Electrical Design Handbook

Part 3: Codes and Standards

Abstract

This part of the EDH lists all codes and standards to which reference may be made when specifying an electrical component, device or system for use by ITER Organization.

	IDM Number: IDM_D_2E8DLM v1.3	**Date:** 3/21/13 11:12 AM
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Major Changes

Version	Date	Location	What
1.0	May 10th 2008	IO	First Release
1.1	May 26th 2008	ALVARO CARDIEL	MV & LV cables
1.1.5	June 13th 2008	JOEL HOURTOULE	Details corrected
1.2	23rd July 2009		New IO Document Format and review by main author
1.3	15th September 2009		Incorporation of 1st review comments

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1 Introduction

The general adopted guidelines referring to codes and standards shall take account of the following needs:

1. To adopt wherever possible the international electrical standards issued by the International Electrotechnical Commission (IEC).

2. To facilitate the licensing process by adopting French Standards and European Directives covering the following items:

    a. Installation and operation rules;

    b. Design, manufacturing and testing of components affecting safety (nuclear and personnel) and fire protection.

The identification of codes and standards applicable to electrical equipment shall also take account of the European harmonisation process which started in the 1950s in support of European legislation and which has helped shape the European internal market. This harmonisation process is coordinated by CENELEC, the European Committee for Electrical Standardisation. This Committee also supports the IEC in achieving its mission and therefore promotes the harmonisation between the electrical standards adopted by the EU Member States and the international electrical standards issued by the IEC. As a consequence of this process, a large proportion of the national electrical standards of the EU Member States are harmonised with the IEC standards.

The main codes and standards, affecting nuclear safety, are also reported in the Preliminary Safety Report (Rapport Préliminaire de Sûreté) (RPrS).. This EDH may require revision following approval of the RPrS.

2 General Binding Rules and Guidelines

Electrical components, devices or systems shall be designed, constructed, tested and operated in accordance with best engineering and industry practice.

The codes and standards listed hereafter apply to the design, manufacturing, testing, installation and operation of electrical components, device or systems for use in the ITER plant:

1. Code and Standards listed in the ITER Preliminary Safety Report.

2. French Standards and Rules applicable or affecting:

    a. Safety (nuclear and personnel safety);

    b. Fire prevention, fire detection and/or fire suppression;

    c. Guidelines and rules for installation of electrical components, devices or systems;

    d. Applicable building codes.

3. European Directives.

4. Codes, Standards and Design Criteria reported in the ITER Baseline Documentation, Task Agreements, Contract Technical Specifications and Procurement Arrangement documents.

5. IEC standards.

The above list also indicates the top-down priority to be considered in case of inconsistency among the codes standards and design criteria quoted in the above listed documents.

If the approval process of a code or standard is well advanced and is expected to come into force during the manufacturing, installation or operational phase of ITER, the ITER Organization may decide to immediately apply the draft version of the new code or standard.

The following chapters and paragraphs of this document have been produced to assist the staff of the ITER Organization and the Domestic Agencies in the identification of the codes and standards applicable to the design, manufacturing, testing, installation and operation of electrical components, devices or systems for use in the ITER plant. However, the following chapters are for information only, therefore designers, manufactures and operators of electrical components, devices and systems shall ensure the implementation of the general binding rules and guidelines reported in the above paragraphs of this Chapter 2.

3 International Standards Related to Nuclear Safety

Standard	Description
IEC 60439-1	Low-Voltage switchgear and control gear assemblies. Part 1: Type tested and partially type-tested assemblies
IEC 60034-1 / NF EN 60034-1	Rotating electrical machines-Part 1: Rating and Performances
IEC 60038	IEC standard voltages
IEC 60050-161	International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility
IEC 60050-461	International Electrotechnical Vocabulary. Chapter 461: Electric cables
IEC 60059	IEC standard current ratings
IEC 60060-1,…,3	High Voltage test techniques
IEC 60068	Environmental testing
IEC 60068-1	Environmental testing – Part 1 General and Guidance
IEC 60068-2-14	Environmental testing – Part 2: Tests –Test N: Change of temperature
IEC 60068-2-2	Basic environmental testing procedure f-Part 2: Tests – Tests B: Dry Heat
IEC 60068-2-57	Environmental testing – Part 2: Tests –Test Fc: Vibration Time history method
IEC 60068-2-59	Environmental testing – Part 2-57: Tests –Test Ff: Sine-Beat method
IEC 60068-2-6	Environmental testing – Part 2: Tests –Test Fc: Vibration (sinusoidal)
IEC 60068-3-3	Environmental testing. Part 3 : Guidance –Seismic test method for equipment
IEC 60071-1,2	Insulation co-ordination
IEC 60076-11	Power transformers – Part 11 : Dry-type transformers
IEC 60085	Electrical insulation - Thermal evaluation and designation
IEC 60146-2	Semiconductor converters – Part 2 : Self commutated semiconductor converters including direct dc converters
IEC 60216-1	Electrical insulating materials - Properties of thermal endurance - Part 1: Ageing procedures and evaluation of test results
IEC 60216-2	Electrical insulating materials - Thermal endurance properties - Part 2: Determination of thermal endurance properties of electrical insulating materials - Choice of test criteria
IEC 60231A	General principles of nuclear reactor instrumentation
IEC 60297-1	Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 1: Panels and racks

