managing and executing software maintenance activities is described.

IEEE Std 1220-1998. *IEEE Standard for Application and Management of the Systems Engineering Process.* The interdisciplinary tasks, which are required throughout a system's life cycle to transform customer needs, requirements, and constraints into a system solution, are defined. In addition, the requirements for the systems engineering process and its application throughout the product life cycle are specified. The focus of this standard is on engineering activities necessary to guide product development while ensuring that the product is properly designed to make it affordable to produce, own, operate, maintain, and eventually to dispose of, without undue risk to health or the environment.

IEEE Std 1226-1998. *IEEE Standard for a Broad-Based Environment for Test (ABBET®: Overview and Architecture).* The overall concept of A Broad-Based Environment for Test (ABBET) is defined, and mandatory requirements for implementation of ABBET are specified. The elements of ABBET and their interrelationships are described. Guidelines and requirements governing the elements of the ABBET set of standards and guides are established, and common terms to be used throughout the set are defined.

IEEE Std 1226.3-1998. *IEEE Standard for Software Interface for Resource Management for A Broad-Based Environment for Test (ABBET®).* The services needed to access and manage descriptive information about resources in an automatic test system (ATS) are covered. This information includes data about the automatic test equipment (ATE) instruments, switching, and the test subject adapter. This standard is a component of the ABBET set of standards.

IEEE Std 1226.6-1996. *IEEE Guide for the Understanding of A Broad-Based Environment for Test (ABBET®) Standard.* As a part of the family of IEEE ABBET standards, this guide facilitates an understanding of the relationships of IEEE ABBET 1226-1993 and its component standards, as well as the relationship of an ABBET implementation with the design, production, support, and operational environments with which it may be used.

IEEE Std 1227-1990 (R1995). *IEEE Guide for the Measurement of DC Electric-Field Strength and Ion Related Quantities.* Guidance is provided for measuring the electric-field strength, ion-current density, conductivity, monopolar space-charge density, and net space-charge density in the vicinity of high-voltage dc (HVDC) power lines, in converter substations, and in apparatus designed to simulate the HVDC power-line environment. The interrelationship between electrical parameters and the operating principles of measuring instruments are described. Methods of calibration are suggested where applicable, and measurement procedures are given. Significant sources of measurement error are identified.

IEEE Std 1228-1994. *IEEE Standard For Software Safety Plans*. The minimum acceptable requirements for the content of a software safety plan are established. This standard applies to the software safety plan used for the development, procurement, maintenance, and retirement of safety-critical software. This standard requires that the plan be prepared within the context of the system safety program. Only the safety aspects of the software are included. This standard does not contain special provisions required for software used in distributed systems or in parallel processors.

IEEE Std 1232-1995. *IEEE Trial-Use Standard for Artificial Intelligence and Expert System Tie to Automatic Test Equipment (AI-ESTATE): Overview and Architecture*. This document is the base standard for the AI-ESTATE set of standards. The overall concept of AI-ESTATE, which is a set of specifications for data interchange and for standard services for the test and diagnostic environment, is defined; mandatory requirements for implementing AI-ESTATE are specified; the elements of AI-ESTATE and their interrelationships are described; guidelines and requirements to govern the documents in the AI-ESTATE set of standards are established; and the terminology used throughout the set is defined. The purpose of the AI-ESTATE set of standards is to standardize interfaces between functional elements of an intelligent test environment and representations of knowledge and data for the functional elements of the intelligent test environment.

IEEE Std 1232.1-1997. *IEEE Trial-Use Standard for Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE): Data and Knowledge Specification*. Formal models for information used in system diagnosis are defined. As part of the AI-ESTATE set of standards, this standard includes several models that form the basis for a format to facilitate exchange of persistent diagnostic information between two reasoners, and also provides a formal typing system for the services defined in the AI-ESTATE service specification.

IEEE Std 1232.2-1998. *IEEE Trial-Use Standard for Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE): Service Specification*. Formal software interfaces to system diagnosis tools and applications are defined. As part of the AI-ESTATE set of standards, this standard defines services to manipulate information models as defined in IEEE Std 1232.1-1997 and to control a diagnostic reasoner. This standard includes a new information model to manipulate dynamic information obtained during the process of system diagnosis. Service bindings to ANSI C and ANSI Ada are also provided.

IEEE Std 1233-1998 Edition. (Includes IEEE Std 1233-1996 and IEEE Std 1233a-1998). *IEEE Guide for Developing System Requirements Specifications*. Guidance for the development of the set of requirements, System Requirements Specification (SyRS), that will satisfy an expressed need is provided. Developing an SyRS includes the identification, organization, presentation, and modification of the requirements. Also addressed are the conditions for incorporating operational concepts, design constraints, and design configuration requirements into the specification. This guide also covers the necessary characteristics and qualities of individual requirements and the set of all requirements.

IEEE Std 1242-1999. *IEEE Guide for Specifying and Selecting Power, Control, and Special-Purpose Cable for Petroleum and Chemical Plants*. Information on the specification and selection of power, control, and special-purpose cable, as typically used in petroleum, chemical, and similar plants, is provided in this guide. Materials, design, testing, and applications are addressed. More recent developments, such as strand filling, low-smoke, zero-halogen materials, and chemical-moisture barriers have been included.

IEEE Std 1243-1997. *IEEE Guide for Improving the Lightning Performance of Transmission Lines*. The effects of routing, structure type, insulation, shielding, and grounding on transmission lines are discussed. The way these transmission-line choices will improve or degrade lightning performance is also provided. An additional section discusses several special methods that may be used to improve lightning performance. Finally, a listing and description of the FLASH program is presented.

IEEE 1246-1997. *IEEE Guide for Temporary Protective Grounding Systems Used in Substations*. The design, performance, use, testing, and installation of temporary protective grounding systems, including the connection points, as used in permanent and mobile substations are covered.

IEEE Std 1247-1998. *IEEE Standard for Interrupter Switches for Alternating Current, Rated Above 1000 Volts*. The basic requirements of interrupter switches used indoors, outdoors, and in enclosures are covered. This standard does not apply to load-break separable insulated connectors.

IEEE Std 1248-1998. *IEEE Guide for the Commissioning of Electrical Systems in Hydroelectric Power Plants*. Inspection procedures and tests for use following the completion of the installation of components and systems through to commercial operation are provided. This guide is directed to the plant owners, designers, and contractors involved in the commissioning of electrical systems of hydroelectric plants.

IEEE Std 1249-1996. *IEEE Guide for Computer-Based Control for Hydroelectric Power Plant Automation*. The application, design concepts, and implementation of computer-based control systems for hydroelectric power plant automation is addressed. Functional capabilities, performance requirements, interface requirements, hardware considerations, and operator training are discussed. Recommendations for system testing and acceptance are provided, and case studies of actual computer-based control applications are presented.

IEEE Std 1250-1995. *IEEE 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 Std 1260-1996. *IEEE Guide on the Prediction, Measurement and Analysis of AM Broadcast Reradiation by Power Lines*. A set of procedures to be followed to cope with reradiation of AM broadcast signals from power lines and other large metallic structures is provided. Reradiation may be described as electromagnetic waves radiated from a structure that has parasitically picked up a signal from the environment. A simplified prediction technique called a survey is described to determine which structures could possibly cause a problem. Guidelines for measurements and data analysis are included.

IEEE Std 1262-1995. *IEEE Recommended Practice for Qualification of Photovoltaic (PV) Modules*. Recommended procedures and specifications for qualification tests that are structured to evaluate terrestrial flat-plate photovoltaic nonconcentrating modules intended for power generation applications are established.

IEEE Std 1264-1993. *IEEE Guide for Animal deterrents for Electrical Power Supply Substations*. Methods and designs to mitigate interruptions and equipment damage resulting from animal intrusions into electric power supply substations thereby improving reliability and minimizing the associated revenue loss are addressed.

IEEE Std 1267-1999. *IEEE Trial-Use Guide for Development of Specification for Turnkey Substation Projects*. The technical requirements to engineer, design, specify, fabricate,

manufacture, furnish, install, test, commission, and provide as-built documents for air-insulated substations are covered. This guide investigates the methods, practices, and requirements of both users and suppliers in order to promogate a systematic and coordinated approach for development of specifications for turnkey substation projects.

IEEE Std 1268-1997. *IEEE Guide for the Safe Installation of Mobile Substation Equipment*. Information pertaining to the installation of mobile substation equipment up to 230 kV is provided.

IEEE Std 1275.4-1995. *IEEE Standard for Boot (Initialization Configuration) Firmware: Bus Supplement for IEEE 896 (FutureBus+®).* Firmware is the read-only-memory (ROM) based software that controls a computer between the time it is turned on and the time the primary operating system takes control of the machine. Firmware's responsibilities include testing and initializing the hardware, determining the hardware configuration, loading (or booting) the operating system, and providing interactive debugging facilities in case of faulty hardware or software. The core requirements and practices specified by IEEE Std 1275-1994 must be supplemented by system-specific requirements to form a complete specification for the firmware for a particular system. This standard establishes such additional requirements pertaining to the bus architecture defined by the IEEE Futurebus+ standards: ISO/IEC 10857:1994 [ANSI/IEEE Std 896.1, 1994 Edition], Information technology—Microprocessor systems—Futurebus+ —Logical protocol specification; and IEEE Std 896.2-1991, IEEE Standard for Futurebus+ —Physical Layer and Profile Specification.

IEEE Std 1276-1997. *IEEE Trial-Use Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Power Transformers*. Technical information is provided related to liquid-immersed power transformers insulated with high-temperature materials. Guidelines for applying existing qualified high-temperature materials to certain insulation systems, recommendations for loading high-temperature liquid-immersed power transformers, and technical information on insulation-system temperature ratings and test procedures for qualifying new high-temperature materials are included.

IEEE Std 1277-2000. *IEEE Trial-Use General Requirements and Test Code for Dry-Type and Oil-Immersed Smoothing Reactors for DC Power Transmission*. The electrical, mechanical, and physical requirements of oil-immersed and dry-type air core smoothing reactors for high-voltage direct current (HVDC) applications are specified. Test code is defined and appropriate technical background information is presented or identified.

IEEE 1278.1-1995. *IEEE Standard for Distributed Interactive Simulation—Applications Protocols*. Data messages, known as protocol data units (PDUs), that are exchanged on a network between simulation applications are defined. These PDUs are for interactions that take place within specified domains called protocol families, which include Entity Information/Interaction, Warfare, Logistics, Simulation Management, Distributed Emission Regeneration, and Radio Communications.

IEEE Std 1278.1a-1998. *IEEE Standard for Distributed Interactive Simulation—Application Protocols*. Data messages, known as protocol data units (PDUs), that are exchanged on a network between simulation applications are defined. These PDUs are for interactions that take place within specified domains called protocol families, which include Entity Information/Interaction, Warfare, Logistics, Simulation Management, Distributed Emission Regeneration, Radio Communications, Entity Management, Minefield, Synthetic Environment, Simulation Management with Reliability, Live Entity Information/Interaction, and Non-Real Time.

IEEE Std 1278.2-1995. *IEEE Standard for Distributed Interactive Simulation—Communication Services and Profiles*. Communication services to support information exchange between simulation applications participating in the Distributed Interactive Simulation (DIS) environment are defined. These communication services describe a connectionless information transfer that supports real-time, as well as non-real-time, exchange. Several communication profiles specifying communication services are provided.

IEEE Std 1278.3-1996. *IEEE Recommended Practice for Distributed Interactive Simulation-Exercise Management and Feedback*. Guidelines are established for exercise management and feedback in Distributed Interactive Simulation (DIS) exercises. Guidance is provided to sponsors, providers, and supporters of DIS compliant systems and exercises as well as to developers of DIS exercise management and feedback stations. The activities of the organizations involved in a DIS exercise and the top-level processes used to accomplish those activities are addressed. The functional requirements of the exercise management and feedback process are also addressed. This standard is one of a series of standards developed for DIS to assure interoperability between dissimilar simulations for currently installed and future simulations developed by different organizations.

IEEE Std 1278.4-1997. *IEEE Trial-Use Recommended Practice for Distributed Interactive Simulation—Verification, Validation, and Accreditation*. Guidelines are established for the verification, validation, and accreditation (VV&A) of distributed interactive simulation (DIS) exercises. "How-to" procedures for planning and conducting DIS exercise VV&A are provided. Intended for use in conjunction with IEEE Std 1278.3-1996, this recommended practice presents data flow and connectivity for all proposed verification and validation activities and provides rationale and justification for each step. VV&A guidance is provided to exercise users/sponsors and developers.

IEEE Std 1284-1994. *IEEE Standard Signaling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers*. A signaling method for asynchronous, fully interlocked, bidirectional parallel communications between hosts and printers or other peripherals is defined. A format for a peripheral identification string and a method of returning this string to the host outside of the bidirectional data stream is also specified.

IEEE Std 1284.1-1997. *IEEE Standard for Information Technology—Transport Independent Printer/System Interface (TIP/SI)*. A protocol and methodology for software developers, computer vendors, and printer manufacturers to facilitate the orderly exchange of information between printers and host computers are defined in this standard. A minimum set of functions that permit meaningful data exchange is provided. Thus a foundation is established upon which compatible applications, computers, and printers can be developed, without compromising an individual organizations desire for design innovation.

IEEE Std 1289-1998. *IEEE Guide for the Application of Human Factors Engineering in the Design of Computer-Based Monitoring and Control Displays for Nuclear Power Generating Stations*. System design considerations, information display and control techniques for use with computer-based displays, and human factors engineering guidance for the use of these techniques in nuclear power generating stations are provided.

IEEE Std 1290-1996 (R2000). *IEEE Guide for Motor Operated Valve (MOV) Motor Application, Protection, Control, and Testing in Nuclear Power Generating Stations*. Motors used to drive valve operators in nuclear power generating stations are discussed. Guidelines to evaluate the adequacy of motors used to drive valve operators; to provide recommendations for motor application; and to provide methods for protection, control, and testing of motors used for valve operation are presented.

IEEE Std 1291-1993 (R1998). *IEEE Guide for Partial Discharge Measurement in Power Switchgear*. The IEEE Guide

for Partial Discharge Measurement in Power Switchgear defines methods of measuring partial discharges that may occur in energized power switchgear apparatus in flaws, voids and interfaces of non-self restoring insulation which may then result in dielectric failure of the switchgear. Guidance on instrumentation and calibration technique are also given. This guide defines methods of measuring partial discharges that may occur in energized power switchgear apparatus in flaws, voids, and interfaces of non-self-restoring insulation that may then result in dielectric failure of the switchgear. Guidance on instrumentation and calibration technique is also given.

IEEE Std 1299/C62.22.1-1996. *IEEE Guide for the Connection of Surge Arresters to Protect Insulated, Shielded Electric Power Cable Systems*. This guide suggests surge arrester installation methods at distribution cable terminal poles in order to minimize the total impressed transient voltage on medium-voltage distribution cables. Grounding electrode techniques, pole ground values, and system ground grid values are not addressed or considered in this document.

IEEE Std 1300-1996. *IEEE Guide for Cable Connections for Gas-Insulated Substations*. The coordination of design, material supply, installation, and test procedures required for the connection of a gas-insulated substation (GIS) is described. Preferred dimensions for mechanical and electrical interchangeability for voltage classes of 69 kV and above are established.

IEEE Std 1301-1991 (R1994). *IEEE Standard for a Metric Equipment Practice for Microcomputers—Coordination Document*. The metric mechanical coordination of microcomputer components, including the cabinet, rack, subracks, printed boards, and common connector-dependent dimensions for connector pitches of 2.5, 2.0, 1.5, 1.0, and 0.5 mm is addressed. This generic standard may be applied in all fields of electronics where equipment and installations are required to conform to a metric modular order. The choice of coordination dimensions for the mechanical structure for heights, widths, and depths lies within a homogeneous, metric modular three-dimensional grid as specified in IEC 917. The intent is to provide a single metric equipment practice for worldwide use.

IEEE Std 1301.1-1991 (R1994). *IEEE Standard for a Metric Equipment Practice for Microcomputers—Convection-Cooled With 2 mm Connectors*. The metric mechanical coordination of microcomputer components, including the cabinet, rack, subracks, printed boards, and common connector-dependent dimensions for connector pitches of 2.5, 2.0, 1.5, 1.0, and 0.5 mm is addressed. This generic standard may be applied in all fields of electronics where equipment and installations are required to conform to a metric modular order. The choice of coordination dimensions for the mechanical structure for heights, widths, and depths lies within a homogeneous, metric, modular, three-dimensional grid as specified in IEC 917. The intent is to provide a single metric equipment practice for worldwide use.

IEEE Std 1301.2-1993 (R1997). *IEEE Recommended Practices for the Implementation of a Metric Equipment Practice*. Recommendations provide guidance in the implementation of the generic standard, IEEE Std 1301-1991, and the connector-related standards, such as IEEE Std 1301.1-1991 and IEEE Std 1301.3-1992. This recommended practice may be applied in all fields of electronics where equipment and installations are required to conform to a metric modular order. The IEEE 1301 metric equipment practices are in accordance with IEC 917 (1988) IEC 917-0 (1989), including cabinet, rack, subracks, printed boards, and common connector-dependent dimensions for connector pitches of 2.5, 2.0, 1l5, 1.0, and 0.5 mm.

IEEE Std 1301.3-1992 (R1997). *IEEE Standard for Metric Practice for Microcomputers—Convection-Cooled with 2.5 mm Connectors*. Dimension requirements are presented for subracks, plug-in units, printed boards, and backplanes to be used in conjunction with IEEE Std 1301-1991 and with a 2.5 mm connector as defined in IEC 48B (Central Office) 245. The general arrangement, dimensions, and environmental requirements are covered. This standard may be used with other IEEE Std 1301.x connector implementations in the subracks.

IEEE Std 1301.4-1996. *IEEE Standard for a Metric Equipment Practice for Microcomputers—Coordination Document for Mezzanine Cards*. This standard establishes the metric modular order and coordination dimensions for mezzanine cards for use on host modules.

IEEE Std 1302-1998. *IEEE Guide for the Electromagnetic Characterization of Conductive Gaskets in the Frequency Range of DC to 18 GHz*. Information to assist users of gaskets in evaluating gasket measurement techniques to determine which reveal the properties critical to the intended application, to highlight limitations and sources of error of the competing measurement techniques, and to provide a basis for comparing the techniques is provided. emphasis is placed on those measurement techniques that have been adopted through incorporation into standards, both commercial and military, or that have been used extensively.

IEEE Std 1303-1994 (R2000). *IEEE Guide for Static Var Compensator Field Tests*. General guidelines and criteria for the field testing of static var compensators (SVCs), before they are placed in-service, for the purpose of verifying their specified performance are described. The major elements of a commissioning program are identified so that the user can formulate a specific plan that is most suited for his or her own SVC.

IEEE Std 1307-1996. *IEEE Trial-Use Guide for Fall Protection for the Utility Industry*. General recommendations for fall protection and worker protection are provided. Sufficient details of the methods, equipment, and training requirements necessary to provide safe and adequate procedures for personnel working at elevated worksites are presented.

IEEE Std 1308-1994. *IEEE Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters—10 Hz to 3 kHz*. Specifications that should be provided to characterize instrumentation used to measure the steady state rms value of magnetic and electric fields with sinusoidal frequency content in the range 10 Hz to 3 kHz in residential and occupational settings as well as in transportation systems are identified. The instrumentation, recommended calibration methods, and sources of measurement uncertainty are also described.

IEEE Std 1309-1996. *IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas from 9 kHz to 40 GHz*. Consensus calibration methods for electromagnetic field sensors and field probes are provided. Data recording and reporting requirements are given, and a method for determining uncertainty is specified.

IEEE Std 1310-1996. *IEEE Trial-Use Recommended Practice for Thermal Cycle Testing of Form-Wound Stator Bars and Coils for Large Generators*. A test method to determine the relative ability of high-voltage, form-wound stator bars and coils of large rotating machines to resist deterioration due to rapid heating and cooling resulting from machine load cycling is described.

IEEE Std 1312-1993. (Reaffirmation and redesignation of ANSI C92.2-1987). *IEEE Standard Preferred Voltage Ratings for Alternating-Current Electrical Systems and Equipment Operating at Voltages Above 230 kV*. Preferred voltage ratings above 230 kV nominal for alternating-current (ac) systems and equipment are provided, along with definitions of various types of system voltages.

IEEE Std 1313.1-1996. *IEEE Standard for Insulation Coordination—Definitions, Principles, and Rules*. The procedure for selection of the withstand voltages for equipment phase-to-ground and phase-to-phase insulation systems is specified. A list of standard insulation levels, based on the voltage stress

to which the equipment is being exposed, is also identified. This standard applies to three-phase ac systems above 1 kV.

IEEE Std 1313.2-1999. *IEEE Guide for the Application of Insulation Coordination.* The calculation method for selection of phase-to-ground and phase-to-phase insulation withstand votlages for equipment is presented. This guide gives methods for insulation coordination of different air-insulated systems like transmission lines and substations. The methods of analysis are illustrated by practical examples.

IEEE Std 1320.1-1998. *IEEE Standard for Functional Modeling Language—Syntax and Semantics for IDEF0.* IDEF0 function modeling is designed to represent the decisions, actions, and activities of an existing or prospective organization or system. IDEF0 graphics and accompanying texts are presented in an organized and systematic way to gain understanding, support analysis, provide logic for potential changes, specify requirements, and support system-level design and integration activities. IDEF0 may be used to model a wide variety of systems, composed of people, machines, materials, computers, and information of all varieties and structured by the relationships among them, both automated and nonautomated. For new systems, IDEF0 may be used first to define requirements and to specify functions to be carried out by the future system. As the basis of this architecture, IDEF0 may then be used to design an implementation that meets these requirements and performs these functions. For existing systems, IDEF0 can be used to analyze the functions that the system performs and to record the means by which these are done.

IEEE Std 1320.2-1998. *IEEE Standard for Conceptual Modeling Language Syntax and Semantics for IDEF1X97 (IDEFobject).* IDEF1X97 consists of two conceptual modeling languages. The key-style language supports data/information modeling and is downward compatible with the US government's 1993 standard, FIPS PUB 184. The identity-style language is based on the object model with declarative rules and constraints. IDEF1X97 identity style includes constructs for the distinct but related components of object abstraction: interface, requests, and realization; utilizes graphics to state the interface; and defines a declarative, directly executable Rule and Constraint Language for requests and realizations. IDEF1X97 conceptual modeling supports implementation by relational databases, extended relational databases, object databases, and object programming languages. IDEF1X97 is formally defined in terms of first order logic. A procedure is given whereby any valid IDEF1X97 model can be transformed into an equivalent theory in first order logic. That procedure is then applied to a meta model of IDEF1X97 to define the valid set of IDEF1X97 models.

IEEE Std 1325-1996. *IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers.* A format is presented that provides a concise and meaningful method for recording pertinent information on power circuit breaker field failures. It is recommended that this format be utilized in record keeping and directing corrective action to improve field reliability of power circuit breakers.

IEEE Std 1329-1999. *IEEE Standard Method for Measuring Transmission Performance of Handsfree Telephone Sets.* Techniques for objective measurement of electroacoustic and voice switching characteristics of analog and digital handsfree telephones (HFTs) are provided. Due to the various characteristics of HFTs and the environments in which they operate, not all of the test procedures in this standard are applicable to all HFTs. Application of the test procedures to atypical HFTs should be determined on an individual basis.

IEEE Std 1332-1998. *IEEE Standard Reliability Program for the Development and Production of Electronic Systems and Equipment.* Guidance for providing products that satisfy the customer is given. This standard guides suppliers in planning a program that suits their design philosophy, the product concept, and the resources at their disposal, so that every activity adds value. This standard encourages suppliers and customers to cooperatively integrate their reliability processes. Requirements are written to properly establish the contractual or obligatory relationship between the supplier and customer in a product program.

IEEE Std 1333-1994 (R2000). *IEEE Guide for Installation of Cable Using the Guided Boring Method.* The method and equipment involved in proper and economical installation of insulated conductors and/or conduits using the guided boring method are covered. The method addresses installations of: insulated cable, cable preinstalled in conduit (CIC), and conduit alone.

IEEE Std 1344-1995 (R2000). *IEEE Standard for Synchrophasors for Power Systems.* The synchronizing input and the data output for phasor measurements made by substation computer systems is discussed. Processes involved in computing phasors from sampled data, data-to-phasor conversions, and formats for timing imputs and phasor data output from a Phasor Measurement Unit (PMU) are also addressed.

IEEE Std 1346-1998. *IEEE 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.

IEEE Std 1348-1995 (R2000). *IEEE Recommended Practice For The Adoption Of Computer-Aided Software Engineering (CASE) Tools.* Difficulties that may be encountered, and how they can be avoided, by organizations intending to adopt CASE tools are addressed. An overview of the adoption process, including analysis of the organization's needs and readiness for automation, use of a pilot project, and definition of activities necessary to integrate the new technology into the organization's standard software engineering practice, is provided.

IEEE Std 1355-1995 (R2000). *IEEE Standard for Heterogeneous InterConnect (HIC), (Low-Cost, Low-Latency Scalable Serial Interconnect for Parallel System Construction).* Enabling the construction of high-performance, scalable, modular, parallel systems with low system integration cost is discussed. Complementary use of physical connectors and cables, electrical properties, and logical protocols for point-to-point serial scalable interconnect, operating at speeds of 10–200 Mb/s and at 1 Gb/s in copper and optic technologies, is described.

IEEE Std 1362-1998. *IEEE Guide for Information Technology—System Definition—Concept of Operations (ConOps) Document.* The format and contents of a concept of operations (ConOps) document are described. A ConOps is a user-oriented document that describes system characteristics for a proposed system from the users viewpoint. The ConOps document is used to communicate overall quantitative and qualitative system characteristics to the user, buyer, developer, and other organizational elements (for example, training, facilities, staffing, and maintenance). It is used to describe the user organization(s), mission(s), and organizational objectives from an integrated systems point of view.

IEEE Std 1364-1995 (R2000). *IEEE Standard Hardware Description Language Based on the Verilog® Hardware Description Language.* The Verilog Hardware Description Language (HDL) is defined. Verilog HDL is a formal notation intended for use in all phases of the creation of electronic systems. Because it is both machine readable and human readable, it supports the development, verification, synthesis, and testing of hardware designs; the communication of hardware design data; and the maintenance, modification, and procure-

ment of hardware. The primary audiences for this standard are the implementors of tools supporting the language and advanced users of the language.

IEEE Std 1366-1998. *IEEE Trial-Use Guide for Electric Power Distribution Reliability Indices*. Useful distribution reliability indices, and factors that affect their calculation, are identified. This guide includes indices that are useful today as well as ones that may be useful in the future. The indices are intended to apply to distribution systems, substations, circuits, and defined regions.

IEEE Std 1374-1998. *IEEE Guide for Terrestrial Photovoltaic Power System Safety*. The design, equipment applicability, and hardware installation of electrically safe, stand-alone, and grid-connected PV power systems operating at less than 50 kW output are addressed. Storage batteries and other generating equipment are discussed briefly.

IEEE Std 1375-1998. *IEEE Guide for the Protection of Stationary Battery Systems*. Guidance in the protection of stationary battery systems is provided. For the purposes of this guide, stationary battery systems include the battery and dc components to and including the first protective device downstream of the battery terminals. This guide does not set requirements; rather, it presents a number of options to the dc system designer of the different types of stationary battery system protection available.

IEEE Std 1377-1997. *IEEE Standard for Utility Industry End Device Data Tables*. Functionally related utility application data elements, grouped into a single data structure for transport are described. Data may be utilized peer-to-peer or upstream to readers or billing systems by being carried by one lower layered protocol to another stack of lower layered protocol. The data structure does not change from end device to the user of the data.

IEEE Std 1378-1997. *IEEE Guide for Commissioning High-Voltage Direct-Current (HVDC) Converter Stations and Associated Transmission Systems*. General guidelines for commissioning high-voltage direct-current (HVDC) converter stations and associated transmission systems are provided. These guidelines apply to HVDC systems utilizing 6-pulse or 12-pulse thyristor-valveconverter units operated as a two-terminal HVDC transmission system or an HVDC back-to-back system.

IEEE Std 1379-1997. *IEEE Trial-Use Recommended Practice for Data Communications Between Intelligent Electronic Devices and Remote Terminal Units in a Substation*. A uniform set of guidelines for communications and interoperations of Intelligent Electronic Devices (IEDs) and Remote Terminal Units (RTUs) in an electric utility substation is provided. A mechanism for adding data elements and message structures to this recommended practice is described.

IEEE Std 1387.2-1995 (R2000). *IEEE Standard for Information Technology—Portable Operating Interface System Interface (POSIX®) System Administration—Part 2: Software Administration*. This standard is part of the POSIX series of standards for applications and user interfaces to open systems. It defines a software packaging layout, a set of information maintained about software, and a set of utility programs to manipulate that software and information.

IEEE Std 1387.3-1996 (R2000). *IEEE Standard for Information Technology—Portable Operating System Interface (POSIX®) System Administration — Part 3: User and Group Account Administration*. IEEE Std 1387.3-1996 System Administration Interface/User and Group Administration for Computer Operating System Environments, is part of the POSIX® series of standards for applications and user interfaces to open systems. The purpose of this standard is to provide a common set of utility programs, for the administration of the User and Group Account entities described in the ISO/IEC 9945-1:1996 (IEEE Std 1003.1-1996) and ISO/IEC 9945-2:1993 (IEEE Std 1003.2-1992) standards.

IEEE Std 1390-1995 (R2000). *IEEE Standard for Utility Telemetry Service Architecture for Switched Telephone Network*. This standard describes a utility telemetry service architecture operated over the telephone network. The architecture described is a basic transport architecture capable of supporting many different applications. The text is described in terms of a utility meter reading application, but any enhanced service provider (ESP) communication can be transported. Telemetry calls may be initiated by either the utility/service provider (outbound) or the telemetry interface unit (TIU)/CPE (inbound) on the end user's premise.

IEEE Std 1390.2-1999. *IEEE Standard for Automatic Meter Reading Via Telephone—Network to Telemetry Interface Unit*. The telephone network interface to a telemetry interface unit operating under the utility telemetry service architecture is described. The interface is described in terms of a utility meter reading application, but any enhanced service provider communication can be transported. Telemetry calls may be initiated by either the utility/enhanced service provider (outbound) or the telemetry Interface unit/customer premise equipment (inbound) on the end user's premise.

IEEE Std 1390.3-1999. *IEEE Standard for Automatic Meter Reading Via Telephone—Network to Utility Controller*. The telephone network interface to a utility controller operating under the utility telemetry service architecture is described. The interface is described in terms of a utility meter reading application but any enhanced service provider communication can be transported. Telemetry calls may be initiated by either the utility/service provider (outbound) or the telemetry interface unit (TIU)/CPE (inbound) on the end user's premises.

IEEE Std 1393-1999. *IEEE Standard for Spaceborne Fiber-Optic Data Bus*. The design requirements for a fiber-optic serial interconnect protocol, topology, and media is established. The application target for this standard is the interconnection of multiple aerospace sensors, processing resources, bulk storage resources, and communications resources onboard aerospace platforms. This standard is for subsystem interconnection, as opposed to intra-backplane connection.

IEEE Std 1394-1995 (R1994). *IEEE Standard for a High Performance Serial Bus*. A high-speed serial bus that integrates well with most IEEE standard 32-bit and 64-bit parallel buses, as well as such nonbus interconnects as the IEEE Std 1596-1992, Scalable Coherent Interface, is specified. It is intended to provide a low-cost interconnect between cards on the same backplane, cards on other backplanes, and external peripherals. This standard follows the IEEE Std 1212-1991 Command and Status Register (CSR) architecture.

IEEE Std 1394a-2000. *IEEE Standard for a High Performance Serial Bus—Amendment 1*. Amended information for a high-speed Serial Bus that integrates well with most IEEE standard 32-bit and 64-bit parallel buses is specified. This amendment is intended to extend the usefulness of a low-cost interconnect between external peripherals, as described in IEEE Std 1394-1995. This amendment to IEEE Std 1394-1995 follows the ISO/IEC 13213:1994 Command and Status Register (CSR) Architecture.

IEEE Std 1402-2000. *IEEE Guide for Electric Power Substation Physical and Electronic Security*. Security issues related to human intrusion upon electric power supply substations are identified and discussed. Various methods and techniques presently being used to mitigate human intrusions are also presented in this guide.

IEEE Std 1404-1998. *IEEE Guide for Microwave Communications System Development: Design, Procurement, Construction, Maintenance, and Operation*. The needs and requirements specific to the design, procurement, construction, maintenance, and operation of a microwave system are addressed. Steps for a variety of applications have been included in this guide; however, users should select only those steps

that apply to their particular system(s) and their procurement policies.

IEEE Std 1406-1998. *IEEE Trial-Use Guide to the Use of Gas-In-Fluid Analysis for Electric Power Cable Systems*. The application of the analysis of gases dissolved in the fluids of fluid-filled cable systems is discussed with respect to the procedures for sampling, obtaining the dissolved gas data, and analyzing the results.

IEEE Std 1407-1998. *IEEE Trial-Use Guide for Accelerated Aging Tests for Medium-Voltage Extruded Electric Power Cables Using Water-Filled Tanks*. Accelerated aging tests on extruded medium-voltage cables using water-filled tanks are addressed. Information on the equipment, cable samples, test conditions, and measurements to perform the aging tests is provided. Techniques on how to analyze the test data are also included. The implementation of this guide will allow a better description of the test data obtained by different laboratories.

IEEE Std 1410-1997. *IEEE Guide for Improving the Lightning Performance of Electric Power Overhead Distribution Lines*.

IEEE Std 1413-1998. *IEEE Standard Methodology for Reliability Prediction and Assessment for Electronic Systems and Equipment*. The framework for the reliability prediction process for electronic systems and equipment, including hardware and software predictions at all levels, is covered.

IEEE Std 1416-1998. *IEEE Recommended Practice for the Interface of New Gas-Insulated Equipment in Existing Gas-Insulated Substations*. Recommendations for the connection of a gas-insulated substation to another gas-insulated substation of a different make are given.

IEEE Std 1420.1-1995. *IEEE Standard for Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Basic Interoperability Data Model (BIDM)*. The minimal set of information about assets that reuse libraries should be able to exchange to support interoperability is provided.

IEEE Std 1420.1a-1996. *(Supplement to IEEE Std 1420.1-1995), Supplement to IEEE Standard for Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Asset Certification Framework*. A consistent structure for describing a reuse library's asset certification policy in terms of an Asset Certification Framework is defined, along with a standard interoperability data model for interchange of asset certification information.

IEEE Std 1420.1b-1999. *IEEE Standard for Information Technology—Software Reuse—Data model for Reuse Library Interoperability: Intellectual Property Rights Framework*. This extension to the Basic Interoperability Data Model (IEEE Std 1420.1-1995) incorporates intellectual property rights issues into software asset descriptions for reuse library interoperability.

IEEE Std 1430-1996. *IEEE Guide for Information Technology—Software Reuse—Concept of Operations for Interoperating Reuse Libraries*. This document describes the concepts necessary and appropriate for Networks of Interoperating Reuse Libraries (NIRLs). The purpose is to provide a context for standardization efforts toward the goal of supporting and enhancing interoperability.

IEEE Std 1445-1998. *IEEE Standard for Digital Test Interchange Format (DTIF)*. The information content and the data formats for the interchange of digital test program data between digital automated test program generators (DATPGs) and automatic test equipment (ATE) for board-level printed circuit assemblies are defined. This information can be broadly grouped into data that defines the following: UUT Model, Stimulus and Response, Fault Dictionary, and Probe.

IEEE Std 1450-1999. *IEEE Standard Test Interface Language (STIL) for Digital Test Vector Data*. Standard Test Interface Language (STIL) provides an interface between digital test generation tools and test equipment. A test description language is defined that: (a) facilitates the transfer of digital test vector data from CAE to ATE environments; (b) specifies pattern, format, and timing information sufficient to define the application of digital test vectors to a DUT; and (c) supports the volume of test vector data generated from structured tests.

IEEE Std 1451.2-1997. *IEEE Standard for a Smart Transducer Interface for Sensors and Actuators Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats*. A digital interface for connecting transducers to microprocessors is defined. A TEDS and its data formats are described. An electrical interface, read and write logic functions to access the TEDS and a wide variety of transducers are defined. This standard does not specify signal conditioning, signal conversion, or how the TEDS data is used in applications.

IEEE Std 1455-1999. *IEEE Standard for Message Sets for Vehicle/Roadside Communications*. Those characteristics of a dedicated short-range communications (DSRC) system that are independent of the Physical and Data Link Layers (ISO model Layers 1 and 2) are specified. The required and optional features of the roadside equipment (RSE) and the onboard equipment (OBE) are specified. In addition, the Applications Layer (ISO model Layer 7) services and protocols, the RSE resource manager, the corresponding OBE command interpreter, and the application-specific messages are all specified. Standard supports and guidelines are provided for implementing secure DSRC systems.

IEEE Std 1459-2000. *IEEE Trial-Use Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions*. This is a trial-use standard for definitions used for measurement of electric power quantities under sinusoidal, nonsinusoidal, balanced, or unbalanced conditions. It lists the mathematical expressions that were used in the past, as well as new expressions, and explains the features of the new definitions.

IEEE Std 1460-1996. *IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields*. A listing of possible measurement goals related to characterizing quasi-static magnetic and electric fields and possible methods for their accomplishment is provided.

IEEE Std 1462-1998. (Adoption of International Standard ISO/IEC 14102:1995). *IEEE Standard for Information Technology—Guideline for the Evaluation and Selection of CASE*. IEEE Std 1462-1998 is an adoption of International Standard ISO/IEC 14102:1995. The International Standard deals with the evaluation and selection of CASE tools, covering a partial or full portion of the software engineering life cycle. The adoption of the International Standard by IEEE includes an implementation note, which explains terminology differences, identifies related IEEE standards, and provides interpretation of the International Standard.

IEEE Std 1465-1998. [Adoption of International Standard ISO/IEC 12119:1994(E)]. *IEEE Standard for Information Technology—Software packages—Quality Requirements and Testing*. Quality requirements for software packages and instructions on how to test a software package against these requirements are established. The requirements apply to software packages as they are offered and delivered, not to the production process (including activities and intermediate products, such as specifications).

IEEE Std 1473-1999. *IEEE Standard for Communications Protocol Aboard Trains*. Communications protocols to be used for intercar and intracar serial data communications between subsystems aboard passenger trains are defined by this standard. Minimum acceptable parameters for a network that can simultaneously handle monitoring and control traffic from multiple systems are set forth. While the network is not vital, it is intended to be capable of carrying vital messages.

IEEE Std 1474.1-1999. *IEEE Standard for Communications-Based Train Control (CBTC) Performance and Functional Requirements.* Performance and functional requirements for a communications-based train control (CBTC) system are established in this standard. A CBTC system is a continuous, automatic train control system utilizing high-resolution train location determination, independent of track circuits; continuous, high-capacity, bidirectional train-to-wayside data communications; and trainborne and wayside processors capable of implementing automatic train protection (ATP) functions, as well as optional automatic train operation (ATO) and automatic train supervision (ATS) functions. In addition to CBTC functional requirements, this standard also defines headway criteria, system safety criteria, and system availability criteria for a CBTC system.

IEEE Std 1475-1999. *IEEE Standard for the Functioning of and Interfaces Among Propulsion, Friction Brake, and Trainborne Master Control on Rail Rapid Transit Vehicles.* The interfaces between and among functional systems on rail rapid transit vehicles is prescribed. The systems themselves are treated as black boxes; requirements for the input signals and the output response are given. For each category of interface, three types are listed in increasing technical sophistication.

IEEE Std 1476-2000. *IEEE Standard for Passenger Train Auxiliary Power Systems Interfaces.* The electrical interfaces among the components comprising the auxiliary power systems and their electrical interface with other train-borne systems are described. As such, this standard treats the auxiliary power system components (e.g., static inverters and converters, low-voltage dc power supplies, back-up battery systems, and battery chargers) as black boxes and addresses only their interface requirements.

IEEE Std 1477-1998. *IEEE Standard for Passenger Information System for Rail Transit Vehicles.* Rail transit vehicle passenger information system interfaces with the vehicles carbody, train crew, control system, power system, and passengers are described in this standard. The physical, logical, and electrical interfaces of the passenger information system for rail transit vehicle systems and subsystems are specified.

IEEE Std 1481-1999. *IEEE Standard for Integrated Circuit (IC) Delay and Power Calculation System.* Ways for integrated circuit designers to analyze chip timing and power consistently across a broad set of electric design automation (EDA) applications are covered in this standard. Methods by which integrated circuit vendors can express timing and power information once per given technology are also covered. In addition, this standard covers means by which EDA vendors can meet their application performance and capacity needs.

IEEE Std 1482.1-1999. *IEEE Standard for Rail Transit Vehicle Event Recorders.* On-board device systems, with crashworthy memory, that record data to support accident incident analysis for rail transit vehicles, are covered. The requirements of this standard are limited to event recorder functions and interfaces. Data transmission methods are excluded. The information in this standard is independent of the hardware and or software employed for other vehicle systems.

IEEE Std 1483-2000. *IEEE Standard for Verification of Vital Functions in Processor-Based Systems Used in Rail Transit.* A set of standard verification tasks for processor-based equipment used in safety-critical applications on rail and transit systems is covered. This standard also covers processes that verify the level of safety achieved in the implementation of safety-critical functions that are required to be fail-safe. Quality assurance or validation processes that affect the overall level of system safety are not covered.

IEEE Std 1488-2000. *IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems.* The expanding use of digital communications among subsystems of the transportation infrastructure has spawned the development of message sets for the communications between these subsystems. A format for Intelligent Transportation System (ITS) message sets, including common terms (e.g., object identifier), as well as attributes necessary to document ITS data messages, is addressed in this standard.

IEEE Std 1489-1999. *IEEE Standard for Data Dictionaries.* for Intelligent Transportation Systems. The expanding use of digital communications among subsystems of the transportation infrastructure has spawned the development of data dictionaries for the communications between these subsystems. A format for Intelligent Transportation System (ITS) data dictionaries, including common terms (e.g., time, date, location), as well as meta-attributes necessary to document ITS data concepts is addressed in this standard.

IEEE Std 1490-1998. (Adoption of PMI Guide to PMBOK). *IEEE Guide—Adoption of PMI Standard—A Guide to the Project Management Body of Knowledge.* The subset of the Project Management Body of Knowledge that is generally accepted is identified and described in this guide. "Generally accepted" means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. It does not mean that the knowledge and practices should be applied uniformly to all projects without considering whether they are appropriate.

IEEE Std 1498-1995. *IEEE Standard for Information Technology—Software Life Cycle Processes—Software Development—Acquirer-Supplier Agreement (Issued for Trial Use).* This standard defines a set of software development activities and resulting software products. It provides a framework for software development planning and engineering. It is also intended to merge commercial and Government software development requirements within the framework of the software life cycle process requirements of the Electronic Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE) and International Organization for Standardization (ISO). The term "software development" is used as an inclusive term encompassing new development, modification, reuse, reengineering, maintenance, and all other processes or activities resulting in software products.

IEEE Std 1499-1998. *IEEE Standard Interface for Hardware Description Models of Electronic Components.* The standard interface for hardware description models of electronic components is defined. The primary audiences of this standard are model developers and implementors of software supporting this interface.

IEEE Std 1512-2000. *IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers.* This standard addresses the exchange of vital data about transportation-related incidents among emergency management centers through common incident management message sets. Message sets specified are consistent with the National Intelligent Transportation Systems Architecture and are described using Abstract Syntax Notation One syntax. This standard comprises the base standard of a family of incident management standards; specific incident management message sets for traffic, public safety, and HAZMAT centers may be found in forthcoming companion volumes which build upon and augment this base standard.