Standard	Description
IEC 60297-2	Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 2: Cabinets and pitches of rack structures
IEC 60297-3	Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series
IEC 60300	Dependability management
IEC 60332-1-1	Tests on electric and optical fibre cables under fire conditions - Part 1-1: Test for vertical flame propagation for a single insulated wire or cable – Apparatus
IEC 60332-1-2	Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame
IEC 60332-1-3	Tests on electric and optical fibre cables under fire conditions - Part 1-3: Test for vertical flame propagation for a single insulated wire or cable - Procedure for determination of flaming droplets/particles
IEC 60332-2-1	Tests on electric and optical fibre cables under fire conditions - Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable - Apparatus
IEC 60332-2-2	Tests on electric and optical fibre cables under fire conditions - Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable - Procedure for diffusion flame
IEC 60332-3-10	Tests on electric cables under fire conditions - Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables - Apparatus
IEC 60352-1	Solderless connections - Part 1: Wrapped connections - General requirements, test methods and practical guidance
IEC 60352-2	Solderless connections - Part 2: Crimped connections - General requirements, test methods and practical guidance
IEC 60359	Electrical and electronic measurement equipment - Expression of performance
IEC 60364 NF C 15-100	Low voltage Electrical Installations Rules
IEC 60364-4-41	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
IEC 60446	Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or alphanumerics
IEC 60470	High-voltage alternating current contactors and contactor-based motor-starters
IEC 60479-1	Effects of current on human beings and livestock – Part 1: General aspects
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60654-2	Operating conditions of measurement, control equipment in industrial processes
IEC 60671	Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing
IEC 60695-11-20	Fire hazard testing - Part 11-20: Test flames - 500 W flame test methods
IEC 60706	Maintainability of equipment
IEC 60721	Classification of environmental classes and severity levels
IEC 60725	Reference impedance for LV power lines
IEC 60780	Nuclear power plants - Electrical equipment of the safety system – Qualification

Standard	Description
IEC 60811-1-2	Insulating and sheathing materials of electric cables – common test methods Part 1-2: Method for general application- thermal ageing method
IEC 60880	Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category A functions
IEC 60909-0	Short-circuit currents in three-phase ac systems - Part 0: Calculation of currents
IEC 60947-2	Low voltage switchgear and control gear – Part 2: Circuit Breakers.
IEC 60947-3	Low voltage switchgear and control gear – Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units.
IEC 60947-4-1	Low voltage switchgear and control gear – Part 4-1: Contactors and motors starters-Electromechanical contactors and motor starters
IEC 60964	Design for control rooms of nuclear power plants
IEC 60980	Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations
IEC 61000-1	Electromagnetic compatibility. General considerations
IEC 61000-1-2	Methodology to achieve functional safety on E/E equipment
IEC 61000-2-10	Description of HEMP environment - Conducted disturbance
IEC 61000-2-11	Environment - Classification of HEMP environments
IEC 61000-2-12	Compatibility levels for low frequency conducted disturbances and signalling in public medium voltage power supply systems
IEC 61000-2-13	Environment - High-power electromagnetic (HPEM) environments - Radiated and conducted
IEC 61000-2-2	Compatibility levels in public LV power systems
IEC 61000-2-3	Description, radiated and non-network frequency conducted disturbances
IEC 61000-2-4	Compatibility levels in industrial plants
IEC 61000-2-5	Classification of the EM environments
IEC 61000-2-7	Low frequency magnetic fields in various environments
IEC 61000-2-8	Voltage dips, short interruptions
IEC 61000-2-9	Description of HEMP environment - Radiated disturbance
IEC 61000-3	Emission variations distribution networks
IEC 61000-4	Immunity tests
IEC 61000-4-7	Measurement techniques. Harmonics
IEC 61000-5	Installation and mitigation guidelines. Protection degree
IEC 6100-6-2	Generic standard Industrial environmental immunity
IEC 6100-6-4	Generic standard Industrial environmental emissions
IEC 61014	Programs for reliability growth
IEC 61024-1-1 **(Replaced by 62305-1)**	Protection against lightning - Part 1: General principles