IEEE Std 1517-1999. *IEEE Standard for Information Technology—Software Life Cycle Processes—Reuse Processes.* A common framework for extending the software life cycle processes of IEEE/EIA Std 12207.0-1996 to include the systematic practice of software reuse is provided. This standard specifies the processes, activities, and tasks to be applied during each phase of the software life cycle to enable a software product to be constructed from reusable assets. It also specifies the processes, activities, and tasks to enable the identification, construction, maintenance, and management of assets supplied.

IEEE Std 1545-1999. *IEEE Standard for Parametric Data Log Format.* A language and file format for describing para-

metric test data is defined. Data types, data formats, and file formats are included.

IEEE Std 1596-1992. *IEEE Standard for Scalable Coherent Interface (SCI).* The Scalable Coherent Interface (SCI), which provides computer-bus-like services but uses a collection of fast point-to-point links instead of a physical bus in order to reach far higher speeds than any bus could, is described. The packets and protocols that implement transactions are defined, and the formal specification of the SCI packet protocols is given. In addition to the usual read and write transactions, SCI supports efficient multiprocessor lock transactions, cache coherence in a shared-distributed memory model, noncoherent caching, and message passing. A mechanical package and several physical links that may be used to implement the logical protocols and the cache coherence protocols are defined. Background information for understanding the protocols used by two or more SCI nodes to maintain coherence between cached copies of shared data is provided.

IEEE 1596.3-1996 (R2000). *IEEE Standard for Low-Voltage Differential Signals (LVDS) for Scalable Coherent Interface (SCI).* Scalable Coherent Interface (SCI), specified in IEEE Std 1596-1992, provides computer-bus-like services but uses a collection of fast point-to-point links instead of a physical bus in order to reach far higher speeds. The base specification defines differential ECL signals, which provide a high transfer rate (16 bits are transferred every 2 ns), but are inconvenient for some applications. IEEE Std 1596.3-1996, an extension to IEEE Std 1596-1992, defines a lower-voltage differential signal (as low as 250 mV swing) that is compatible with low-voltage CMOS, BiCMOS, and GaAs circuitry. The power dissipation of the transceivers is low, since only 2.5 mA is needed to generate this differential voltage across a 100 W termination resistance. Signal encoding is defined that allows transfer of SCI packets over data paths that are 4-, 8-, 32-, 64-, and 128-bits wide. Narrow data paths (4 to 8 bits) transferring data every 2 ns can provide sufficient bandwidth for many applications while reducing the physical size and cost of the interface. The wider paths may be needed for very-high-performance systems.

IEEE Std 1596.4-1996 (R2000). *IEEE Standard for High-Bandwidth Memory Interface Based on Scalable Coherent Interface (SCI) Signaling Technology (RamLink).* A high-bandwidth interface optimized for interchanging data between a memory controller and one or more dynamic RAMs is specified. RamLink is an applicable interface for other RAM-like devices as well.

IEEE Std 1596.5-1993 (R2000). *IEEE Standard for Shared-Data Formats Optimized for Scalable Coherent Interfaces (SCI) Processors.* Formats for interchanging integer, bit-field, and floating-point data between heterogeneous multiprocessors in a Scalable Coherent Interface (SCI) system are specified. The defined data formats can also be used to share data among multiprocessors on other bus standards that support the read, write, and lock transactions set defined by IEEE Std 1212-1991 CSR Architecture. The intent is to support efficient data transfers among heterogeneous workstations within a distributed computing environment.

IEEE Std 1754-1994 (R2000). *IEEE Standard for a 32-bit Microprocessor Architecture.* A 32-bit microprocessor architecture, available to a wide variety of manufacturers and users, is defined. The standard includes the definition of the instruction set, register model, data types, instruction opcodes, and coprocessor interface.

IEEE Std 1802.3-1991 (R2000). *Conformance Test Methodology for IEEE Standards for Local and Metropolitan Area Networks: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications [Currently contains Attachment Unit Interface (AUI) Cable (Section 4)].* This standard is part of a standards series on conformance test methodology for the family of local area network (LAN) and metropolitan area network (MAN) standards dealing with the physical and data link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model. Methods for the conformance testing of AUI cable implementations to satisfy conformance requirements arising from the ISO/IEC 8802-3 AUI cable specification are defined. The conformance test suite is intended to detect incorrect implementations of the ISO/IEC 8802-3 standard. It is comprised of two categories of test groups. The first category relates to basic interconnection testing, and the second to capability and behavior testing. The test setups, adapters, and instruments used are described.

IEEE Std 1802.3d-1993 (R2000). *Supplement to IEEE Std 1802.3-1991, Type 10BASE-T Medium Attachment unit (MAU) Conformance Test Methodology (Section 6).* Methods for conformance testing to satisfy requirements arising from the ISO/IEC 8802-3 [ANSI/IEEE Std 802.3] standard are defined. The conformance test suite is intended to detect incorrect implementations of the ISO/IEC 8802-3 standard, clause 14. It comprises two categories of test groups. The first category relates to basic interconnection testing and the second to capability and behavior testing. The test setups, adapters, and instruments used are described.

IEEE Std 2000.1-1999. *IEEE Standard for Year 2000 Terminology.* This standard revises IEEE Std 2000.1-1998. It provides a detailed set of definitions. In addition, it addresses calendar information that is helpful in understanding the timeline issues surrounding the year 2000 rollover. The definitions section remains the core of the standard. With this expanded set of definitions, the standard now addresses areas that are relevant to both engineering and business environments. An increased degree of specificity has been added to the definition of "Year 2000 compliance," making it more precise in its meaning and application.

IEEE Std 2000.2-1999. *IEEE Recommended Practice for Information Technology—Year 2000 Test Methods.* This document provides users of computer hardware, firmware, software, or data systems with recommended practices for assessing and demonstrating the system elements within their organization that may be at risk of failure due to the Year 2000 problem and related date-specific issues. This recommended practice provides the framework for detailed planning and execution of all steps and tasks involved in testing for Year 2000 compliance. The resulting plan will outline the testing approach and identify system elements that are at risk of failure when crossing into the Year 2000 or using data that includes dates after 2000-01-01.

IEEE Std 2001-1999. *IEEE Recommended Practice for Internet Practices—Web Page Engineering—Intranet/Extranet Applications.* This standard defines recommended practices for Web page engineering. It addresses the needs of Webmasters and managers to effectively develop and manage World Wide Web projects (internally via an intranet or in relation to specific communities via an extranet). This standard discusses life cycle planning: identifying the audience, the client environment, objectives, and metrics, and continues with recommendations on server considerations, and specific Web page content. IEEE Std 2001-1999 defines conformance for both Web pages and tools that generate Web pages. This document is intended to reduce site-management costs, reduce legal risks, facilitate user satisfaction, and increase the productivity of Web applications for both maintainers and users.

IEEE Std 2003-1999. *IEEE Standard for Information Technology—Requirements and Guidelines for Test Methods Specifications and Test Method Implementations for Measuring Conformance to POSIX® Standards.* This International Standard defines the requirements and guidelines for test method specifications and test method implementations for measuring conformance to POSIX standards. Test specification standard developers for other Application Programming

Interface (API) standards are encouraged to use this standard. This document is aimed primarily at developers and users of test method specifications and implementations.

IEEE Std 2003.1-1992 (R2000). *IEEE Standard for Information Technology—Test Methods for Measuring Conformance to POSIX®—Part 1: System Interfaces*. This standard provides a definition of the requirements placed upon providers of POSIX test methods for POSIX.1 (IEEE Std 1003.1-1990; ISO/IEC 9945-1:1990). These requirements consist of a POSIX.1-ordered list of assertions defining those aspects of POSIX.1 that are to be tested and the associated test methods that are to be used in performing those tests. This standard is aimed primarily at POSIX.1 test suite providers and POSIX.1 implementors. This standard specifies those aspects of POSIX.1 that shall be verified by conformance test methods.

IEEE Std 2003.2-1996. *IEEE Standard for Information Technology—Test Methods for Measuring Conformance to POSIX® Part 1: Shell and Utilities Interfaces*. This standard defines the test methods to be used to measure conformance to IEEE 1003.2 (Shell and Utility Application Interface for Computer Operating System Environments). A definition of the requirements placed upon providers of a POSIX Conformance Test Suite for the POSIX.2 standard (ISO/IEC 9945-2: 1993, IEEE/ANSI Std 1003.2-1992) is provided. These requirements consist of a list of assertions defining those aspects of POSIX.2 that are to be tested and the associated test methods that are to be used in performing those tests. This standard is primarily aimed at test suite providers, but it also defines to POSIX.2 implementors those aspects of the standard that will be verified by a conformance test suite.

IEEE/ASTM SI 10-1997. *IEEE/ASTM Standard for Use of the International System of Units (SI): The Modern Metric System*. Guidance for the use of the modern metric system is given. Known as the International System of Units (abbreviated SI), the system is intended as a basis for worldwide standardization of measurement units. Information is included on SI, a list of units recognized for use with SI, and a list of conversion factors, together with general guidance on proper style and usage.

ISO/IEC 8802-2:1998 (R2000). (ANSI/IEEE Std 802.2, 1998 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 2: Logical Link Control*. This standard is part of a family of standards for local area networks (LANs) and metropolitan area networks (MANs) that deals with the physical and data link layers as defined by the ISO Open Systems Interconnection Basic Reference Model. The functions, features, protocol, and services of the Logical Link Control (LLC) sublayer, which constitutes the top sublayer in the data link layer of the ISO/IEC 8802 LAN protocol, are described. The services required of, or by, the LLC sublayer at the logical interfaces with the network layer, the medium access control (MAC) sublayer, and the LLC sublayer management function are specified. The protocol data unit (PDU) structure for data communication systems is defined using bit-oriented procedures, as are three types of operation for data communication between service access points. In the first type of operation, PDUs are exchanged between LLCs without the need for the establishment of a data link connection. In the second type of operation, a data link connection is established between two LLCs prior to any exchange of information-bearing PDUs. In the third type of operation, PDUs are exchanged between LLCs without the need for the establishment of a data link connection, but stations are permitted to both send data and request the return of data simultaneously.

ISO/IEC 8802-3:1996 (R2000). (ANSI/IEEE Std 802.3, 1996 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.* [Supplements ANSI/IEEE 802.3b-1985, ANSI/IEEE 802.3c-1985, ANSI/IEEE 802.3d-1987, and ANSI/IEEE 802.3e-1987 have been incorporated into this edition.] This standard is part of a family of local area network (LAN) and metropolitan area network (MAN) standards dealing with the physical and data link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Reference Model. Media access control characteristics for the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method are specified. The media, Medium Attachment Unit (MAU), and physical layer repeater unit for 10 Mb/s baseband and broadband systems are also specified and a 1 Mb/s baseband implementation is provided. Specifications for MAU types 10BASE5, 10BASE2, FOIRL (fiber-optic inter-repeater link), 10BROAD36, and 1BASE5 are included. Layer and sublayer interface specifications are aligned to the ISO Open Systems Interconnection Basic Reference Model and 8802 models. The 8802-3 internal model is defined and used.

ISO/IEC 8802-4:1990 [ANSI/IEEE Std 802.4-1990 (R1995)]. *Information processing systems—Telecommunications and information exchange between systems—Local area networks—Part 4: Token-passing bus access method and physical layer specifications*. This standard is part of a family of local area network (LAN) and metropolitan area network (MAN) standards dealing with the physical and data link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Reference Model. The following are specified in this standard: the electrical and/or optical and physical characteristics of the transmission medium; the electrical or optical signaling method used; the frame formats transmitted; the actions of a station upon receipt of a frame; the services provided at the conceptual interface between the medium access control (MAC) sublayer and the Logical Link Control (LLC) sublayer above it; and the actions, entities, and values used to manage the MAC sublayer and physical layer entity.

ISO/IEC 8802-5:1998 (ANSI/IEEE 802.5, 1998 Edition) *Information processing systems—Telecommunications and information exchange between systems—Local area networks—Part 5: Token ring access method and physical layer specifications*. This Local and Metropolitan Area Network standard, ISO/IEC 8802-5:1998, is part of a family of local area network (LAN) standards dealing with the physical and data link layers as defined by the ISO/IEC Open Systems Interconnection Basic Reference Model. Its purpose is to provide compatible interconnection of data processing equipment by means of a LAN using the token-passing ring access method. The frame format, including delimiters, addressing, and priority stacks, is defined. The medium access control (MAC) protocol is defined. The finite state machine and state tables are supplemented with a prose description of the algorithms. The physical layer (PHY) functions of symbol encoding and decoding, symbol time, and latency buffering are defined. The services provided by the MAC to the station management (SMT) and the services provided by the PHY to SMT and the MAC are described. These services are defined in terms of service primitives and associated parameters. The 4 and 16 Mbit/s, shielded twisted pair attachment of the station to the medium, including the medium interface connector (MIC), is also defined. The applications environment for the LAN is intended to be commercial and light industrial. The use of token ring LANs in home and heavy industrial environments, while not precluded, has not been considered in the development of the standard. A Protocol Implementation Conformance Statement (PICS) proforma is provided as an annex to the standard.

ISO/IEC 8802-5:1998/Amd 1. (ANSI/IEEE 802.5 and 802.5j, 1998 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 5: Token ring access method and physical layer specifications—*

Amendment 1: Dedicated token ring operation and fibre optic media. This amendment to Local and Metropolitan Area Network standard, ISO/IEC 8802-5:1998, is part of a family of local area network (LAN) standards dealing with the physical and data link layers as defined by the ISO/IEC Open Systems Interconnection Basic Reference Model. The requirements for dedicated token ring (DTR) operation are specified, including the changes and additions to the Medium Access Control (MAC) layer to provide for an additional full-duplex mode of operation (switching), and for interconnection of shared LAN segments to switch ports. Also specified are the characteristics of a fibre optic interface for connecting a 4 Mbit/s or 16 Mbit/s token ring station to the trunk coupling unit (TCU) of a token ring, including station, port, and channel requirements. Fibre optic trunk signaling recommendations are also made.

ISO/IEC 8802-6:1994. (ANSI/IEEE 802.6, 1994 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 6: Distributed queue dual bus (DQDB) access method and physical layer specifications*. This standard is part of a family of standards for local area networks (LANs) and metropolitan area networks (MANs) that deals with the Physical and Data Link Layers as defined by the ISO Open Systems Interconnection Reference Model. It defines a high-speed shared medium access protocol for use over a dual, counterflowing, unidirectional bus subnetwork. The Physical Layer and Distributed Queue Dual Bus (DQDB) Layer are required to support a Logical Link Control (LLC) Sublayer by means of a connectionless Medium Access Control (MAC) Sublayer service in a manner consistent with other IEEE 802® networks. Additional DQDB Layer functions are specified as a framework for other services. These additional functions will support Isochronous Service Users and Connection-Oriented Data Service Users, but their implementation is not required for conformance.

ISO/IEC 8802-9:1996. (ANSI/IEEE Std 802.9, 1996 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 9: Integrated services (IS) LAN interface at the medium access control (MAC) and physical (PHY) layers*. A unified access method that offers integrated services (IS) to the desktop for a variety of publicly and privately administered backbone networks (e.g., ANSI FDDI, IEEE 802.x, and ISDN) is defined. In addition, the interface at the MAC sublayer and the PHY Layer is specified.

ISO/IEC 8802-11:1999. (IEEE Std 802.11-1999). *Information technology—Telecommunications and information exchange between systems—Part 11: Wireless LAN medium access control (MAC) and physical layer (PHY) specifications*. The medium access control (MAC) and physical characteristics for wireless local area networks (LANs) are specified in this standard, part of a series of standards for local and metropolitan area networks. The medium access control unit in this standard is designed to support physical layer units as they may be adopted dependent on the availability of spectrum. This standard contains three physical layer units: two radio units, both operating in the 2400–2500 MHz band, and one baseband infrared unit. One radio unit employs the frequency-hopping spread spectrum technique, and the other employs the direct sequence spread spectrum technique.

ISO/IEC 8802-12:1998. (ANSI/IEEE Std 802.12, 1998 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Part 12: Demand-priority access method, physical layer and repeater specifications*. The media access control characteristics for the demand-priority access method are specified. The layer management, physical layers, and media that support this access method are also specified. Layer and sublayer interface specifications are aligned to the ISO Open Systems Interconnection Basic Reference Model and ISO/IEC 8802 models. Specifications for 100 Mb/s operation over 100 balanced cable (twisted-pair) Categories 3 through 5, 150 shielded balanced cable, and fibre-optic media are included. Optional implementation of redundant links to facilitate automatic recovery of network connectivity in case of link or repeater failure any where in the network path is specified. Rules for connecting redundant links within a network are defined.

ISO/IEC 9945-1:1996 (IEEE Std 1003.1-1996). *Information technology—Portable Operating System Interface (POSIX®)—Part 1: System Application Interface (API) [C Language]*. A standard operating system interface and environment based on the UNIX® operating system documentation to support application portability at the source level is defined. Intended for use by both application developers and system implementors, the standard focuses on a C language interface, although future revisions are expected to contain bindings for other programming languages as well. Information is provided on: terminology, concepts, and definitions and specifications that govern structures, headers, environment variables, and related requirements; definitions for system service and subroutines; language-specific system services for the C programming language; and interface issues, including portability, error handling, and error recovery.

ISO/IEC 9945-2:1993 (R1995). (IEEE Std 1003.2-1992). *Information technology—Portable Operating System Interface (POSIX®)—Part 2: Shell and Utilities*. This standard is part of the POSIX series of standards for applications and user interfaces to open systems. It defines the applications interface to a shell command language and a set of utility programs for complex data manipulation. When the User Portability Utilities Option is included, the standard also defines a common environment for general-purpose time-sharing users on character-oriented display terminals. Included in this standard is ANSI/IEEE Std 1003.2a-1992.

ISO/IEC 10857:1994 (ANSI/IEEE 896.1, 1994 Edition). *Information technology—Microprocessor Systems-Futurebus+®—Logical Protocol Specification*. This International Standard provides a set of tools with which to implement a Futurebus+ architecture with performance and cost scalability over time, for multiple generations of single- and multiple-bus multiprocessor systems. Although this specification is principally intended 64-bit address and data operation, a fully compatible 32-bit subset is provided, along with compatible extensions to support 128- and 256-bit data highways. Allocation of bus bandwidth to competing modules is provided by either a fast centralized arbiter, or a fully distributed, one or two pass, parallel contention arbiter. Bus allocation rules are provided to suit the needs of both real-time (priority based) and fairness (equal opportunity access based) configurations. Transmission of data over the multiplexed address/data highway is governed by one of two intercompatible transmission methods: a) a technology-independent, compelled-protocol, supporting broadcast, broadcall, and transfer intervention (the minimum requirement for all Futurebus+ systems), and b) a configurable transfer-rate, source-synchronized protocol supporting only block transfers and source-synchronized broadcast for systems requiring the highest possible performance. Futurebus+ takes its name from its goal of being capable of the highest possible transfer rate consistent with the technology available at the time modules are designed, while ensuring compatibility with all modules designed to this standard both before and after. The plus sign (+) refers to the extensible nature of the specification, and the hooks provided to allow further evolution to meet unanticipated needs of specific application architectures. It is intended that this International Standard be used as a key component of an approved IEEE Futurebus+ profile.

ISO/IEC 10861:1994 (ANSI/IEEE Std 1296-1994). *Information technology—High Performance Synchronous 32-Bit Bus: MULTIBUS II*. The operation, functions, and attributes

of a parallel system bus (PSB), called MULTIBUS II, are defined. A high-performance backplane bus intended for use in multiple processor systems, the PSB incorporates synchronous, 32-bit multiplexed address/data, with error detection, and uses a 10 MHz bus clock. This design is intended to provide reliable state-of-the-art operation and to allow the implementation of cost-effective, high-performance VLSI for the bus interface. Memory, I/O, message, and geographic address spaces are defined. Error detection and retry are provided for messages. The message-passing design allows a VLSI implementation, so that virtually all modules on the bus will utilize the bus at its highest performance—32 to 40 Mbyte/s. An overview of PSB, signal descriptions, the PSB protocol, electrical characteristics, and mechanical specifications are covered.

ISO/IEC 11802-5:1997(E). ISO/IEC Technical Report 11802-5:1997 [ANSI/IEEE Std 802.1H, 1997 Edition]. *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Technical reports and guidelines—Part 5: Media access control (MAC) bridging of ethernet V2.0 in local area networks*. Extensions to the behavior of ISO/IEC 10038 (IEEE 802.1D) media access control (MAC) Bridges, in order to facilitate interoperability in bridged local area networks (LANs) comprising CSMA/CD networks interconnected with other types of LAN using MAC Bridges, where the CSMA/CD networks contain a mixture of ISO/IEC 8802-3 and Ethernet V2.0 end stations, are specified. Additionally, guidelines are provided for the of nonstandard 802® protocols, with particular emphasis on conversion of existing Ethernet protocols and the behavior to be expected from a Bridge, for the purpose of avoiding future incompatibilities.

IEEE/EIA 12207.0-1996. *IEEE/EIA Standard for Industry Implementation of International Standard ISO/IEC 12207: 1995 (ISO/IEC 12207) for Information Technology—Software Life Cycle Processes*. ISO/IEC 12207 provides a common framework for developing and managing software. IEEE/EIA 12207.0 consists of the clarifications, additions, and changes accepted by the Institute of Electrical and Electronics Engineers (IEEE) and the Electronic Industries Association (EIA) as formulated by a joint project of the two organizations. IEEE/EIA 12207.0 contains concepts and guidelines to foster better understanding and application of the standard. Thus this standard provides industry a basis for software practices that would be usable for both national and international business.

IEEE/EIA 12207.1-1997. *IEEE/EIA Guide for Industry Implementation of International Standard ISO/IEC 12207:1995 (ISO/IEC 12207) Standard for Information Technology—Software Life Cycle Processes—Life Cycle*. ISO/IEC 12207 provides a common framework for developing and managing software. IEEE/EIA 12207.0 consists of the clarifications, additions, and changes accepted by the Institute of Electrical and Electronics Engineers (IEEE) and the Electronic Industries Association (EIA) as formulated by a joint project of the two organizations. IEEE/EIA 12207.1 provides guidance for recording life cycle data resulting from the life cycle processes of IEEE/EIA 12207.0.

IEEE/EIA 12207.2-1997. *IEEE/EIA Guide for Industry Implementation of International Standard ISO/IEC 12207:1995 (ISO/IEC 12207) Standard for Information Technology—Software life cycle processes—Implementation considerations*. ISO/IEC 12207 provides a common framework for developing and managing software. IEEE/EIA 12207.0 consists of the clarifications, additions, and changes accepted by the Institute of Electrical and Electronics Engineers (IEEE) and the Electronic Industries Association (EIA) as formulated by a joint project of the two organizations. IEEE/EIA 12207.2 provides implementation consideration guidance for the normative clauses of IEEE/EIA 12207.0. The guidance is based on software industry experience with the life cycle processes presented in IEEE/EIA 12207.0.

ISO/IEC 13210:1994 (ANSI/IEEE 1003.3-1991). *Information technology—Test Methods for Measuring Conformance to POSIX®*. The general requirements and test methods for measuring conformance to POSIX standards are defined. This document is aimed primarily at working groups developing test methods for POSIX standards, developers of POSIX test methods, and users of POSIX test methods.

ISO/IEC 13213:1994. [ANSI/IEEE Std 1212, 1994 Edition] (Incorporates ANSI/IEEE Std 1212-1991). *Information technology—Microprocessor systems—Control and Status Registers (CSR) Architecture for microcomputer*. The document structure and notation are described, and the objectives and scope of the CSR Architecture are outlined. Transition set requirements, node addressing, node architectures, unit architectures, and CSR definitions are set forth. The ROM specification and bus standard requirements are covered.

IEEE Std 14143.1-2000. (Adoption of ISO/IEC 14143-1: 1998). *Implementation Note for IEEE Adoption of ISO/IEC 14143-1:1998 Information Technology—Software Measurement—Functional Size Measurement—Part 1: Definition of Concepts*. Implementation notes that relate to the IEEE interpretation of ISO/IEC 14143-1:1998 are described.

ISO/IEC 14536:1995 (ANSI/IEEE Std 896.5-1993). *IEEE Standard for Futurebus+®, Profile M (Military)*. Futurebus+ standards provide systems developers with a set of tools with which high performance bus-based systems may be developed. This architecture provides a wide range of performance scalability over both cost and time for multiple generations of single- and multiple-bus multiprocessor systems. This document, a companion standard to IEEE Std 896.1-1991, builds on the logical layer by adding requirements for three military profiles. It is to these profiles that products will claim conformance. Other specifications that may be required in conjunction with this standard are IEEE Std 896.1-1991, IEEE Std 896.2-1991, IEEE Std 896.3-1993, IEEE Std 896.4-1993, IEEE Std 1101.3-1993, IEEE Std 1101.4-1993, IEEE Std 1212-1991, IEEE Std 1194.1-1991, IEEE Std 1394-1995, IEEE Std 1301-1991, and IEEE Std 1301.1-1991.

ISO/IEC 15802-3:1998. (ANSI/IEEE Std 802.1D, 1998 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan networks area networks—Common specifications—Part 3: Media access control (MAC) bridges*. The concept of Media Access Control (MAC) Bridging. Introduced in the 1993 edition of this standard, has been expanded to define additional capabilities in Bridged LANs aimed at providing for expedited traffic capabilities, to support the transmission of time-critical information in a LAN environment; and providing filtering services that support the dynamic use of Group MAC Addresses in a LAN environment.

ISO/IEC 15802-5:1998. (ANSI/IEEE Std 802.1G, 1998 Edition). *Information technology—Telecommunications and information exchange between systems—Local and metropolitan networks area networks—Common specifications—Part 5: Remote media access control (MAC) bridging*. Extensions to the behavior of ISO/IEC 10038 (IEEE 802.1D) media access control (MAC) bridges, including the aspects of operation of remote MAC bridges that are observable on the interconnected LANs, are specified. A protocol for (optional) use between remote MAC bridges, across the non-LAN communications equipment that interconnects them, to configure the remote bridges within the bridged LAN in accordance with the spanning tree algorithm of ISO/IEC 10038: 1993, is also provided.

ANSI C2-1997. *American National Standard Electrical Safety Code®—1997 Edition*. This standard covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of 1) conductors and equipment in electric supply stations, and 2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance,

and operation of electric supply and communication lines and equipment. The standard is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This standard consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 1997 Edition of the National Electrical Safety Code.

ANSI C12.1-1988. *American National Standard Code for Electricity Metering*. Acceptable performance criteria for new types of ac watt-hour meters, demand meters, demand registers, pulse devices, instrument transformers, and auxiliary devices are established. Acceptable in-service performance levels for meters and devices used in revenue metering are stated. Information on related subjects, such as recommended measurement standards, installation requirements, test methods, and test schedules, is included. Some of the provisions are applicable to dc watthour meters as well, and acceptable in-service performance levels of such meters are given in an appendix.

ANSI C12.4-1984 (R1995). *American National Standard for Mechanical Demand Registers*. The voltage and frequency ratings, full-scale values, scale classes, demand intervals, multiplying constants, timing mechanisms, and other general features of mechanical demand registers required for use on watthour meters are covered. Single-pointer-form, cumulative-form, and multiple-pointer-form registers are included. Although mechanical demand registers are designed for use as accessories in watthour meters, items relating to watthour meters are not covered.

ANSI C12.6-1987 (R1992). *American National Standard for Marking and Arrangement of Terminals for Phase-Shifting Devices Used in Metering*. Phase-shifting devices designed to provide the proper lagged voltages required for kVAR and kVA measurement are covered. Terminal marking for devices for specific types of services as well as universal devices is considered. The number of terminals and the provision of diagrams of internal connections are specified.

ANSI C12.7-1993. *American National Standard Requirements for Watthour Meter Sockets*. The general requirements and pertinent dimensions applicable to watthour meter sockets rated up to and including 600 V and up to and including 320 A continuous duty per socket opening are covered.

ANSI C12.8-1981 (R1991). *American National Standard for Test Blocks and Cabinets for Installation of Self-Contained "A" Base Watthour Meters*. The dimensions and functions of test blocks and cabinets used with self-contained A-base watthour meters are covered. Standard ratings are defined, and general requirements are addressed.

ANSI C12.9-1993. *American National Standard for Test Switches for Transformer-Rated Meters*. This standard is intended to encompass the dimensions and functions of meter test switches used with transformer-rated watthour meters in conjunction with instrument transformers.

ANSI C12.10-1987 (R1991). *American National Standard for Electromechanical Watthour Meters*. Class designations, voltage and frequency ratings, test-current values, internal wiring arrangements, pertinent dimensions, rotor markings, register requirements, and other general specifications are covered for both detachable and bottom-connected electromechanical watthour meters. Combination devices, the essential elements of watthour meters, are also covered insofar as their application is practicable. The terminal arrangements and mounting dimensions covered by this standard are essentially those adopted by the watthour meter industry during 1928 to 1936.

ANSI C12.11-1987 (R1991). *American National Standard for Instrument Transformers for Revenue Metering 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)*. The general requirements, metering accuracy, thermal ratings, and dimensions are established for current and inductively coupled voltage transformers for revenue metering. Both indoor and outdoor types are covered.

ANSI C12.13-1991. *American National Standard for Time-of-Use Registers for Electricity Meters*. Physical requirements and test procedures for time-of-use registers are set forth. The following features of the register are covered: number and format of displays; voltage frequency and temperature ratings; demand intervals; multiplying constants; timing systems; communication requirements; nameplate information; finish; rain-tightness; and other general requirements. Test requirements and conditions and performance requirements for the registers are specified.

ANSI C12.14-1982 (R1987). *American National Standard for Magnetic Tape Pulse Recorders for Electricity Meters*. Minimum requirements for magnetic tape pulse recorders for electricity meters are recommended. The voltage, frequency ratings, recording format, enclosure requirements, and other general specifications are covered. The intent is to assure recorder reliability to the extent that such a quality can be demonstrated by laboratory testing.

ANSI C12.15-1990. *American National Standard for Solid-State Demand Registers for Electromechanical Watthour Meters*. Solid-state demand registers designed for use as accessories with electromechanical watthour meters are covered. Requirements are set forth regarding number and format of displays; voltage, frequency, and temperature ratings; demand intervals; multiplying constants; timing systems; and other general features. Test conditions for evaluating register performance are stated. Items relating to the watthour meters themselves are not covered.

ANSI C12.16-1991. *American National Standard for Solid-State Electricity Meters*. Acceptable performance criteria for solid-state electricity meters are established. Detachable socket, type S, and bottom-connected, type A, as well as any other arrangement agreed upon between the manufacturer and the user are included. Class designations, voltage and frequency ratings, test current values, service connection arrangements, pertinent dimensions, form designations, and environmental tests are covered.

IEEE Std C37.37-1996. *IEEE Loading Guide for AC High-Voltage Air Switches (in Excess of 1000 V)*. An aid to users to determine (1) the allowable continuous current class (ACCC), (2) the continuous load current capabilities of air switches under various conditions of ambient temperature, and (3) the emergency load current capabilities of air switches under various conditions of ambient temperature, is provided. This guide does not apply to switches used in enclosures covered by IEEE Std C37.20.2-1993, IEEE Std C37.20.3-1996, IEEE Std C37.23-1987, IEEE Std C37.71-1984, and ANSI C37.72-1987.

IEEE Std C37.04-1999. *IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers*. This standard covers the rating structure for all high-voltage circuit breakers, which include all voltage ratings above 1000 V ac and comprise both indoor and outdoor types having the preferred ratings as listed in ANSI C37.06-1997. Typical circuit breakers covered by these standards have maximum voltage ratings ranging from 4.76 kV through 800 kV, and continuous current ratings of 600 A, 1200 A, 2000 A, and 3000 A associated with the various maximum voltage ratings. The rating structure establishes the basis for all assigned ratings, including continuous current, dielectric withstand voltages, short-circuit current, transient recovery voltage, and capacitor switching, plus associated capabilities such as mechanical endurance, load current, and out-of-phase switching. This standard does not cover generator circuit breakers, which are covered in IEEE Std C37.013-1997.

ANSI C37.06-1997. *American National Standard for Switchgear—AC High-Voltage Circuit Breakers Rated on a Sym-*

metrical Current Basis—Preferred Ratings and Related Required Capabilities.

ANSI C37.06.1-1997. *American National Standard Trial-Use Guide for High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis Designated Definite Purpose for Fast Transient Recovery Voltage Rise Times.*

IEEE Std C37.09-1999 *IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.* The testing procedures for all high-voltage circuit breakers that include all voltage ratings above 1000 V ac and comprise both indoor and outdoor types having the preferred ratings as listed in ANSI C37.06-1997 are covered. Typical circuit breakers covered by these standards have maximum voltage ratings from 4.76 kV through 800 kV, and continuous current ratings of 600 A, 1200 A, 2000 A, and 3000 A associated with the various maximum voltage ratings. The test procedures verify all assigned ratings, including continuous current, dielectric withstand voltages, short-circuit current, transient recovery voltage, and capacitor switching, plus associated capabilities such as mechanical endurance, load current, and out-of-phase switching. Production test procedures are also included. This standard does not cover generator circuit breakers as these are covered in IEEE Std C37.013-1993.

IEEE Std C37.010-1999. *IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current.* This guide covers the application of indoor and outdoor high-voltage circuit breakers rated above 1000 V for use in commercial, industrial, and utility installations. It deals with usage under varied service conditions, temperature conditions affecting continuous current compensation, reduced dielectrics, reclosing derating as applicable, calculation of system short-circuit current, compensation at different X/R ratios, detailed calculations with application curves, out-of-phase switching, and general application.

IEEE Std C37.011-1994. *IEEE Application Guide for Transient Recovery Voltage for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.* Procedures and calculations necessary to apply the standard transient recovery voltage (TRV) ratings for ac high-voltage circuit breakers rated above 1000 V and on a symmetrical current basis are covered. The capability limits of these circuit interrupting devices are determined largely by the TRV. TRV ratings are compared with typical system TRV duties.

IEEE Std C37.013-1997. *IEEE Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis.* Ratings, performance requirements, and compliance test methods are provided for ac high-voltage generator circuit breakers rated on a symmetrical current basis that are installed between the generator and the transformer terminals. Guidance for applying generator circuit breakers is given. Pumped storage installations are considered a special application, and their requirements are not completely covered by this standard.

IEEE Std C37.015-1993. *IEEE Application Guide for Shunt Reactor Switching .* Guidance for the application of ac high voltage circuit breakers for shunt reactor switching is provided. Overvoltage generation for the three cases of directly grounded, ungrounded, and neutral reactor grounded shunt reactors is addressed in terms of derivation and limitation methods. Circuit breaker specification for the purpose and the use of laboratory test results to predict field performance is also covered by this guide.

IEEE Std C37.081-1981 (R1988). *IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.* Guidelines are established for synthetic testing of circuit breakers, as well as test criteria for demonstrating the short-circuit current rating of circuit breakers on a single-phase basis. Criteria for evaluating results are also provided. The standard covers short-circuit current interruption process; basic principles of synthetic test; synthetic test circuits; requirements for synthetic test methods; parameters, test procedures, and tolerances; short line fault; multiple loops; circuit breakers equipped with parallel impedance; duty cycle; and test records.

IEEE Std C37.081a-1997 *Supplement to IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Systemmetrical Current Basis—8.3.2: Recovery Voltage for Terminal Faults; Asymmetrical Short-Circuit Current.* The transient recovery voltage needs to be modified when interrupting asymmetrical currents. The voltage rate R, the peak voltage E2 and the rate of change of current di/dt all change with the asymmetrical current zero. Guidance is provided on how to make these corrections when compared to the symmetrical case.

IEEE Std C37.082-1982 (R1988). *IEEE Standard Methods for the Measurement of Sound Pressure Levels of AC Power Circuit Breakers.* Guidelines for uniform measurement and reporting of sound produced by ac power circuit breakers are established. The methods are intended for measuring the sound produced by outdoor circuit breakers in a free-field environment. The methods may be used indoors or in a restricted field, provided that precautions are observed in measurement and interpretation of results. Three types of tests are described: design tests, conformance tests, and field tests. The methods are intended to provide data that can be used in evaluating the effects of circuit breaker sound on human observers, but the evaluation itself is not covered.

IEEE Std C37.083-1999. *IEEE Guide for Synthetic Capacitive Switching Tests of AC High-Voltage Circuit Breakers.* As an aid in testing circuit breakers under conditions of switching capacitive currents synthetic test circuits may be used. The design of the circuit should simulate the stress of actual service conditions as closely as possible. A number of circuits are given as examples. The limitation of the use of synthetic test methods is that the breaker under test must not display evidence of reignition or restriking. The known circuits do not properly represent the interaction between the source and the capacitive load under this condition. Such breakers must be tested using direct circuits.

IEEE Std C37.1-1994. *IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control.* Distributed multicomputer master stations and distributed remote terminal units (RTUs) are introduced. Submaster RTUs used in an automated distribution system with downstream feeder RTUs is defined. Local area networks with master stations are discussed. Intelligent electronic devices (IEDs) with respect to their interface to RTUs and master stations are defined. New surge withstand capability (SWC) standards and their applicability to SCADA is shown. An example channel loading calculation is provided.

IEEE Std C37.10-1995. *IEEE Guide for Diagnostics and Failure Investigation of Power Circuit Breakers.* Procedures to be used to perform failure investigations of power circuit breakers are recommended. Although the procedure may be used for any circuit breaker, it is mainly focused on high-voltage ac power circuit breakers used on utility systems. Recommendations are also made for monitoring circuit breaker functions as a means of diagnosing their suitability for service condition.

IEEE Std C37.11-1997. *IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.* Standard requirements for all types of electrical control circuits for ac high-voltage breakers rated above 1000 V are given. This standard is applicable for any type of power-operated mechanism and for both ac and dc control power. Only basic control elements of the circuit breaker, including reclosing where required, are included in this standard. Devices or circuits for protective relaying, special interlocking, etc., are not included.

IEEE Std C37.13-1990 (R1995). *IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.* This

standard covers enclosed low-voltage ac power circuit breakers of the stationary or draw-out type of two- or three-pole construction; with one or more rated maximum voltages of 635 V (600 V for units incorporating fuses), 508 V, and 254 V, for application on systems having nominal voltages of 600 V, 480 V, and 240 V; with unfused or fused circuit breakers; manually or power operated; and with or without electromechanical or solid-state trip devices. The standard deals with service conditions, ratings, functional components, temperature limitations and classifications of insulating materials, insulation-withstand (dielectric) voltage requirements, test procedures, and application.

IEEE Std C37.14-1999. *IEEE Standard for Low-Voltage DC Power Circuit Breakers Used in Enclosures.* This standard covers enclosed low-voltage dc power circuit breakers of the stationary or draw-out type of single- or two-pole construction with one or more rated maximum voltages of 300 V, 325 V, 800 V, 1200 V, 1600 V, or 3200 V for applications on dc systems having nominal voltages of 250 V, 275 V, 750 V, 1000 V, 1500 V, or 3000 V, with general-purpose, high-speed, semi-high-speed and rectifier circuit breakers; manually or power-operated; and with or without electro-mechanical or electronic trip devices. It deals with service conditions, ratings, functional components, temperature limitations and classification of insulating materials, dielectric withstand voltage requirements, test procedures, and application.

IEEE Std C37.18-1979 (R1996). *IEEE Standard for Enclosed Field Discharge Circuit Breakers for Rotating Electric Machinery.* Low-voltage power-circuit breakers that are intended for use in field circuits of apparatus such as generators, motors, synchronous condensers, or exciters, and embodying contacts for establishing field discharge circuits, are covered. Service conditions, ratings, and functional components are discussed. Temperature limitations and classification of insulating materials, insulation (dielectric) withstand voltage requirements, and test requirements are addressed. An application guide is included.

IEEE Std C37.2-1996. *IEEE Standard Electrical Power System Device Function Numbers and Contact Designations.* The definition and application of function numbers for devices used in electrical substations and generating plants and in installations of power utilization and conversion apparatus are covered. The purpose of the numbers is discussed, and 94 numbers are assigned. The use of prefixes and suffixes to provide a more specific definition of the function is considered. Device contact designation is also covered.

IEEE Std C37.20.1-1993 (R1998). *IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear.* Low-voltage metal-enclosed switchgear, which can contain either stationary or drawout, manually or electrically operated low-voltage ac or dc power circuit breakers in individual grounded metal compartments, in three-pole, two-pole, or single-pole construction is covered. Rated maximum voltage levels can be 254 V, 508 V, or 635 V ac and 300/325 V, 800 V, 1000 V, 1600 V, or 3200 V dc. The continuous current ratings of the main bus in ac designs can be 1600 A, 2000 A, 2500 A, 4000 A, 6000 A, 8000 A, 10 000 A, or 12 000 A. The switchgear can also contain associated control, instruments, metering, protective, and regulating devices as necessary. The standard deals with service conditions, ratings, temperature limitations, and classification of insulating materials, insulation (dielectric) withstand voltage requirements, test procedures, and application.

IEEE Std C37.20.2-1999. *IEEE Standard for Metal-Clad Switchgear.* Metal-clad (MC) medium-voltage switchgear that contains drawout electrically operated circuit breakers is covered. MC switchgear is compartmentalized to isolate all components such as instrumentation, main bus, and both incoming and outgoing connections with grounded metal barriers. Rated maximum voltage levels for metal-clad switchgear range from 4.76 kV to 38 kV with main bus continuous current ratings of 1200 A, 2000 A, and 3000 A. MC switchgear also contains associated control, instruments, metering, relaying, protective, and regulating devices, as necessary. Service conditions, ratings, temperature limitations and classification of insulating materials, insulation (dielectric) withstand voltage requirements, test procedures, and applications are discussed.

IEEE Std C37.20.3-1996. *IEEE Standard for Metal-Enclosed Interrupter Switchgear.* Metal-enclosed interrupter switchgear assemblies containing but not limited to such devices as interrupter/switches, selector switches, power fuses; control, instrumentation and metering; and protective equipment is covered. It includes, but is not specifically limited to, equipment for the control and protection of apparatus used for distribution of electrical power.

IEEE Std C37.20.4-1996. *IEEE Trial-Use Standard for Indoor AC Switches (1 kV–38 kV) for Use in Metal-Enclosed Switchgear.* Indoor ac medium-voltage switches for use in enclosures for application in power circuits at voltages above 1 kV through 38 kV are covered. These include stationary or drawout, manual or power operation, fused or unfused.

IEEE Std C37.20.6-1997. *IEEE Standard for 4.76 kV to 38 kV Rated Grounding and Testing Devices Used in Enclosures.* Drawout type grounding and testing (GT) devices for use in medium-voltage metal-clad switchgear rated above 4.76 kV through 38 kV are covered. The description, design, and testing of these accessory devices that are inserted in place of drawout circuit breakers for the purpose of grounding and testing are also covered.

IEEE Std C37.21-1985 (R1998). *IEEE Standard for Control Switchboards.* Ratings, construction, and testing of dead-front control switchboards containing, but not limited to, devices such as switches, control devices, instrumentation, metering, monitoring, protective and auxiliary relays, and regulating devices and accessories are covered. Switchboards for the control and protection of apparatus used for, or associated with, power generation, conversion, transmission, and distribution are included, but the Standard is not limited to these. Industrial controls, communication equipment, switchboards for use onboard ships, Class 1E switchboards for use in nuclear generating stations, and human factors are not considered.

IEEE Std C37.23-1987 (R1991). *IEEE Standard for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus.* Assemblies of metal-enclosed conductors and their associated interconnections, enclosures, supporting structures, switches, and disconnecting links are addressed. Ratings, tests, construction, miscellaneous accessories, and loss calculation for isolated-phase buses are covered. Specifically excluded are busways or bus assemblies for distribution of electric power less than 600 V consisting of enclosed sectionalized prefabricated bus bars or associated structures and fittings, such as feeder busways (indoor or outdoor) and plug-in busways (indoor only) and bus assemblies utilized at voltages in excess of 38.0 kV.