Standard	Description
IEC 61024-1-2 **(Replaced by 62305-3)**	Protection against lightning - Part 3: Physical damage to structures and life hazard
IEC 61124	Reliability testing - Compliance tests for constant failure rate and constant failure intensity
IEC 61131-2	Programmable controllers - Part 2: Equipment requirements and tests
IEC 61160	Design review
IEC 61163	Reliability stress screening
IEC 61165	Application of Markov Techniques
IEC 61180-1	High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements
IEC 61189	Test methods for electrical materials, interconnection structures and assemblies
IEC 61225	Safety Instrumented systems for process industry
IEC 61226	Nuclear Power Plants - Instrumentation and Control Systems Important to Safety - Classification of Instrumentation and Control Functions
IEC 61227	Nuclear power plants - Control rooms – Operator controls
IEC 61312-1 **(Replaced by 62305-4)**	Protection against lightning - Part 4: Electrical and electronic systems within structures
IEC 61312-4 **(Replaced by 62305-4)**	Protection against lightning - Part 4: Electrical and electronic systems within structures
IEC 61326	Electrical equipment for measurement control and laboratory use
IEC 61508-1,…,7	Functional safety of electrical electronic/electronic programmable safety
IEC 61513	Nuclear power plants - Instrumentation and control for systems important to safety - General requirements for systems
IEC 61662 **(Replaced by 62305-2)**	Protection against lightning - Part 2: Risk management
IEC 61709	Reference conditions for failure rates and stress models for conversions
IEC 61771	Nuclear power plants - Main control-room - Verification and validation of design
IEC 61772	Nuclear power plants - Main control room - Application of visual display units (VDU)
IEC 61936-1	Electrical Installations of nominal voltage above 1 kV in AC
IEC 62138	Nuclear power plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK codes)
IEC 62271-100	High-voltage switchgear and control gear - Part 100: High-voltage alternating-current circuit-breakers
IEC 62271-200	High-voltage switchgear and control gear - Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV

Standard	Description
IEC 62308	Reliability assessment methods
IEC 62347	Guidance on system dependability specifications
IEC 62429	Reliability growth – Stress testing for early failures in unique complex systems
IEC/TS 61000-6-5	Electromagnetic compatibility (EMC) - Part 6-5: Generic standards - Immunity for power station and substation environments
NF C 13-200	High Voltage Electrical Installations – Requirements (V<63 kV)
NF C 15-100	Low Voltage Electrical Installations
NF C 17-100	Protection against Lightning – Protection of structures against Lightning- Installation of lightning Protective System
NF C 32-070	Classification test on cable and cords with respect of the behaviour to fire insulated cables and flexible cords for installations
NF C 93-022	Electronic components-Point-to-point Clip Terminals
NF C04-200	Marking of conductors (status change of the standard NF C 04-200 dated June 1974, ENR)
NF EN 2812-1	Paints and varnishes – determinations of resistance to liquids – Part 1: General methods
NF EN 45014	General Criteria for Supplier's Declaration of Conformity
NF EN 50110 -1,2	Operation of electrical installations
NF EN ISO 9000-3	Quality assurance and quality management standards – Part 3: Directives for the application of ISO 9001:9004 with reference to the provision, installation and maintenance of software
NF ISO 2859-0	Sample procedures for inspection by attributes. Part 0: Introduction to the ISO 2859 Attribute Sampling System.
NF ISO 3951	Sampling procedures and charts for inspection by variables
NF ISO 9001	Quality management systems – Requirements
NF M 64-001	Procedure for qualifications of electric equipment installed in containments for pressurised water reactors and subject to accident conditions.
NF T 30-900	Paints and varnishes. Paint for the nuclear industry. Behavioural test under controlled accident conditions and reparability of paint systems (PWR)
NF T 30-901	Paints and varnishes. Paint for the nuclear industry. Performance test for susceptibility to contamination and fitness to decontamination.
NF T 30-903	Paints and varnishes. Paint for the nuclear industry.- Test of the behaviour in ionising radiation (PWR)
NF X 06-021	Application of statistics – Principles of the statistical control of batches.
UTE C93-751	Electronic components – Base materials for printed circuits – Detailed specifications.
UTE C96-027	Semi-conductor devices. Rules concerning the management of product discontinuance and replacement (obsolescence of electronic components) Provisional recommendations.
UTE-C18-540	Operation of electrical installations

4 Applicable Standards for Electrical Distribution Networks in Nuclear Power Plants

A table of standards applicable to every device has been created and organised by standard category.

Standards applicable for each component list are organised as described below:

- Manufacturing Standard: Processes used by a manufacturer including communication standard, e.g. IEC 61850: Seismic Area
- Site Installation Standard: Standards to be met in order to enable the operation of the system in all situations
- Personal Safety: Standards to be met for personal safety during the construction and device installation phase. Standards for personal protection in case of fault due to the device or due to human factors
- Nuclear Safety: Standards defined for every nuclear installation. (Refer to RCC-E manual)
- Tokamak Building: A particularity of this building is the high humidity level that may occur in event of an accident. Consequently, components installed in that building must tolerate this condition
- Tokamak Complex (including buildings 11, 14 and 74): Particularities of these buildings are that no halogen is allowed; consequently any component installed in these buildings must respect this condition
- Test and Commissioning: All standards to be met during tests, including tests after installation, recurring commissioning tests during the exploitation and tests after a fault
- Devices Installed Inside or Outside: For all equipment, an analysis must be performed to determine the influence of an installation inside or outside. In accordance with SRD conditions