IEEE Std C37.24-1986 (R1998). *IEEE Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear.* This standard applies to all forms of outdoor metal-enclosed switchgear. It covers operating limitations; the effect of ambient temperature, solar radiation, and wind on internal operating temperatures; ventilation and condensation control; enclosure color and finish considerations; current-carrying capabilities of switchgear; and suggested modifications of standard designs.

IEEE Std C37.26-1972 (R1996). *IEEE Guide for Methods of Power-Factor Measurement for Low-Voltage Inductive Test Circuits.* Methods used to measure the power factor in low-voltage test circuits are covered. Since the power factor measurement for high-capacity test circuits is particularly difficult and different methods may yield different results, the methods that are least likely to yield error are recommended for particular circuit conditions. The ratio method is recommended

for fast clearing devices that may have total interrupting times of 0.5 cycle or less. The dc decrement method is recommended for circuits of 30% power factor or less when the device to be tested interrupts at a point in time more than one-half cycle from the initiation of the current. The phase relationship method, using current and voltage waves, is recommended for circuits having power factors over 30%.

IEEE Std C37.27-1987 (R1998). *IEEE Application Guide for Low-Voltage AC Non-Integrally Fused Power Circuit Breakers (Using Separately Mounted Current-Limiting Fuses).* Low-voltage power circuit breakers of the 600 V insulation class with separately mounted current-limiting fuses, for use on ac circuits with available short-circuit current of 200 000 A (rms symmetrical) or less, are covered. Guidance is provided respecting coordination of circuit breaker and fuse, location of fuses, open fuse trip devices, addition of fuses to existing installations, protection of connected equipment, and tested combinations of circuit breakers and fuses.

IEEE Std C37.29-1981 (R1985). *IEEE Standard for Low-Voltage AC Power Circuit Protectors Used in Enclosures.* This standard covers enclosed low-voltage ac power circuit protectors of the stationary type with 2-pole or 3-pole construction, having one or more rated maximum voltages of 508 V and 254 V rms for application on systems having nominal voltages of 480 V and 240 V rms, that are manually operated or power operated. The circuit protectors considered are furnished with current limiting fuses such that the entire device is suitable for application on circuits capable of delivering not more than 200 000 A rms symmetrical short-circuit current. Service conditions and ratings are discussed, and the functional components of the circuit protectors are described. Temperature limitations and classification of insulating materials are covered. Insulation (dielectric) withstand voltage requirements are specified, and an application guide is given. Test procedures are also specified.

IEEE Std C37.30-1997. *IEEE Standard Requirements for High-Voltage Switches.* Required ratings and constructional requirements for switches above 1000 V are described.

IEEE Std C37-1996. *IEEE Standard Electrical Power System Device Function Numbers and Contact Designations.* The definition and application of function numbers for devices used in electrical substations and generating plants and in installations of power utilization and conversion apparatus are covered. The purpose of the numbers is discussed, and 94 numbers are assigned. The use of prefixes and suffixes to provide a more specific definition of the function is considered. Device contact designation is also covered.

IEEE Std C37.34-1994. *IEEE Standard Test Code for High-Voltage Air Switches.* Design test requirements for all high-voltage enclosed indoor and outdoor and non-enclosed indoor and outdoor air switches rated above 1000 V are specified. This includes requirements for such switches as disconnecting, selector, horn-gap, grounding, interrupter, etc., for manual and power operation, except for distribution-enclosed single-pole air switches and distribution cutouts fitted with disconnecting blades.

IEEE Std C37.35-1995. *IEEE Guide for the Application, Installation, Operation, and Maintenance of High-Voltage Air Disconnecting and Interrupter Switches.* Guidance for users in the application, installation, operation, and maintenance of high-voltage air switches and interrupter switches is provided.

IEEE Std C37.36b-1990 (1996). *IEEE Guide to Current Interruption with Horn-Gap Air Switches.* Ameans for determining the magnitude of excitation as well as resistive and capacitive currents that may be successfully interrupted with horn-gap, vertical-break air switches in outdoor locations is provided for users of air switches. The practices suggested apply only to switches mounted in the normal horizontal-upright position and not equipped with interrupting aids. It is assumed that the switches are applied to an effectively grounded wye system.

IEEE Std C37.38-1989. *IEEE Standard for Gas-Insulated, Metal-Enclosed Disconnecting, Interrupter, and Grounding Switches.* Requirements for switches rated 72.5 kV and above intended for use in metal-enclosed, gas insulated substations are presented. These switches are characterized by grounded, leak-tight metal enclosures that are filled with a gas (most commonly SF_6) at some pressure above atmospheric, with live parts contained within the housing and insulated therefrom by the gas and by suitable solid insulation that supports the live parts in their proper position. Gas-insulated switches are normally electrically connected to and structurally joined to other gas-insulated components such as buses, gas-to-air bushings, circuit breakers, instrument transformers, cable terminations, etc. Switches may be manually or power operated. Service conditions, ratings, supporting structures, and nameplates are covered. Testing of disconnecting and grounding switches is covered.

IEEE Std C37.40-1993. *IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.* Service conditions and definitions for high-voltage fuses (above 1000 V), distribution enclosed single-pole air switches, fuse disconnecting switches, and accessories for ac distribution systems are covered. These include enclosed, open, and open-link types of distribution cutouts and fuses; distribution current-limiting fuses; distribution oil cutouts; distribution enclosed single-pole air switches; power fuses, including current-limiting types; outdoor and indoor fuse disconnecting switches; fuse supports, mountings, hooks, and links, all of the type used exclusively with the above; and removable switch blades for certain products among the above.

IEEE Std C37.40b-1996. *IEEE Standard Service Conditions and Definitions for External Fuses for Shunt Capacitors Supplement to IEEE Std C37.40-1993.* Definitions for high-voltage external capacitor fuses (above 1000 V) used for the protection of shunt capacitor banks are covered in this supplement.

IEEE Std C37.41-1994. *IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.* Required procedures for performing design tests for high-voltage distribution-class and power-class fuses, as well as for fuse disconnecting switches and enclosed single-pole air switches are specified. These design tests, as appropriate to a particular device, include the following test types—dielectric, interrupting, load-break, making-current, radio-influence, short-time current, temperature-rise, time-current, mechanical, and liquid-tightness.

IEEE Std C37.48-1997. *IEEE Guide for the Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.* Information on the application, operation, and maintenance of high-voltage fuses (above 1000 V), distribution enclosed single-pole air switches, fuse disconnecting switches, and accessories for use on ac distribution systems is provided. This guide is one of a series of complementary standards covering various types of high-voltage fuses and switches, so arranged that two of the standards apply to all devices while each of the other standards provides additional specifications for a particular device. For each device, IEEE Std C37.40-1993, IEEE Std C37.41-1994, plus the standard covering that device, constitute a complete set of standards for each device. In addition, IEEE Std C37.48-1997 is an application, operation, and maintenance guide for all the devices.

IEEE Std C37.59-1996. *IEEE Standard Requirements for Conversion of Power Switchgear Equipment.* Power switchgear equipment that is converted from the original manufacturer's designs, whether the conversion is performed in manufacturing plants or at installation sites, is covered.

IEEE Std C37.60-1981 (R1992). *IEEE Standard Requirements for Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems.* The requirements set forth apply to all overhead, pad mounted, dry vault and submersible single- or multipole ac automatic circuit reclosers and fault interrupters for rated maximum voltages above 1000 V. Service conditions and ratings are discussed. Conditions and procedures are specified for design tests, including dielectric, interruption, current, partial-discharge, radio-influence-voltage, surge-current, temperature-rise, time-current, mechanical-operations, and surge-withstand tests. Production tests and construction requirements are covered.

IEEE Std C37.61-1973 (R1992). *IEEE Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers.* Information on the selection, application, operation, and maintenance of single- or multipole ac automatic circuit reclosers is provided. The principal characteristics of reclosers are identified, and the necessary system information is indicated. Step-by-step procedures for selecting reclosers for specific applications are given.

IEEE Std C37.63-1997. *IEEE Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems.* Required definitions (for cutout type sectionalizers), ratings, procedures for performing design tests and production tests, constructional requirements, and application considerations for overhead and pad-mounted, dry-vault, and submersible automatic line sectionalizers for ac systems are specified.

IEEE Std C37.71-1984 (R1990). *IEEE Standard for Three-Phase, Manually Operated Subsurface Load-Interrupting Switches for AC Systems.* This standard applies to three-phase, group-operated, 60 Hz, subsurface, load-interrupting switches with maximum ratings of 600 A and 38 kV and utilizing separable insulated connectors. It covers service conditions; ratings and test requirements; design, production, and conformance tests; construction requirements; and shipping requirements.

IEEE Std C37.73-1998. *IEEE Standard Requirements for Pad-Mounted Fused Switchgear.* Requirements for assemblies of single-phase and three-phase, dead-front and live-front, pad-mounted, load-interrupter switches with expulsion, current-limiting, and other types of fuses in enclosures up to 38 kV rated maximum voltage are given. Definitions are given, and service conditions and ratings are discussed. Design tests, production tests, and construction requirements are included.

IEEE Std C37.81-1989 (R1999). *IEEE Guide for Seismic Qualification of Class 1E Metal-Enclosed Power Switchgear Assemblies.* Requirements and guidance are provided for the seismic qualification of metal-enclosed power switchgear assemblies including switching, interrupting, control, instrumentation, metering, and protective and regulating devices mounted therein. Seismic criteria are discussed, performance requirements are established, and qualification by testing alone and by combined testing and analysis is considered. Documentation is addressed. Although the primary purpose of this guide is for the application of metal-enclosed power switchgear assemblies in nuclear power generating stations, it may be used in other applications in which the seismic response of metal-enclosed power switchgear assemblies is a consideration.

IEEE Std C37.82-1987 (R1998). *IEEE Standard for the Qualification of Switchgear Assemblies for Class 1E Applications in Nuclear Power Generating Stations.* Methods and requirements for qualifying switchgear assemblies for indoor areas outside of the containment in nuclear power generating stations are described. These assemblies include metal-enclosed low-voltage power circuit breaker switchgear assemblies, metal-clad switchgear assemblies, and metal-enclosed interrupter switchgear assemblies. This standard amplifies the general requirements of IEEE Std 323-1983, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, as they apply to Class 1E switchgear assemblies.

IEEE Std C37.90-1989 (R1994). *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.* Standard service conditions, standard ratings, performance requirements, and requirements for testing of relays and relay systems associated with power apparatus are established. Test requirements cover temperature rise limits for foils, dielectric tests, and surge withstand capability tests. Relays designed primarily for industrial control, for switching communication or other low-level signals, or any other equipment not intended for the control of power apparatus are not covered.

IEEE Std C37.90.1-1989 (R1994). *IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.* Design tests intended for protective relays and relay systems, including those incorporating digital processors, are specified. The tests are intended to be applied to a complete relay system under simulated operating conditions. Oscillatory and fast transient test wave shapes and characteristics are defined. The equipment to be tested and the test conditions are described, and the points of application of the test wave are shown. Acceptance is defined, and the requisite test data are specified.

IEEE Std C37.90.2-1995. *IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.* A design test to evaluate the susceptibility of protective relays to single-frequency electromagnetic fields in the radio frequency domain, such as those generated by portable or mobile radio transceivers is established.

IEEE Std C37.91-1985 (R1990). *IEEE Guide for Protective Relay Applications to Power Transformers.* A guide to the effective application of relays and other devices for the protection of power transformers is provided. Emphasis is placed on practical applications. The general philosophy and economic considerations involved in transformer protection are reviewed, the types of faults experienced are described, and technical problems with such protection, including current transformer behavior during fault conditions, are discussed. Various types of electrical, mechanical, and thermal protective devices are described, and associated problems such as fault clearing and re-energizing considerations are discussed.

IEEE Std C37.93-1987 (R1999). *IEEE Guide for Power System Protective Relay Applications of Audio Tones over Telephone Channels.* Information and recommendations are provided for applying, installing, and testing audio tones over telephone channels for power system relaying. A basic introduction to and description of leased telephone channels is provided. Also included are typical interface requirements and the transmission line characteristics of three channel offerings along with examples. The intent is to provide a reference for equipment manufacturers engaged in the design and application of relaying equipment, and for telephone personnel engaged in providing telecommunications channels for audio-tone protective relay schemes. The guide has been prepared not only for those considering audio-tone relaying for the first time, but also as a reference for the experienced user.

IEEE Std C37.95-1989 (R1994). *IEEE Guide for Protective Relaying of Utility-Consumer Interconnections.* Information on a number of different protective relaying practices for the utility-consumer interconnection is provided. The following are covered: establishing consumer service requirements and supply method, typical utility-consumer interconnection configurations, protection theory, system studies, and interconnection examples. The information is provided only for applications involving service to a consumer that normally requires a transformation between the utility's supply voltage and the consumer's utilization voltage. Interconnections supplied at the ultimate utilization voltage are not covered.

IEEE Std C37.97-1979 (R1990). *IEEE Guide for Protective Relay Applications to Power System Buses.* The effective application of relays for protection of power system electrical buses is addressed. Common bus arrangements and some special arrangements used in the United States are covered; not all bus protection systems or all possible bus arrangements are included. Factors which determine the need and type of bus protection and basic principles of bus protection operation are discussed. Relay input sources are covered. Bus protection systems and common bus arrangements with relay input sources are described. Also discussed are current transformer locations, wiring and grounding, location of the bus on the system, bus construction, problems associated with switching and by-passing, auxiliary tripping relays, reclosing of breakers after a bus differential operation, testing of bus differential relaying, and bus backup protection.

IEEE Std C37.98-1987 (R1999). *IEEE Standard for Seismic Testing of Relays.* The procedures to be used in the seismic testing of relays used in power system facilities are specified. The concern is with determining the seismic fragility level of relays. Recommendations for proof testing are given. Documentation and generalization of test results are discussed.

IEEE Std C37.99-2000. *IEEE Guide for the Protection of Shunt Capacitor Banks.* The protection of shunt power capacitor and filter banks are covered. Guidelines for reliable applications of protection methods intended for use in many shunt capacitor applications and designs are included. The protection of pole-mounted capacitor banks on distribution circuits and the application of capacitors connected directly to routing apparatus are not included.

IEEE Std C37.100-1992. *IEEE Standard Definitions for Power Switchgear.* Terms that encompass the products within the scope of the C37 project are defined. These include power switchgear for switching, interrupting, metering, protection, and regulating purposes, as used primarily in connection with generation, transmission, distribution, and conversion of electric power. The definitions do not purport to embrace other meanings that the terms may properly have when used in connection with other subjects.

IEEE Std C37.101-1993 (R2000). *IEEE Guide for Generator Ground Protection.* Guidance in the application of relays and relaying schemes for protection against stator ground faults on high-impedance grounded generators is provided.

IEEE Std C37.102-1995. *IEEE Guide for AC Generator Protection.* A review of the generally accepted forms of relay protection for the synchronous generator and its excitation system is presented. This is guide primarily concerned with protection against faults and abnormal operating conditions for large hydraulic, steam, and combustion-turbine generators.

IEEE Std C37.105-1987 (R1999). *IEEE Standard for Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations.* The basic principles, requirements, and methods for qualifying Class 1E protective relays and auxiliaries such as test and control switches, terminal blocks, and indicating lamps for applications in nuclear power generating stations are described. The qualification procedure is generic in nature can be used to demonstrate the design adequacy of such equipment under normal, abnormal, design-basis-event, and post-design-basis-event conditions. Protective relays and auxiliaries located inside primary containment in a nuclear power generating station are not covered.

IEEE Std C37.106-1987 (R1992). *IEEE Guide for Abnormal Frequency Protection for Power Generating Plants.* This guide has been prepared to assist the protection engineer in applying relays for the protection of generating plant equipment from damage caused by operation at abnormal frequencies including overexcitation. Emphasis is placed on the protection of the major generating station components at steam generating stations, nuclear stations, and on combustion-turbine installations. Consideration is also given to the effect of abnormal frequency operation on those associated station auxiliaries whose response can affect plant output. The guide also presents background information regarding the hazards caused by operating generation equipment at abnormal frequencies. It documents typical equipment capabilities and describes acceptable protective schemes. Recommended methods for coordinating the underfrequency protective scheme with system load shielding schemes are also included. Sufficient information is provided to apply suitable coordinated protection for given specific situations.

IEEE Std C37.108-1989 (R1994). *IEEE Guide for the Protection of Network Transformers.* This guide is intended to aid those engineers who have reevaluated the risks associated with faults within network vaults, particularly for those network vaults located within or near high-rise buildings. Currently available devices that are being used in network transformer protection schemes are identified. The fault-detection capabilities of these devices are described.

IEEE Std C37.109-1988 (R1999). *IEEE Guide for the Protection of Shunt Reactors.* Protection of shunt reactors used typically to compensate for capacitive shunt reactance of transmission lines is covered. Two basic shunt-reactor configurations are considered: dry-type, connected ungrounded wye, which is connected to the impedance-grounded tertiary of a power transformer; and oil-immersed, wye-connected, with a solidly grounded or impedance-grounded neutral, connected to the transmission system. Reactor construction and characteristics are discussed. Other arrangements or special applications of reactors such as harmonic filter banks, static VAR compensation (SVC), high-voltage direct current (HVDC), or current-limiting reactors are not specifically addressed; however, the protective methods described in this guide are usually applicable to this equipment.

IEEE Std C37.110-1996. *IEEE Guide For The Application of Current Transformers Used for Protective Relaying Purposes.* The characteristics and classification of current transformers (cts) used for protective relaying are described. This guide also describes the conditions that cause the ct output to be distorted and the effects on relaying systems of this distortion. The selection and application of cts for the more common protection schemes are also addressed.

IEEE Std C37.111-1999. *IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems.* A common format for data files and exchange medium used for the interchange of various types of fault, test, or simulation data for electrical power systems is defined. Sources of transient data are described, and the case of diskettes as an exchange medium is recommended. Issues of sampling rates, filters, and sample rate conversions for transient data being exchanged are discussed. Files for data exchange are specified, as is the organization of the data. A sample file is given.

IEEE Std C37.112-1996 (R1999). *IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays.* The inverse-time characteristics of overcurrent relays are defined in this standard. Operating equations and allowances are provided in the standard. The standard defines an integral equation for microprocessor relays that ensures coordination not only in the case of constant current input but for any current condition of varying magnitude. Electromechanical inverse-time overcurrent relay reset characteristics are defined in the event that designers of microprocessor based relays and computer relays want to match the reset characteristics of the electromechanical relays.

IEEE Std C37.113-1999. *IEEE Guide for Protective Relay Applications to Transmission Lines.* This newly developed guide compiles information on the application considerations of protective relays to ac transmission lines. The guide describes accepted transmission line protection schemes and the different electrical system parameters and situations that affect their application. Its purpose is to provide a reference for

the selection of relay schemes and to assist less experienced protective relaying engineers in their application.

IEEE Std C37.122-1993 (R1999). *IEEE Standard for Gas-Insulated Substations.* The technical requirements for the design, fabrication, testing, and installation of a gas-insulated substation (GIS) are covered. The parameters to be supplied by the purchaser are set, and the technical requirements for the design, fabrication, testing, and installation to be furnished by the manufacturer are established.

IEEE Std C37.122.1-1993. *IEEE Guide for Gas-Insulated Substations.* The technical requirements for the design, fabrication, testing, and installation of a gas-insulated substation (GIS) are covered. Parameters to be supplied by the purchaser are suggested, and technical requirements for the design, fabrication, testing, and installation to be furnished by the manufacturer are established.

IEEE Std C37.123-1996 (R1996). *IEEE Guide to Specifications for Gas-Insulated Electric Power Substation Equipment.* IEEE Std C37.123-1996 covers the technical requirements for the design, fabrication, testing and installation of a gas-insulated substation (GIS); its intent is advisory. This guide discusses parameters to be supplied by the purchaser and technical requirements for the design, fabrication, testing, and installation to be furnished by the manufacturer. Environmental conditions, general and specific equipment requirements, and a proposal data sheet form are included to aid the user.

ANSI C50.13-1977 (R1999). *American National Standard Requirements for Cylindrical-Rotor Synchronous Generators.* Requirements for 60Hz cylindrical-rotor synchronous generators, except those covered in standard C50.14-1977, are set forth. The standard covers classification, usual service conditions, rating, temperature rise, abnormal conditions, efficiency, overspeed, telephone influence factor, tests, direction of rotation, nameplate marking, and performance specification forms.

ANSI C50.14-1977 (R1999). *American National Standard Requirements for Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators.* Requirements are provided for 60 Hz open-ventilated air-cooled cylindrical rotor synchronous generators rated 10 000 kVA and above. Classification, service conditions, output rating and capabilities, temperature, abnormal and short-circuit requirements, efficiency, overspeed, telephone influence factor, tests, direction of rotation, and nameplate marking are covered. A performance specification form is shown.

IEEE Std C57.12.00-2000. *IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.* Electrical, mechanical, and safety requirements are set forth for liquid-immersed distribution and power transformers, and autotransformers and regulating transformers; single and polyphase, with voltages of 601 V or higher in the highest voltage winding. This standard is a basis for the establishment of performance, limited electrical and mechanical interchangeability, and safety requirements of equipment described; and for assistance in the proper selection of such equipment. The requirements in this standard apply to all liquid-immersed distribution, power, and regulating transformers except the following: instrument transformers, step-voltage and induction voltage regulators, arc furnace transformers, rectifier transformers, specialty transformers, grounding transformers, mobile transformers, and mine transformers.

IEEE Std C57.12.01-1998. *IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin-Encapsulated Windings.* Electrical, mechanical, and safety requirements of ventilated, nonventilated, and sealed dry-type distribution and power transformers or autotransformers, single and polyphase, with a voltage of 601 V or higher in the highest voltage winding, are described. Information that can be used as a basis for the establishment of performance, interchangeability, and safety requirements of equipment described, and for assistance in the proper selection of such equipment, is given.

ANSI C57.12.20-1997. *American National Standard for Transformers Standard For Overhead Type Distribution Transformers, 500 kVA and Smaller: High Voltage, 34500 Volts and Below; Low Voltage, 7970/13800Y Volts and Below.*

IEEE Std C57.12.23-1992 (R1999). *IEEE Standard for Transformers—Underground-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable, Insulated, High-Voltage Connectors; High Voltage (24 940 GrdY/14 400 V and Below) and Low-Voltage (240/120 V, 167 kVA and Smaller).* Electrical, dimensional, and mechanical characteristics and certain safety features of single-phase, 60 Hz, mineral-oil-immersed, self-cooled, distribution transformers with separable insulated high-voltage connectors are covered. Ratings, testing, and construction are discussed. These transformers are generally used for step-down purposes from an underground primary cable supply and are suitable for occasional submerged operation. The intent is to provide a basis for determining their performance, interchangeability, and safety, and for their selection. This standard does not cover the electrical and mechanical requirements of accessory devices that may be supplied with the transformer.

IEEE Std C57.12.35-1996. *IEEE Standard for Bar Coding for Distribution Transformers.* This standard sets forth bar code label requirements for overhead, padmounted, and underground-type distribution transformers. Included herein are requirements for data content, symbology, label layout, print quality, and label life expectancy.

IEEE Std C57.12.44-1994. *IEEE Standard Requirements for Secondary Network Protectors.* The performance, electrical and mechanical interchangeability as well as the safety of the equipment are covered. The proper selection of such equipment is established as a basis for use in this standard. Certain electrical, dimensional, and mechanical characteristics are described, and certain safety features of three-phase, 60 Hz, low-voltage 600 V and below network protectors are taken into consideration. They are used for automatically connecting and disconnecting a network transformer from a secondary spot or grid network.

IEEE Std C57.12.56-1986 (R1998). *IEEE Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers.* A test procedure for determining the temperature classification of ventilated dry-type power and distribution transformer insulation systems by test rather than by chemical composition is established. The intent is to provide a uniform method for providing data for selection of the temperature classification of the insulation system, for providing data which may be used as a basis for a loading guide, and for comparative evaluation of different insulation systems. Voltage withstand endpoint criteria are related to the impulse voltage distribution within the coil or to the initial-voltage withstand of the coil. A relationship between impulse withstand of the insulation and short-term 60 Hz withstand is identified so that 50/60 Hz testing of model coils is possible.

IEEE Std C57.12.58-1991 (R1996). *IEEE Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil.* General recommendations for measuring voltage transients in dry-type distribution and power transformers are provided. Recurrent surge-voltage generator circuitry, instrumentation, the test sample, test point location, mounting the test coil, conducting the test, and reporting results are covered.

IEEE Std C57.12.60-1998. *IEEE Guide for Test Procedures for Thermal Evaluation of Insulation Systems for Solid-Cast and Resin-Encapsulated Power and Distribution Transformers.* A uniform method is established for determining the temperature classification of solid-cast and resin-encapsulated

power and distribution transformer insulation systems by testing rather than by chemical composition. These insulation systems are intended for use in transformers covered by C57.12.01-1989 and C57.12.91-1995 as they apply to solid-cast and resin-encapsulated transformers whose highest voltages exceed nominal 600 V.

IEEE Std C57.12.80-1978 (R1992). *IEEE Standard Terminology for Power and Distribution Transformers*. This standard is a compilation of terminology and definitions primarily related to electrical transformers and associated apparatus included within the scope of ANSI Committee C57, Transformers, Regulators, and Reactors. It also includes similar data relating to power systems and insulation that is commonly involved in transformer technology.

IEEE Std C57.12.90-1999. *IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers*. Methods for performing tests specified in IEEE Std C57.12.00-1993 and other standards applicable to liquid-immersed distribution, power, and regulating transformers are described. Instrument transformers, step-voltage and induction voltage regulators, arc furnace transformers, rectifier transformers, specialty transformers, grounding transformers, and mine transformers are excluded. This standard covers resistance measurements, polarity and phase-relation tests, ratio tests, no-load-loss and excitation current measurements, impedance and load loss measurements, dielectric tests, temperature tests, short-circuit tests, audible sound level measurements, calculated data, and certified test data.

IEEE Std C57.12.91-1995. *IEEE Test Code for Dry-Type Distribution and Power Transformers*. Methods for performing tests specified in IEEE Std C57.12.01-1989 and other referenced standards applicable to dry-type distribution and power transformers are described. This standard is intended for use as a basis for performance, safety, and the proper testing of dry-type distribution and power transformers. This standard applies to all dry-type transformers except instrument transformers, step-voltage and induction voltage regulators, arc furnace transformers, rectifier transformers, specialty transformers, and mine transformers.

IEEE Std C57.13-1993. *IEEE Standard Requirements for Instrument Transformers*. Electrical, dimensional, and mechanical characteristics are covered, taking into consideration certain safety features, for current and inductively coupled voltage transformers of types generally used in the measurement of electricity and the control of equipment associated with the generation, transmission, and distribution of alternating current. The aim is to provide a basis for performance, interchangeability, and safety of equipment covered and to assist in the proper selection of such equipment. Accuracy classes for metering service are provided. The test code covers measurement and calculation of ratio and phase angle, demagnetization, impedance and excitation measurements, polarity determination, resistance measurements, short-time characteristics, temperature rise tests, dielectric tests, and measurement of open-circuit voltage of current transformers.

IEEE Std C57.13.1-1981 (R1999). *IEEE Guide for Field Testing of Relaying Current Transformers*. A description is given of field test methods that will assure that the current transformers used as a source of relay input current are connected properly, are of marked ratio and polarity, and are in condition to perform as designed both initially and after a period of service. The standard covers safety considerations; current transformer types and construction, and the effect of these on test methods; insulation resistance tests; ratio tests; polarity check; winding and lead resistance (internal resistance) excitation test, burden measurements, and specialized situations.

IEEE Std C57.13.3-1983 (R1990). *IEEE Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases*. General and specific recommendations for grounding current and voltage transformer secondary circuits and cases of connected equipment are provided. The practices recommended apply to all transformers of this type, including capacitive voltage transformers and linear couplers, irrespective of primary voltage or whether the primary windings are connected to, or are in, power circuits or are connected in the secondary circuits of other transformers as auxiliary current or voltage transformers. The primary emphasis is personnel safety and proper performance of relays at power-line frequencies. The grounding and shielding of cables and other grounding considerations are not addressed.

IEEE Std C57.15-1999. *IEEE Standard Requirements, Terminology, and Test Code for Step-Voltage Regulators*. Electrical, mechanical, and safety requirements of oil-filled, single- and three-phase voltage regulators not exceeding regulation of 2500 kVA (for three-phase units) or 833 kVA (for single-phase units) are covered.

IEEE Std C57.16-1996. *IEEE Standard Requirements, Terminology, and Test Code for Dry-Type Air-Core Series-Connected Reactors*. Series-Connected dry-type air-core single-phase and three-phase outdoor or indoor reactors of distribution and transmission voltage class that are connected in the power system to control power flow under steady-state conditions and/or limit fault current under short-circuit conditions are covered. Dry-Type air-core reactors covered by this standard are self-cooled by natural air convection. With some restrictions, other reactors, including filter reactors, shunt capacitor reactors (used with shunt capacitor banks), and discharge current limiting reactors (used with series capacitor banks), are also covered.

IEEE Std C57.18.10-1998. *IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers*. Practices and requirements for semiconductor power rectifier transformers for dedicated loads rated single-phase 300 kW and above and three-phase 500 kW and above are included. Static precipitators, high-voltage converters for dc power transmission, and other nonlinear loads are excluded. Service conditions, both usual and unusual, are specified, or other standards are referenced as appropriate. Routine tests are specified. An informative annex provides several examples of load loss calculations for transformers when subjected to nonsinusoidal currents, based on calculations provided in the standard.

IEEE Std C57.19.00-1991 (R1997). *IEEE Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings*. Service conditions, rating, general requirements, and test procedures for outdoor apparatus bushings are set forth. They apply to outdoor power apparatus bushings that have basic impulse insulation levels of 110 kV and above for use as components of oil-filled transformers, oil-filled reactors, and oil circuit breakers. The following are not covered: high-voltage cable terminations (potheads), bushings for instrument transformers, bushings for test transformers, bushings in which the internal insulation is provided by a gas, bushings applied with gaseous insulation (other than air at atmospheric pressure) external to the bushing, bushings for distribution-class circuit breakers and transformers, bushings for automatic circuit reclosures and line sectionalizers, and bushings for oil-less and oil-poor apparatus.

IEEE Std C57.19.01-2000. *IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings*. Electrical, dimensional, and related requirements for outdoor power apparatus bushings that have basic impulse insulation levels (BILs) of 200 kV and above are covered. Specific values for dimensional and related requirements that are to be interpreted, measured, or tested, in accordance with IEEE Std C57.19.00-1991, are provided.

IEEE Std C57.19.03-1996. *IEEE Standard Requirements, Terminology, and Test Code for Bushings for DC Applications*. This standard applies to outdoor and indoor power apparatus dc bushings of condenser type that have basic impulse insulation levels of 110 kV and above for use as components of oil-filled converter transformers and smoothing reactors,

as well as air-to-air dc bushings. This standard defines the special terms used, service conditions, rating, general requirements, electrical insulation characteristics, and test procedures for the bushings for dc application.

IEEE Std C57.19.100-1995. *IEEE Guide for Application of Power Apparatus Bushings*. Guidance on the use of outdoor power apparatus bushings is provided. The bushings are limited to those built in accordance with IEEE Std C57.19.00-1991. General information and recommendations for the application of power apparatus bushings, when incorporated as part of power transformers, power circuit breakers, and isolated-phase bus, are provided.

IEEE Std C57.21-1990 (R1995). *IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA*. An oil-immersed or dry-type, single-phase or three-phase, outdoor or indoor shunt reactors rated over 500 kVA are covered. Terminology and general requirements are stated, and the basis for rating shunt reactors is set forth. Routine, design, and other tests are described, and methods for performing them are given. Losses and impedance, temperature rise, dielectric tests, and insulation levels are covered. Construction requirements for oil-immersed reactors and construction and installation requirements for dry-type reactors are presented.

IEEE Std C57.91-1995. *IEEE Guide for Loading Mineral-Oil-Immersed Transformers*. General recommendations for loading 65 °C rise mineral-oil-immersed distribution and power transformers are covered.

IEEE Std C57.93-1995. *IEEE Guide for Installation of Liquid-Immersed Power Transformers*. Guidance is given for the shipping, installation, and maintenance of liquid-immersed power transformers rated 501 kVA and above with secondary voltage of 1000 V and above. The entire range of power transformers is covered, including EHV transformers, with distinctions as required for various sizes, voltage ratings, and liquid insulation types.

IEEE Std C57.94-1982 (R2000). *IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers*. The application, installation, operation and maintenance of single- and polyphase dry-type general purpose, distribution, power, and autotransformers are covered. The following types are included: ventilated, indoor and outdoor, self- or forced-air cooled; nonventilated, indoor and outdoor, self- or forced-air cooled; and sealed, indoor and outdoor, and self-cooled. Instrument transformers, step voltage and induction voltage regulators, arc furnace transformers, rectifier transformers, and specialty transformers are not covered.

IEEE Std C57.96-1999. *IEEE Guide for Loading Dry-Type Distribution and Power Transformers*. General recommendations for the loading of dry-type distribution and power transformers that have 80 °C, 115 °C, and 150 °C average winding rises and insulation systems limited to 150 °C, 180 °C, and 220 °C maximum hottest-spot operating temperatures, respectively, are covered in this guide. Recommendations for ventilated, nonventilated, and sealed dry-type transformers having impregnated insulation systems are included.

IEEE Std C57.98-1993 (R1999). *IEEE Guide for Transformer Impulse Tests*. Transformer connections, test methods, circuit configurations, and failure analysis of lightning impulse and switching impulse testing of power transformers are addressed. This guide is also generally applicable to distribution and instrument transformers.

IEEE Std C57.100-1999. *IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution and Power Transformers*. A test procedure is established to provide a uniform method for investigating the effect of operating temperature on the life expectancy of liquid-immersed transformers. The test procedures are intended to provide data for the selection of a limiting hottest-spot temperature for rating purposes, provide data which may serve as the basis for a guide for loading, and permit the comparative evaluation of a proposed insulation system with reference to a system that has proven to be acceptable in service.

IEEE Std C57.104-1991. *IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers*. Detailed procedures for analyzing gas from gas spaces or gas-collecting devices, as well as gas dissolved in oil, are described. The procedures cover: (1) the calibration and use of field instruments for detecting and estimating the amount of combustible gases present in gas blankets above oil, or in gas-detector relays; (2) the use of fixed instruments for detecting and determining the quantity of combustible gases present in gas-blanketed equipment; (3) methods for obtaining samples of gas and oil from the transformer for laboratory analysis; (4) laboratory methods for analyzing the gas blanket and the gases extracted from the oil; and (5) methods for interpreting the results in terms of transformer serviceability. The intent is to provide the operator with positive and useful information concerning the serviceability of the equipment. An extensive bibliography on gas evolution, detection, and interpretation is included.

IEEE Std C57.105-1978 (R1999). *IEEE Guide for Application of Transformer Connections in Three-Phase Distribution Systems*. The characteristics of the various transformer connections and possible operating problems under normal or abnormal conditions are treated for three-phase distribution systems. These systems are characterized by primary voltages up to and including 34.5 kV, usually have a preponderance of connected transformers with low-voltage windings below 1000 V, and furnish electric service to consumers. All combinations of D and Y, grounded and ungrounded, T-connected, zigzag, and certain special connections are considered. Only two-winding transformers are included. Phasing procedures and loading practices are not covered.

IEEE Std C57.106-1991 (R1998). *IEEE Guide for Acceptance and Maintenance of Insulating Oil in Equipment*. Recommendations are made regarding oil tests and evaluation procedures, methods of reconditioning and reclaiming conventional petroleum (mineral) dielectric oils, the levels at which these become necessary, and the routines for restoring oxidation resistance, where required, by the addition of inhibitors. The intent is to assist the power equipment operator in evaluating the serviceability of oil received in equipment, oil as received from the refiner for filling new equipment at the installation site, and oil as processed into such equipment, and to assist the operator in maintaining the oil in serviceable condition. The mineral oil covered is used in transformers, switchgear, reactors, and current breakers.

IEEE Std C57.109-1993 (R2000). *IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration*. Recommendations believed essential for the application of overcurrent protective devices applied to limit the exposure time of transformers to short circuit current are set forth. Transformer coordination curves are presented for four categories of transformers. There is no intent to imply overload capability.

IEEE Std C57.110-1998. *IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents*. Methods are developed to conservatively evaluate the feasibility of supplying additional nonsinusoidal load currents from an existing installed dry-type or liquid-filled transformer, as a portion of the total load. Clarification of the necessary application information is provided to assist in properly specifying a new transformer expected to carry a load, a portion of which is composed of nonsinusoidal load currents. A number of examples illustrating these methods and calculations are presented. Reference annexes make a comparison of the document calculations to calculations found in other industry standards and suggested temperature rise methods are detailed for reference purposes.

IEEE Std C57.111-1989 (R1995). *IEEE Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers.* Tests and evaluation procedures for silicone transformer fluid are recommended. Criteria for maintenance and methods of reconditioning of silicone fluid are described. The aim is to assist the transformer operator in evaluating the silicone insulating fluids in transformers, fluid received from the manufacturer for filling transformers at the installation site, and fluid processed into such transformers as well as in maintaining the properties of silicone fluid in operating transformers.

IEEE Std C57.113-1991 (R1995). *IEEE Guide for Partial-Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors.* The detection and measurement by the wideband apparent charge method of partial discharges occurring in liquid-filled power transformers and shunt reactors during dielectric tests are covered. The measuring instrument, calibrator characteristics, test circuits, calibration procedure, and partial discharge measurement during induced-voltage tests are covered.

IEEE Std C57.116-1989 (R2000). *IEEE Guide for Transformers Directly Connected to Generators.* The selection, application, and specification considerations for the unit and unit auxiliaries transformers are described, taking into account their connections, voltage and kilovoltampere ratings, and excitation and through-fault capabilities during possible operating conditions, both normal and abnormal. Consideration is given to direct connections and connections through generator breakers and load-break switches. Both hydroelectric and thermal electric generating stations are covered. Phasing procedures, basic impulse insulation level selection, and loading practices are not covered.

IEEE Std C57.117-1986 (R1998). *IEEE Guide for Reporting Failure Data for Power Transformers and Shunt Reactors on Electric Utility Power Systems.* The reporting and statistical analysis of reliability of power transformers and shunt reactors used on electric utility power systems are addressed. The following types and applications of transformers are covered: power transformers, autotransformers, regulating transformers, phase-shifting transformers, shunt reactors, HVDC converter transformer, substation transformers, transmission tie transformers, unit transformers, unit auxiliary transformers, and grounding transformers. The format for the collection and reporting of data is presented, and the kinds of reports that may be useful to both users and manufacturers of transformers are illustrated.

IEEE Std C57.120-1991 (R2000). *IEEE Standard Loss Evaluation Guide for Power Transformers and Reactors.* A method for establishing the dollar value of the electric power needed to supply the losses of a transformer or reactor is provided. Users can use this loss evaluation to determine the relative economic benefit of a high-first-cost, low-loss unit versus one with a lower first cost and higher losses, and to compare the offerings of two or more manufacturers to aid in making the best purchase choice. Manufacturers can use the evaluation to optimize the design and provide the most economical unit to bid and manufacture. The various types of losses are reviewed.

IEEE Std C57.121-1998. *IEEE Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers.* The evaluation and handling procedures for less flammable hydrocarbon transformer insulating fluids are covered. The guide's purpose is to assist the transformer operator in receiving new fluids, filling transformers, and maintaining the fluids in serviceable condition.

IEEE Std C57.124-1991 (R1996). *IEEE Recommended Practice for the Detection of Partial Discharge and the Measurement of Apparent Charge in Dry-Type Transformers.* The detection of partial discharges occurring in the insulation of dry type transformers or their components, and the measurement of the associated apparent charge at the terminals when an alternating test voltage is applied, are covered. The wideband method is used. The detection system and calibrator characteristics are described, and the test procedure is established.

IEEE Std C57.125-1991 (R1998). *IEEE Guide for Failure Investigation, Documentation, and Analysis for Power Transformers and Shunt Reactors.* A procedure to be used to perform a failure analysis is recommended. The procedure is primarily focused on power transformers used on electrical utility systems, although it may be used for an investigation into any ac transformer failure. This document provides a methodology by which the most probable cause of any particular transformer failure may be determined. This document is also intended to encourage the establishment of routine and uniform data collection procedures, consistency of nomenclature and compatibility with similar efforts by other organizations, and cooperative effects by users and manufacturers during the failure analysis.

IEEE Std C57.129-1999. *IEEE Trial Use General Requirements and Test Code for Oil Immersed HVDC Converter Transformers.* The electrical, mechanical, and physical requirements of oil-immersed single-phase and three-phase converter transformers are specified. Tests are described and test code defined. Devices such as arc furnace transformers and rectifier transformers for industrial or locomotive applications are not covered.

IEEE Std C57.131-1995 (R1998). *IEEE Standard Requirements for Load Tap Changers.* Electrical and mechanical performance and test requirements for load tap changers installed in power transformers and voltage regulating transformers of all voltage and kVA ratings are covered.

IEEE Std C57.134-2000. *IEEE Guide for Determination of Hottest-Spot Temperature in Dry-Type Transformers.* Methodologies for determination of the steady-state winding hottest-spot temperature in dry-type distribution and power transformers with ventilated, sealed, solid cast, and encapsulated windings built in accordance with IEEE Std C57.12.01-1998 and IEC 60726 (1982-01) are described in this guide. Converter transformers are not included in this guide.

IEEE Std C57.138-1998. *IEEE Recommended Practice for Routine Impulse Test for Distribution Transformers.* General test procedures for performing routine quality control test that is suitable for high-volume, production line testing. Transformer connections, test methods, circuit configurations, and failure detection methods are addressed. This recommended practice covers liquid-immersed, single- and three-phase distribution transformers.

IEEE Std C62.11-1999. *IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (1 kV).* Metal-oxide surge arresters designed to repeatedly limit the voltage surges on 4862 Hz power circuits (1 kV) are covered in this standard. These devices operate by discharging surge current. Devices for separate mounting and those supplied integrally with other equipment are also discussed.

IEEE Std C62.22-1997. *IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.* The application of metal-oxide surge arresters to safeguard electric power equipment against the hazards of abnormally high voltage surges of various origins is covered. Step-by-step directions toward proper solutions of various applications are provided. In many cases, the prescribed steps are adequate. More complex and special solutions requiring study by experienced engineers are described, but specific solutions are not always given. The procedures are based on theoretical studies, test results, and experience.

IEEE Std C62.23-1995. *IEEE Application Guide for Surge Protection of Electric Generating Plants.* This standard consolidates most electric utility power industry practices, accepted theories, existing standards/guides, definitions, and technical references as they specifically pertain to surge protection of electric power generating plants. Where technical

information is not readily available, guidance is provided to aid toward proper surge protection and to reduce interference to communication, control, and protection circuits due to surges and other overvoltages. It has to be recognized that this application guide approaches the subject of surge protection from a common or generalized application viewpoint. Complex applications of surge protection practices may require specialized study by experienced engineers.

IEEE Std C62.31-1987 (R1998). *IEEE Standard Test Specifications for Gas-Tube Surge-Protective Devices.* Gas-tube surge-protective devices for application on systems with voltages = 1000 V rms or 1200 V dc are covered. These protective devices are designed to limit voltage surges on balanced or unbalanced communication circuits and on power circuits operating from dc to 420 Hz. Test criteria for determining the electrical characteristics of these devices are provided.

IEEE Std C62.32-1987 (R1997). *IEEE Standard Test Specifications for Low-Voltage Air Gap Surge-Protective Devices.* Air gaps for over-voltage protection applications on systems with operating voltages equal to or less than 600 V rms are covered. These protective devices are designed for limiting the voltages on balanced or unbalanced communication, power, and signaling circuits. A series of standard design tests for determining the electrical characteristics of these air gap devices is specified. The tests provide a means of comparison among various air gap surge-protective devices.

IEEE Std C62.33-1982 (R1994). *IEEE Standard Test Specifications for Varistor Surge-Protective Devices.* Varistors for surge-protective applications on systems with dc to 420 Hz frequency and voltages equal to or less than 1000 V rms, or 1200 V dc, are covered. Definitions, service conditions, and a series of test criteria for determining the electrical characteristics of the varistors are provided. The tests are intended as design tests and provide a means of comparing various surge-protective devices.

IEEE Std C62.34-1996. *IEEE Standard for Performance of Low-Voltage Surge-Protective Devices (Secondary Arresters).* Surge-protective devices designed for application on the low-voltage ac supply mains (1000 V rms and less, frequency between 48 Hz and 62 Hz) are covered.

IEEE Std C62.35-1987 (R2000). *IEEE Standard Test Specifications for Avalanche Junction Semiconductor Surge-Protective Devices.* A two-terminal avalanche junction surge suppressor for surge protective application on systems with dc to 420 Hz frequency and voltages equal to or less than 1000 V rms or 1200 V dc is considered. The device is a single package that may be assembled from any combination of series and/or parallel diode chips. Definitions, service conditions, and a series of test criteria for determining its electrical characteristics are provided. These devices are used as a surge diverter for limiting transient overvoltages in power and communications circuits.

IEEE Std C62.36-1994. *IEEE Standard Test Methods for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.* Methods are established for testing and measuring the characteristics of surge protectors used in low-voltage data, communications, and signaling circuits with voltages less than or equal to 1000 V rms or 1200 V dc. The surge protectors are designed to limit voltage surges, current surges, or both. The surge protectors covered are multiple-component series or parallel combinations of linear or nonlinear elements. Tests are included for characterizing standby performance, surge-limiting capabilities, and surge lifetime. Packaged single gas-tube, air-gap, varistor, or avalanche junction surge-protective devices are not covered, nor are test methods for low-voltage power circuit applications.

IEEE Std C62.37-1996. *IEEE Standard Test Specification for Thyristor Diode Surge Protective Devices.* This standard applies to two or three terminal, four or five layer, thyristor surge protection devices (SPDs) for application on systems with voltages equal to or less than 1000 V rms or 1200 V dc.

IEEE Std C62.38-1994 (R1999). *IEEE Guide on Electrostatic Discharge (ESD): ESD Withstand Capability Evaluation Methods for Electronic Equipment Subassemblies.* This guide establishes test methods for the evaluation of ESD withstand capability for electronic equipment subassemblies. It includes information about test conditions, test equipment, and test procedures for ESD tests of printed circuit boards and other subassemblies.

IEEE Std C62.41-1991 (R1995). *IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.* A practical basis is provided for the selection of voltage and current tests to be applied in evaluating the surge withstand capability of equipment connected to utility power circuits, primarily in residential, commercial, and light industrial applications. The standard covers the origin of surge voltages, rate of occurrence and voltage levels in unprotected circuits, waveshapes of representative surge voltages, energy and source, and impedance. AC power circuits with rated voltages up to 277 V line to ground are addressed, although some of the conclusions offered could apply to higher voltages and also to some dc power systems. The data have been recorded primarily on 120, 220/380, or 277/480 V systems. The general conclusions may be valid for 600 V systems, but more data are needed for the higher voltages.

IEEE Std C62.42-1992 (R1999). *IEEE Guide for the Application of Gas Tube and Air Gap Arrester Low-Voltage (Equal to or Less than 1000 V rms or 1200 V dc) Surge-Protective Devices.* Assistance in selecting the most appropriate type of low-voltage surge-protection device (either gas tube or air gap) for a particular application is provided. Evaluation of the characteristics of each device to meet specific service requirements is also given.

IEEE Std C62.43-1999. *IEEE Guide for the Application of Surge Protectors Used in Low-Voltage (Equal to or Less than 1000 V rms or 1200 V dc) Data, Communications, and Signaling Circuits.* Assistance is provided for the selection of the most appropriate type of low-voltage data, communications, and/or signalling circuit surge protector for a particular application or set of conditions. Surge protector functions and characteristics are also explained and evaluated. AC power circuit applications are not addressed in this document.

IEEE Std C62.45-1992 (R1997). *IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.* Guidance is provided for applying surge testing to ac power interfaces of equipment connected to low-voltage ac power circuits that are subject to transient overvoltages. Signal and data lines are not addressed in this document, nor are any specifications stated on the withstand levels that might be assigned to specific assignments. An important objective of the document is to call attention to the safety aspects of surge testing.

IEEE Std C62.47-1992 (R1997). *IEEE Guide on Electrostatic Discharge (ESD)—Characterization of the ESD Environment.* This guide describes the electromagnetic threat posed to electronic equipment and subassemblies by actual Electrostatic Discharge (ESD) events from humans and mobile furnishings. This guide organizes existing data on the subject of ESD in order to characterize the ESD surge environment. This guide is not an ESD test standard. It is intended to be a resource for equipment designers, and for preparers and users of ESD test standards. The manufacturing, handling, packaging, and transportation of individual electronic components, including integrated circuits, are not discussed, and this guide does not deal with mobile items such as automobiles, aircraft, or other masses of comparable size.

IEEE Std C62.48-1995 (R2000). *IEEE Guide on Interactions Between Power System Disturbances and Surge-Protective Devices.* Information is provided to users and manufacturers of surge-protective devices (SPDs) about the interactions that

may occur between SPDs and power system disturbances. This guide applies to SPDs manufactured to be connected to 50 or 60 Hz ac power circuits rated at 100–1000 V rms. The effects and side effects of the presence and operation of SPDs on the quality of power available to the connected loads are described. The interaction between multiple SPDs on the same circuit is also described.

IEEE Std C62.62-2000. *IEEE Standard Test Specifications for Surge-Protective Devices for Low-Voltage AC Power.* This standard establishes methods for testing and measuring the performance characteristics for surge-protective devices used in low-voltage ac power circuits. Definitions are stated that apply specifically to surge-protective devices. The testing requirements are categorized into two groups, in which a minimum set of basic tests (BTs) are prescribed for all surge-protective devices within the scope of its documents, supplemented by additional tests (ATs) that might be needed to establish particular application requirements.

IEEE Std C62.64-1997. *IEEE Standard Specifications for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.* This standard applies to surge protectors for application on multiconductor and coaxial, balanced or unbalanced, data, communications, and signaling circuits with voltages less than or equal to 1000 V rms, or 1200V dc. These surge protectors are intended to limit voltage surges, current surges, or both.

IEEE Std C62.92.1-1987 (R1993). *IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems Part I—Introduction.* Some basic considerations for the selection of neutral grounding parameters that will provide for the control of ground-fault current and overvoltage on all portions of three-phase electrical utility systems are presented. These considerations apply specifically to electric utility systems and do not recognize the neutral grounding requirements for dispersed storage and generation. They are intended to serve as an introduction to a series of standards on neutral grounding in electrical utility systems.

IEEE Std C62.92.2-1989 (R2000). *IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems Part II—Grounding of Synchronous Generator Systems.* General considerations for grounding synchronous generator systems are summarized, focusing on the objectives of generator grounding. The factors to be considered in the selection of a grounding class and the application of grounding methods are discussed. Four generator grounding types are considered: unit-connected generation systems, common-bus generators without feeders, generators with feeders directly connected at generated voltage, and three-phase, four-wire connected generators.

IEEE Std C62.92.3-1993 (R2000). *IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part III—Generator Auxiliary Systems.* Basic factors and general considerations in selecting the class and means of neutral grounding for electrical generating plant auxiliary power systems are given in this guide. Apparatus to be used to achieve the desired grounding are suggested, and methods to specify the grounding devices are given. Sensitivity and selectivity of equipment ground-fault protection as affected by selection of the neutral grounding device are discussed, with examples.

IEEE Std C62.92.4-1991 (R1996). *IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part IV—Distribution.* The neutral grounding of single- and three-phase ac electric utility primary distribution systems with nominal voltages in the range of 2.4 to 34.5 kV is addressed. Classes of distribution systems grounding are defined. Basic considerations in distribution system grounding concerning economics, control of temporary overvoltages, control of ground-fault currents, and ground relaying are addressed. Also considered are use of grounding transformers, grounding of high-voltage neutral of Wye-Delta distribution transformers, and interconnection of primary and secondary neutrals of distribution transformers.

IEEE Std C62.92.5-1992 (R1997). *IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part V—Transmission Systems and Subtransmission Systems.* Basic factors and general considerations in selecting the class and means of neutral grounding for a particular ac transmission or subtransmission system are covered. Apparatus to be used to achieve the desired grounding are suggested, and methods for specifying the grounding devices are given. Transformer tertiary systems, equipment neutral grounding, and the effects of series compensation on grounding are discussed. The document includes references and an extensive bibliography on the subject of Transmission and Subtransmission Grounding.

ANSI C63.022-1996. *American National Standard for Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment.* Emission limits are provided that are an are acceptable alternative for limits of the current issue of FCC Part 15, Subpart B, for Information Technology Equipment (ITE). This document republishes CISPR 22 (1993) and Amendment 1 (1995) as an American National Standard, ANSI C63.022-1996, which is recognized within the U.S.

ANSI C63.4-1991. *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.* Uniform methods of measurement of radio-frequency (RF) signals and noise from both unintentional and intentional emitters of RF energy in the frequency range of 9 kHz to 40 GHz are set forth. Methods for the measurement of radiated and ac power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. Measurement of licensed transmitters is not covered, nor is certification/approval of avionic equipment or industrial, scientific, and medical (ISM) equipment.

ANSI C63.5-1998. *American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electromagnetic Interference (EMI) Control.* Methods for determining antenna factors of antennas used for radiated emission measurements of electromagnetic interference (EMI) from 30 MHz to 1000 MHz are provided. Antennas included are linearly polarized antennas such as tuned dipoles, biconical dipoles, log-periodic arrays, etc. The methods include standard site, reference antennas, standard antenna and standard field methods. The latter two methods are incorporated by reference.

ANSI C63.6-1996. *American National Standard Guide for the Computation of Errors in Open-Area Test Site Measurements.* The basis for the acceptability criterion of $\pm$ 4 dB for the site attenuation measurements required by ANSI C63.4-1988, American National Standard Methods of Measurements of Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 10 kHz to 1 GHz is shown.

ANSI C63.7-1992 (R1997). *American National Standard Guide for Construction of Open-Area Test Sites for Performing Radiated Emission Measurements.* Information that is useful in constructing an open-area test site (OATS) is used to perform radiated emission measurements in the frequency range of 30-1000 MHz is provided. Final validity of the test site can only be made by performing site attenuation measurements as described in ANSI C63.4-1992.

IEEE Std C37.63-1997 (R1997). *IEEE Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems.* Required definitions (for cutout type sectionalizers), ratings, procedures for performing design tests and production tests, constructional requirements, and application considerations for overhead and pad-mounted, dry-vault, and submersible automatic line sectionalizers for ac systems are specified.

ANSI C63.12-1999. *American National Standard Recommended Practice for Electromagnetic Compatibility Limits.* This recommended practice presents a rationale for developing limits and recommends sets of limits that are representative of current practice. These limits may be adjusted in particular applications as circumstances dictate.

ANSI C63.13-1991 (R1997). *American National Standard Guide on the Application and Evaluation of EMI Power-Line Filters for Commercial Use.* A basic understanding of the application, evaluation, and safety considerations of electromagnetic interference (EMI) power-line filters used in both ac and dc applications is provided. The construction of an EMI power-line filter and its functions in providing suppression of conducted noise are described. The functions and performance of the filter components, particularly the capacitors and inductors, are discussed. It is explained why seemingly identical filters may not give the same performance in a particular application. No-load insertion-loss test methods are presented. Proper installation of the filters in equipment is discussed. Safety regulations are briefly addressed.

ANSI C63.14-1998. *American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD).* Terms associated with electromagnetic compatibility (EMC), electromagnetic pulse (EMP), and electrostatic discharge (ESD) are defined. Quantities, units, multiplying factors, symbols, and abbreviations are covered.

ANSI C63.16-1993. *American National Standard Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment.* Based upon ESD events on electronic equipment in actual use environments, a process to establish ESD test criteria is provided. Test procedures for highly repeatable ESD immunity evaluation of tabletop and floor-standing equipment are described. Simulator characteristics for hand/metal and furniture ESD testing are specified both for air and contact discharge methods. Statistical criteria is given to determine the number of test trials required, based on the confidence factor desired and various pass/fail categories. This ANSI ESD guide has been harmonized with other international ESD standards except where other standards have technical approaches that would reduce equipment quality or result in degraded product operation.

ANSI C63.17-1998. *American National Standard for Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices.* Specific test procedures are established for verifying the compliance of unlicensed personal communications services (UPCS) devices with applicable regulatory requirements regarding radio-frequency (RF) emission levels and spectrum access procedures.

ANSI C63.18-1997. *American National Standard Recommended Practice for an On-Site, Ad Hoc Test Method for Estimating Radiated Electromagnetic Immunity of Medical Devices to Specific Radio-Frequency Transmitters.* Guidance is provided for health-care organizations in evaluating the radiated RF electromagnetic immunity of their existing inventories of medical devices to their existing inventories of RF transmitters, as well as to RF transmitters that are commonly available. This recommended practice can also be used for newly purchased medical devices and RF transmitters, as well as for pre-purchase evaluation. It applies to medical devices used in health-care facilities and to portable transmitters with a rated power output of 8 W or less. It does not apply to implantable medical devices, transport environments such as ambulances and helicopters, or to RF transmitters rated at more than 8 W.

IEEE Std C95.1-1999 Edition. *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.* IEEE Std C95.1-1991 gives recommendations to prevent harmful effects in human beings exposed to electromagnetic fields in the frequency range from 3 kHz to 300 GHz. The recommendations are intended to apply to exposures in controlled, as well as uncontrolled, environments. They are not intended to apply to the purposeful exposure of patients under the direction of practitioners of the healing arts. The induced and contact current limits of C95.1-1991 are modified in this edition. In addition, field strengths below which induced and contact currents do not have to be measured are specified, spatial averaging and measurement distance requirements are clarified, and more precise definitions for averaging volume and radiated power are provided.

IEEE Std C95.2-1999. *IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols.* Symbols to inform people about the presence of potentially hazardous levels of radio-frequency energy or the presence of contact current hazards in the frequency range of 3 kHz to 300 GHz are specified. Guidance is given about how these symbols should be used on warning signs and labels.

IEEE Std C95.3-1991 (R1997). *IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave.* Techniques and instrumentation for the measurement of potentially hazardous electromagnetic fields are specified. The recommendations apply to hazards to personnel. However, the measurement techniques and instruments described are also applicable to the measurement of fields in the neighborhood of flammable materials and explosive devices, even though exposure standards for these situations have not been established.

IEEE Std C135.1-1999. (Revision of ANSI C135.1-1979). *IEEE Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction.* The requirements for inch-based carriage bolts, machine bolts, double-arming bolts, and double-end bolts and nuts, commonly used in overhead line construction and where the applied load is primarily a tensile load, are covered.

IEEE Std C135.2-1999. (Revision of ANSI C135.2-1987). *IEEE Standard for Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction.* Requirements for threaded zinc-coated ferrous strand-eye anchor rods and nuts commonly used in overhead line construction are covered in this standard.

IEEE Std C135.20-1998. *IEEE Standard for Zinc-Coated Ferrous Insulator Clevises for Overhead Line Construction.* Zinc-coated ferrous clevises for spool-type insulators commonly used for supporting or dead-ending conductors in line construction are covered. The specifications for spool-type insulators used with these clevises are covered in C29.3-1986.

IEEE Std C135.61-1997. *IEEE Standard for the Testing of Overhead Transmission and Distribution Line.* Hardware Requirements for mechanically testing load-rated line hardware for use on transmission and distribution facilities are described. Items specifically addressed in this standard include clevis and eye fittings, Y-clevis fittings, socket fittings, ball fittings, chain links, shackles, triangular and rectangular yoke plates, suspension clamps, and strain clamps. This standard is intended to cover routine acceptance testing. It is not intended for initial design tests.

IEEE Std C135.63-1998. *IEEE Standard for Shoulder Live Line Extension Links for Overhead Line Construction.* Dimensions and strength requirements for shoulder live line extension links used in overhead transmission and distribution hardware are covered.

ANSI C136.2-1996. *American National Standard for Roadway Lighting Equipment—Luminaires Voltage Classification.* Three voltage classifications for luminaires used in roadway lighting are covered. General testing methods for determining the dielectric withstand and the transient voltage withstand are given. This standard applies to luminaire electrical insulation between ungrounded current-carrying members and noncurrent-carrying members that may be grounded by design or accident.

ANSI C136.3-1995. *American National Standard for Roadway Lighting Equipment—Luminaire Attachments.* Attachment features of luminaires used in roadway lighting equipment are covered. The features covered apply to luminaires that are side- or post-top-mounted.

ANSI C136.4-1995. *American National Standard for Roadway Lighting Equipment—Series Sockets and Series Sockets Receptacles.* Equipment for luminaires for lighting roadways is covered in the following categories: series sockets having medium impact strength and intended for service at high temperatures, series sockets having high impact strength and intended for service at limited temperatures, and series-socket receptacles in the 5000 V classification.

ANSI C136.5-1996. *American National Standard for Roadway Lighting Equipment—Film Cutouts (Reaffirmation of C136.5-1969).* Operating and dimensional features of single-shot film cutouts used with series roadway lighting equipment and circuits are covered. The film cutouts function by dielectric breakdown and subsequent partial fusing of components.

ANSI C136.6-1997. *American National Standard for Roadway Lighting Equipment—Metal Heads and Reflector Assemblies—Mechanical and Optical Interchangeability.* Dimensional features of luminaires with metal heads that permit mechanical and optical interchangeability of both head and reflector assemblies are covered. The features covered in this standard apply to metal heads that are slipfitter mounted. The reflector assembly is of the latched collar type and may be part of an open or enclosed optical assembly.

ANSI C136.10-1996. *American National Standard for Roadway Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.* Equipment that may be physically and electrically interchanged to operate within established values is covered in this standard, such as locking-type photocontrol devices, locking-type mating receptacles, and shorting and nonshorting caps.

ANSI Std C136.11-1995 (R1997). *American National Standard for Roadway Lighting Equipment—Multiple Sockets.* Medium and mogul multiple sockets as used in luminaires designed and intended for use in lighting roadways and other areas open to general use by the pubic are covered. This standard provides interchangeability of lamps, minimum safety standards for operating personnel, and minimum performance criteria.

ANSI C136.12-1996. *American National Standard for Roadway Lighting Equipment—Mercury Lamps—Guide for Selection.* Medium and mogul multiple sockets as used in luminaires designed and intended for use in lighting roadways and other areas open to general use by the pubic are covered. This standard provides interchangeability of lamps, minimum safety standards for operating personnel, and minimum performance criteria.

ANSI C136.15-1997. *American National Standard for Roadway Lighting Equipment—High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires—Field Identification.* A simple, uniform method for identifying the type and wattage rating of a high-intensity-discharge or a low-pressure sodium lamp installed in a luminaire is provided.

ANSI C136.16-1997. *American National Standard for Roadway Lighting Equipment Enclosed Post Top-Mounted Luminaires.* Dimensional, maintenance, and light distribution features that will permit interchange of post top-mounted luminaires whose center of mass is approximately over the mounting tenon are covered.

ANSI C136.17-1997. *American National Standard for Roadway Lighting Equipment—Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps—Mechanical Interchangeability of Refractors.* The dimensional features and the material of refractors as described in ANSI C136.14-1988, American National Standard for Roadway Lighting Equipment—Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity Discharge Lamps, are covered

ANSI C136.18-1999. *American National Standard for High-Mast Side-Mounted Luminaires for Horizontal- or Vertical-Burning High-Intensity Discharge Lamps.* Used in Roadway Lighting Equipment. Physical, operational, maintenance, and light-distribution features that permit use of high-mast luminaires in roadway applications when so specified are covered. It is not intended that compliance with this standard will permit interchangeability with existing roadway equipment without thorough engineering review and evaluation.

ANSI C136.19-1997. *American National Standard for Roadway Lighting Equipment High-Pressure Sodium Lamps—Guide for Selection.* The selection of high-pressure sodium lamps recommended for use in roadway lighting equipment is covered.

ANSI C136.23-1997. *American National Standard for Roadway Lighting Equipment Enclosed Architectural Luminaires.* Physical, operating, maintenance, and light distribution features that permit use of architectural luminaires in roadway applications when so specified are covered. Specific features for horizontal, pendant, and vertical architectural luminaires, together with various types of lamps to meet the individual needs of special architectural roadway lighting applications, are included.

ANSI C136.27-1996. *American National Standard for Roadway Lighting Equipment—Tunnel Lighting Luminaires.* Luminaires used for illuminating roadway tunnels are covered. The requirements in this standard are limited to general attributes of tunnel luminaires due to the wide variety of designs possible.

ANSI C136.32-1999. *American National Standard for Roadway Lighting Equipment—Enclosed Setback Luminaires and Directional Floodlights for High-Intensity-Discharge Lamps Accredited Standards.* Dimensional, maintenance, and electrical features that permit the interchange of similar style enclosed luminaires having the same light distribution classification or type for high-intensity-discharge lamps used in roadway lighting equipment are covered. Luminaires covered by this standard are generally yoke, trunnion, or tenon mounted.

ANSI N42.4-1971 (R1991). *American National Standard for High Voltage Connectors for Nuclear Instruments.* Coaxial high-voltage connectors on nuclear instruments for dc applications up to 5000 V and ac applications up to 3500 V rms at 60 Hz are covered. The connectors may also be used at higher frequencies provided the operating voltage is appropriately reduced to provide for interchangeability of safe high-voltage connectors in nuclear instrument applications. The connectors are safe in that the pin and socket contacts are well and securely recessed in the connector housing so that hand or body contact of the unmated connector with rated voltage applied will not result in electrical shock.

ANSI N42.5-1965 (R1991)/N42.6-1980 (R1991). *Bases for GM Counter Tubes and American National Standard Interrelationship of Quartz-Fiber Electrometer Type Exposure Meters and Companion Exposure Meter Chargers.* This document contains two standards. ANSI N42.5 specifies bases for Geiger-Mueller counter tubes. ANSI N42.6 specifies interrelating mechanical and electrical properties so that quartz-fiber exposure meters may be used with any charger. Characteristics peculiar to these devices but not affecting the interrelationship between chargers and exposure meters are omitted.

ANSI N42.12-1994. *American National Standard Calibration and Usage of Thallium-Activated Sodium Iodide Detector Systems for Assay of Radionuclides.* This standard establishes methods for performance testing, calibration, and usage of NaI(Tl) detector systems for the measurement of gamma ray

emission rates of radionuclides; the assay for radioactivity; and the determination of gamma ray energies and intensities. It covers both energy calibration and efficiency calibration.

ANSI N42.13-1986 (R1993). *American National Standard for Calibration and Usage of "Dose Calibrator" Ionization Chambers for the Assay of Radionuclides.* A technique for the quantification of the activity of identified radionuclides using any of a variety of ionization chambers currently available for this purpose is presented. Application of the standard is limited to instruments that incorporate well-type ionization chambers as detectors. The method provides measurements that are accurate to within ± 10% and reproducible to within ± 5%. The standard is also intended to assure continuing performance of the apparatus within these specifications.

ANSI N42.14-1999. *American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides.* Methods for the calibration and use of germanium spectrometers for the measurement of gamma-ray energies and emission rates over the energy range from 59 keV to approximately 3000 keV, and for the calculation of source activities from these measurements, are established. Minimum requirements for automated peak finding are stated. Methods for measuring the full-energy peak efficiency with calibrated sources are given. Performance tests that ascertain the proper functioning of the Ge spectrometer and evaluate the limitations of the algorithms used for locating and fitting single and multiple peaks are described. Methods for the measurement of, and the correction for pulse pileup are suggested. Techniques are recommended for the inspection of spectral-analysis results for large errors resulting from summing of cascade gamma rays in the detector. Suggestions are provided for the establishment of data libraries for radionuclide identification, decay corrections, and the conversion of gamma-ray rates to decay rates.

ANSI N42.15-1997. *American National Standard Check Sources for and Verification of Liquid Scintillation Counting Systems.* Tests and procedures to ensure that a liquid-scintillation counting system is producing reliable data are provided for designers and users. This standard does not cover the calculation of sample activity for quenched unknown samples, sample preparation, efficiency correlation (quench correction) procedures, or identification of unknown radionuclides.

ANSI N42.17A-1989. *Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Normal Environmental Conditions.* Minimum acceptable performance criteria for health physics instrumentation for use in ionizing radiation fields are established. Included are testing methods to establish the acceptability of each type of instrumentation. This standard does not specify which instruments or systems are required, nor does it consider the number of specific applications of such instruments.

ANSI N42.17B-1989. *American National Standard Performance Specifications for Health Physics Instrumentation—Occupational Airborne Radioactivity Monitoring Instrumentation.* Performance criteria and testing procedures for instruments and instrument systems designed to continuously sample and quantify concentrations of radioactivity in ambient air in the workplace are specified. General test procedures, general criteria, electronic criteria, radiation response, interfering responses, environmental criteria, air circuit criteria, and documentation are covered. This standard does not specify which instruments or systems are required, nor does it address the specific locations or applications of such instruments.

ANSI N42.17C-1989. *American National Standard for Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Extreme Environmental Conditions.* Minimum acceptable performance criteria for health physics instrumentation for use in ionizing radiation fields under extreme environmental conditions are established. Included are testing methods to establish the acceptability of each type of instrumentation. Performance testing criteria for use in generic (type) tests of new instrument models are given. This standard covers general test procedures, general characteristics, electronic and mechanical requirements and tests, radiation response, interfering responses, environmental factors, and documentation. It does not specify which instruments or systems are required, nor does it consider the number of specific applications of such instruments.

ANSI N42.18-1980 (R1991) (Redesignation of ANSI N13.10-1974). *American National Standard Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents.* Installed instrumentation for measuring the quantity or rate, or both, of the release of radionuclides in the effluent streams, and to provide documentation useful for scientific and legal purposes is covered. Recommendations for the selection of instrumentation are provided. This standard applies to continuous monitors that measure normal releases, detect inadvertent releases, show general trends, and annunciate radiation levels that have exceeded predetermined values.

ANSI N42.20-1995. *American National Standard Performance Criteria for Active Personnel Radiation Monitors.* This standard provides performance and design criteria for monitors that are worn on the trunk of the body to measure the personal dose equivalent or the dose equivalent rate from external sources of ionizing radiation

ANSI N42.22-1995. *American National Standard Traceability of Radioactive Sources to NIST and Associated Instrument Quality Control.* A mechanism for manufacturers to establish traceability of radionuclide sources that are certified for radionuclide activity; concentration; or alpha, beta, x-, or gamma-ray emission rate to the National Institute of Standards and Technology (NIST) is described.

ANSI N42.23-1996. *American National Standard Measurement and Associated Instrumentation Quality Assurance for Radioassay Laboratories.* A framework that can be used to create a national or an organizational NIST-traceable measurement quality assurance (MQA) program that will optimize the quality of radioassays performed by service laboratories is presented. This standard serves as a guide for MQA programs developed for specialized sectors of the radioassay laboratory community, i.e., bioassay, routine environmental monitoring, environmental restoration and waste management, radiopharmaceuticals, nuclear power radiochemistry, and other areas involved in radioassays.

ANSI N42.25-1997. *American National Standard Calibration and Usage of Alpha/Beta Proportional Counters.* This standard establishes methods for the calibration and use of gas proportional counters with and without active guard detectors. This standard also establishes methods for measuring the alpha and beta counting plateau, crosstalk factors, background, alpha and beta efficiency from prepared standards, correction factors for samples whose self-attenuation or mass differs from that of the standard, and calculation of the sample activities together with their random and total uncertainties. Correction for pulse pileup due to high count rate is also discussed. Although many principles articulated in this standard apply to the counting of radionuclides emitting a maximum beta energy below 100 keV as well, the counting of these low-energy beta emitters requires a higher degree of attention to detail in sample preparation, instrument calibration, and measurement correction factors than addressed in this standard. Therefore, this standard is intended for measuring radionuclides with maximum beta energies above 100 keV.

ANSI N42.27-1999. *American National Standard for Determination of Uniformity of Solid Gamma-Emitting Flood Sources.* Minimum informational requirements for a Test and Measurement Report for flood sources used with scintillation cameras are provided. It is not intended to specify the means by which such information is obtained although it does place

requirements and limitations on the methodology. In addition, it is not intended to cover the use of the source in the determination of the operating characteristics or correction factors for a scintillation camera.

ANSI N317-1980 (R1991). *American National Standard Performance Criteria for Instrumentation Used for Inplant Plutonium Monitoring.* Performance criteria are defined, and plutonium radiation is characterized. The specifications apply to plutonium handling and storage facilities, excluding reactors and irradiated fuel reprocessing facilities. This standard does not apply to the construction of specific instruments nor does it specify instrumentation to be employed for each survey to be conducted, other than in generic terms. It does not define specifications for personnel dosimeters, effluent monitoring systems, or instruments needed in bioassay programs, nor does it define those requirements that may be needed to monitor emergency conditions.

ANSI N320-1979 (R1993). *American National Standard Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation.* The essential performance parameters and general placement for monitoring the release of radionuclides associated with a postulated serious accident at a reactor facility are defined for various types of instrumentation. The predominant consideration in the assessment of radiation emergencies is the measurement of fission products made promptly enough to permit timely emergency decisions. This standard does not specify which of the instruments or systems are required, nor does it consider the number or specific locations of such instruments. This standard also does not address single failure criteria associated with nuclear safety instrumentation.

ANSI N322-1997. *American National Standard Inspection, Test, Construction, and Performance Requirements for Direct Reading Electrostatic/Electroscope Type Dosimeters.* Inspection, test, construction and performance requirements for direct reading electrostatic/electroscope type dosimeters designed to measure the personal dose equivalent or ambient exposure delivered by external sources of ionizing radiation (X-rays or gamma-rays) are given.

ANSI N323-1978 (R1983). *American National Standard for Radiation Protection Instrumentation Test and Calibration.* Calibration methods for portable (hand-carried) radiation protection instruments used for detection and measurement of levels of ionizing radiation fields or levels of radioactive surface contamination are established. Included are conditions, equipment, and techniques for calibration as well as the degree of precision and accuracy required. Alpha, beta, photon, and neutron radiation are considered. Passive integrating dosimetric devices such as film, thermoluminescent, and chemical dosimeters are not covered, although the basic principles and intent may apply to them as well as to nonportable radiation detection instrumentation in general.

ANSI N323A-1997. *American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments.* Specific requirements are established for portable radiation protection instruments used for detection and measurement of levels of ionizing radiation fields or levels of radioactive surface contamination.

ANSI N449.1-1978 (R1983). *American National Standard Procedures for Periodic Inspection of Cobalt-60 and Cesium-137 Teletherapy Equipment.* Procedures for the inspection of cobalt-60 and cesium-137 teletherapy equipment are suggested. Their purpose is to enable users to identify and quantify malfunctions or maladjustments of the safety and radiation defining components. Methods and equipment are listed for each procedure.

ANSI Y32.9-1972 (R1989). *American National Standard for Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction.* A basis is provided for showing the general physical location and arrangement of the sections of the required wiring system and identifying the physical requirements for various types of materials needed to provide the electrical installation in buildings. In some instances, the symbols may indicate the function or electrical characteristics of the system; however, that is not their primary purpose. The required installation is shown on the drawing by the use of the various applicable outlet and equipment symbols, together with interconnecting circuit or feeder run lines, supplemented with necessary notations. In general, basic symbols have been included in the symbol schedule.

J-STD-016-1995. *Standard for Information Technology—Software Life Cycle Processes—Software Development—Acquirer-Supplier Agreement (Issued for Trial-Use).* This standard defines a set of software development activities and resulting software products. It provides a framework for software development planning and engineering. It is also intended to merge commercial and Government software development requirements within the framework of the software life cycle process requirements of the Electronic Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE) and International Organization for Standardization (ISO). The term "software development" is used as an inclusive term encompassing new development, modification, reuse, reengineering, maintenance, and all other processes or activities resulting in software products.

Non-IEEE Standard Sources

[1] Sequential events recording systems terms prepared by the Power Generation Committee of the Power Engineering Society in 1974. (Terms approved for use in IEEE Std 100 only).
[2] Mil. Std. 1309B; Automated Instrumentation 9.8 Terms for Test Measurement, and Diagnostic Equipment, Definitions of.
[3] ANSI Std C85.1-1963, (a) 1966 (b) 1972 Terminology for Automatic Control.
[4] IEEE Power Engineering Society Committee on Insulated Conductors.
[5] IEEE Power Engineering Society Committee on Power Generation.
[6] IEEE Power Engineering Society Committee on Power System Relaying.
[7] IEEE Information Theory Group.
[8] IEEE Power Engineering Society Committee on Surge Protective Devices. See IEEE Std 28-1974 and IEEE Std 32-1973 (R1984).
[9] IEEE Power Engineering Society Committee on Rotating Machinery.
[10] IEEE Power Engineering Society Committee on Transmission and Distribution.
[11] IEEE Industry Applications Society Committee on Petroleum and Chemical Industry. Definitions taken from the NFPA (National Fire Protection Association)
[12] IEEE Industry Application Society Committee on Static Power Converters.
[13] IEEE Circuits and Systems Society. Network Applications of Circuits and Systems.
[14] IEEE Instrumentation and Measurement Society, Nonreal Time Spectrum Analyzer.
[15] IEEE Instrumentation and Measurement Society, Test, Measurement, and Diagnostic Equipment. See source [2].
[16] ANSI Std SE3.13-1974; NFPA 72E-1974, Standard on Automatic Fire Detectors.
[17] IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society. Definitions for specific (acoustic-optical) devices, delay lines, and ferroelectric material terms. See sources [21], [22], and [23].
[18] IEEE Industry Applications Society, Subcommittee 2-447-02 on Emergency and Standby Power Systems. See IEEE Std 446-1987.
[19] IEEE Communications Society, Committee on Space Communications. Definitions of Communication Satellite Terms.
[20] IEEE Computer Society, Computing Systems.
[21] IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society. Definitions replaced by those in IEEE Std 180-1986.
[22] IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society. Definitions for Delay Lines, Dispersive and Nondispersive.
[23] IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society. Definitions for Acousto-optic Devices.
[24] IEEE Communications Society, Space Communications Committee. Component parts of communications systems; Communications satellite terms.
[25] IEEE Communications Society, Space Communications Committee. Transmission and Propagation Terms.
[26] ANSI Std C55.2-1974. See IEEE Std 18-1980 and IEEE Std 824-1985.
[27] ANSI Std C104.2-1968; EIA RS 330-1966 Closed Circuit Television Camera 525/60 Inter face 2:1, Electrical Performance of.
[28] ANSI Std C80.1-1971, Rigid Steel Conduit, Zinc Coated, Specification for.
[29] IEEE Reliability Society. Availability, Reliability, and Maintainability Terms.
[30] IEEE Electromagnetic Compatibility Society.
[31] IEV entry. Document 7.
[32] IEEE Acoustics, Speech, and Signal Processing Society.
[33] IEEE Broadcast Technology Society—Television.
[34] IEEE Broadcast Technology Society—Video Techniques.
[35] IEEE Antennas and Propagation Society—Antennas and Waveguides.
[36] IEEE Antennas and Propagation Society—Wave Propagation.
[37] IEEE Vehicular Technology Society—Mobile, Communications Systems.
[38] IEEE Instrumentation and Measurement Society—Electromagnetic Measurement State-of-the-Art.
[39] IEEE Instrumentation and Measurement Society—Fundamental Electrical Standards.
[40] IEEE Instrumentation and Measurement Society—High-Frequency Instrumentation and Measurements.
[41] IEEE Aerospace and Electronic Systems Society—Energy Conversion.
[42] IEEE Aerospace and Electronic Systems Society—Navigational Aids. See IEEE Std 686-1990 and IEEE Std 172-1983.
[43] IEEE Industrial Electronics Society.
[44] IEEE Electron Devices Society—Solid-State Devices.
[45] IEEE Electron Devices Society—Standards on Electron Tubes.
[46] IEEE Electron Devices Society—Standards on Solid State Devices.
[47] IEEE Engineering in Medicine and Biology Society.
[48] IEEE Communications Society—Communications Switching.
[49] IEEE Communications Society—Data Communication Systems.
[50] IEEE Communications Society—Wire Communication.
[51] IEEE Components, Hybrids, and Manufacturing Technology Society.
[52] IEEE Instrumentation and Measurement Society—Control Systems.
[53] IEEE Electromagnetic Compatibility Society.
[54] IEEE Power Engineering Society—Power System Engineering.
[55] IEEE Power Engineering Society—Power System Instrumentation and Measurement.
[56] IEEE Power Engineering Society—Switchgear.
[57] IEEE Power Engineering Society—Transformers.
[58] IEEE Industry Applications Society—Cement Industry.
[59] IEEE Industry Applications Society—Corrosion and Cathodic Protection.
[60] IEEE Industry Applications Society—Industrial Control.
[61] IEEE Industry Applications Society—Machine Tools Industry.
[62] IEEE Industry Applications Society—Static Power Converters.
[63] IEEE Systems, Man and Cybernetics Society.
[64] AD8—American Society for Testing and Materials Publication D8.
[65] AD16—American Society for Testing and Materials Publication D16.
[66] AD123—American Society for Testing and Materials Publication D123.
[67] AD883—American Society for Testing and Materials Publication 883.
[68] ADl566—American Society for Testing and Materials Publication D1566.
[69] National Electrical Manufacturers Association Publication AS 1.
[70] CISPR—International Special Committee on Radio Interference.
[71] CM—Corrosion Magazine.
[72] CTD—Chambers Technical Dictionary.
[73] CV 1—National Electrical Manufacturers Association Publication CV 1.
[74] Electronic Industries Association Publication 3B.
[75] IC 1—National Electrical Manufacturers Association Publication IC 1.

[76] 15A-Instrument Society of America.
[77] International Telecommunications Union.
[78] KPSH—Kepco Power Supply Handbook.
[79] LA 1—National Electrical Manufacturers Association Publication LA 1.
[80] MA 1—National Electrical Manufacturers Association Publication MA 1.
[81] MDE—Modern Dictionary of Electronics.
[82] MG 1—National Electrical Manufacturers Association Publication MG 1.
[83] SCC—IEEE Standards Coordinating Committee. See source [123].
[84] IEC—International Electrotechnical Commission.
[85] ANSI Std X3.l2-l970; Std 2382/V, VI (150) Vocabulary for Information Processing.
[86] NFPA No.70-1978 (previously Std C1-1978). National Electrical Code.
[87] ANSI Std C83.16-1971, Relays and Electronic Equipment, Definitions and Terminology for.
[88] ANSI Std C84.1-1970 (revised in 1977); IEC 38 and 71 Voltage Ratings for Electric Power Systems and Equipment (60 Hz), including Supplement C84.1A-1973.
[89] ANSI Std C29.1-1961 (R1974), Electrical Power Insulators, Test Methods for, including Addendum C29.2A (reaffirmed 1974).
[90] ANSI Std C71.l-1972, Household Electric Ranges (AHAM ER-1), including Supplements C71.1A-1975 and C71.1B-1975.
[91] ANSI Std C87.1-1971; NEMA Publication EW 1-1970. Electric Arc Welding Apparatus.
[92] ANSI Std C83.l4-1963 (R1969); EIA RS 225-1959; IEC 339-1. Requirements for Rigid Coaxial Transmission Lines—50 ohms.
[93] ANSI Std C85.1-1963, Automatic Control, Terminology for, including Supplements C85.1A-1966 and C85.1B-1972.
[94] ANSI Std C82.1-1972, Fluorescent Lamp Ballasts, including Supplement C82.lA-1973, Specifications for.
[95] ANSI Std C82.4-1974 (ANSI); IEC 262. Mercury Lamp Ballasts (Multiple Supply Type), Specifications for.
[96] ANSI Std C82.3-l972 (ANSI); IEC 82. Fluorescent Lamp Reference Ballasts, Specifications for.
[97] ANSI Std C82.9-1971, High-Intensity Discharge Lamp Ballasts and Transformers, Definitions for.
[98] ANSI Std C82.7-1971 (ANSI); IEC 262. Mercury Lamp Transformers, Constant Current (Series) Supply Type, Specifications for.
[99] ANSI Std C82.8-1963 (R1971), Incandescent Filament Lamp Transformers, Constant Current (Series) Supply Type, Specifications for.
[100] ANSI Std C92.1-1971, Voltage Values for Preferred Transient Insulation Levels.
[101] ANSI Std C64.1-1970 (ANSI); IEC 136-1; IEC 136-2; IEC 276. Brushes for Electrical Machines.
[102] ANSI Std C39.1-1972, Electrical Analog Indicating Instruments, Requirements for.
[103] ANSI Std C37.1 (redesignated C37.90). See IEEE Std C37.90-1989.
[104] ANSI Std C78.385-1961, Electric Lamps.
[105] ANSI Std C99.1, Highly Reliable Soldered Connections in Electronic and Electrical Application.
[106] ANSI Std C79.1-1971, Glass Bulbs Intended for Use with Electron Tubes and Electric Lamps, Nomenclature for.
[107] ANSI Std C57.12.75, Removable Air-Filled Junction Boxes for Cable Termination for Power Transformers.
[108] ANSI Std 51.1-1960 (R1971). Integral Air-Filled Junction Boxes for Cable Termination for Power Transformers.
[109] ANSI Std 51.1-1960 (R1971); ISO 131; ISO 16; IEC 50-08. Acoustical Terminology (including Mechanical Shock and Vibration).
[110] ANSI Std C31.4-1958 (R1975). Pool-Cathode Mercury-Arc Power Converters, Practices and Requirements for.
[111] ANSI Std C39.2-1964 (R1969). Direct Acting Electrical Recording Instruments, Requirements for.
[112] ANSI Std C39.4-1966 (R1972), Automatic Null-Balancing Electrical Measuring Instruments, Specifications for.
[113] ANSI Std C80.4-1963 (R1974), Fittings for Rigid Metal Conduit and Electrical Metallic Tubings, Specifications for.
[114] ANSI Std C5.1-1969; NFPA No. 70-1968. Lightning Protection Code.
[115] ANSI Std C50.10-1977; IEC 34-1. Synchronous Machines, General Requirements for.
[116] ANSI Std C89.1-1974, Specialty Transformers except General-Purpose Type.
[117] ANSI Std C57.14, Constant-Current Transformers of the Moving Coil Type.
[118] ANSI Std C67.1, Preferred Nominal Voltages, 100 Volts and Under.
[119] This definition was derived from a standard previously listed in the ANSI category C42.
[120] IEEE Committee on Automatic Control, now the IEEE Instrumentation and Measurement Society.
[121] Office definition prepared by the staff of IEEE Std 100.
[122] IEEE Committee on Sonics and Ultrasonics.
[123] SCC—IEEE Standards Coordinating Committee. See source [83].
[124] ANSI/ASME Std NQA-1-1979, Quality Assurance Program Requirements for Nuclear Power Plants. These definitions are reprinted here with the permission of the American Society of Mechanical Engineers (ASME).
[125] Std 545 (unapproved IEEE Project Standard; as of May 1988 to be issued for trial use).
[126] ANSI/IES Std RP-16-1980, Nomenclature and Definitions for Illuminating Engineering. A revision of ANSI Z7.1-1967 (R1973).
[127] P347 (IEEE Committee draft) (withdrawn). Task group for solid-state displays of the Standardization Committee of the IEEE Group on Electron Devices.