

REPORT NO.  
**ITR-20-005**

TITLE

## **ITER Electrical Design Handbook Codes & Standards**

AUTHOR/AUTHORS  
**Joel Hourtoule**

AUTHOR EMAIL(S)  
**Joel.Hourtoule@iter.org**

DATE  
**16 July 2020**



The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.  
© 2020, ITER Organization

[www.iter.org](http://www.iter.org)



This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 IGO-ported license. (CC BY-NC-ND 3.0 IGO) You are free to share this work (copy, distribute and transmit) under the following conditions: you must give credit to the ITER Organization, you cannot use the work for commercial purposes and you cannot modify it. For a full copy of this license visit: <https://creativecommons.org/licenses/by-nc-nd/3.0/igo/>.

# **ITER Electrical Design Handbook**

## **Codes & Standards**



This work is licensed under the Creative Commons Attribution-Noncommercial-NoDerivs 3.0 IGO-ported license. (CC BY-NC-ND 3.0 IGO) You are free to share this work (copy, distribute and transmit) under the following conditions: you must give credit to the ITER Organization, you cannot use the work for commercial purposes and you cannot modify it. For a full copy of this license visit: <https://creativecommons.org/licenses/by-nc-nd/3.0/igo/>.

- ❖ Introduction
- ❖ Terminology & Acronyms
- ❖ Codes and Standards

# **Introduction**

## **Abstract**

This manual is provided for the use of all Departments of the ITER Organization and is addressed to system specifiers, designers and users of electrical components in otherwise non-electrical plant systems.

This is an initial version of this document that has been reviewed in accordance with the ITER MQP. Review comments have in part been addressed and others will be considered in detail and addressed at the next revision.

## Contents

|            |                                     |          |
|------------|-------------------------------------|----------|
| <b>1</b>   | <b><i>Introduction</i></b>          | <b>3</b> |
| <b>1.1</b> | <b>Standard Voltages</b>            | <b>5</b> |
| 1.1.1      | Applicable IEC standards            | 5        |
| 1.1.2      | Low Voltage, single & 3 phase, 50Hz | 5        |
| 1.1.3      | High Voltage, 3 phase, 50 Hz        | 6        |
| <b>1.2</b> | <b>Standard Test Voltages</b>       | <b>6</b> |
| 1.2.1      | Applicable IEC standards            | 6        |
| <b>1.3</b> | <b>Voltage Classes</b>              | <b>7</b> |
| <b>1.4</b> | <b>Insulation Coordination</b>      | <b>8</b> |
| 1.4.1      | Applicable IEC standards            | 8        |
| <b>1.5</b> | <b>Standard Current Ratings</b>     | <b>8</b> |
| 1.5.1      | Applicable IEC standards            | 8        |

## List of Tables

|                  |                                                                                           |          |
|------------------|-------------------------------------------------------------------------------------------|----------|
| <i>Table 1.1</i> | <i>IEC Definition of Voltage Levels</i>                                                   | <i>5</i> |
| <i>Table 1.2</i> | <i>Low Voltage (LV) used at ITER</i>                                                      | <i>5</i> |
| <i>Table 1.3</i> | <i>Medium Voltages (MV), Intermediate Voltage (IV) and High Voltage (HV) used at ITER</i> | <i>6</i> |
| <i>Table 1.4</i> | <i>Test Voltages</i>                                                                      | <i>7</i> |
| <i>Table 1.5</i> | <i>Voltage Classes</i>                                                                    | <i>7</i> |
| <i>Table 1.6</i> | <i>Insulation Withstand Voltages</i>                                                      | <i>8</i> |
| <i>Table 1.7</i> | <i>IEC Standard Current Ratings</i>                                                       | <i>9</i> |

# 1 Introduction

This document will be published in the Baseline documentation folder of the ITER Document Management (IDM) System and will be the subject of continual review and revision throughout the lifetime of the ITER project.

This handbook is provided for the use of all Departments of the ITER Organization and is addressed primarily to system specifiers, designers and users of electrical components in otherwise non-electrical plant systems, rather than to designers of the power supply systems. The latter shall in addition comply with many other standards, instructions and industrial practices that are beyond the scope of this handbook.

## **Standardisation Guides**

All electrical components and plant systems used or installed at ITER shall comply with the requirements set out in this EDH.

In particular, voltage and current ratings must be selected for connection to the ITER standard nominal system voltages that have been selected from the IEC standards as given in the Section on [Standard Voltages](#).

The related test voltages are given in the Section on [Standard Test Voltages](#).



## 1.1 Standard Voltages

### 1.1.1 Applicable IEC standards

#### IEC 60038 IEC Standard Voltages

International Standard **IEC 60038** defines a set of standard voltages for use in low voltage and high voltage AC electricity supply systems.

The definition of voltage levels is as follows:

| IEC voltage range | AC                       | DC         | defining risk     |
|-------------------|--------------------------|------------|-------------------|
| Extra-low voltage | < 50 V <sub>rms</sub>    | < 120 V    | low risk          |
| Low voltage       | 50–1000 V <sub>rms</sub> | 120–1500 V | electrical shock  |
| High voltage      | > 1000 V <sub>rms</sub>  | > 1500 V   | electrical arcing |

**Table 1.1 IEC Definition of Voltage Levels**

### 1.1.2 Low Voltage, single & 3 phase, 50Hz

The 230V/400V level (in bold text) is that adopted for use by ITER:

|           | rms voltage between a phase and the neutral connector | Corresponding rms voltage between two phases. Four-wire (with neutral) or three-wire (without neutral) systems |
|-----------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>LV</b> | <b>230 V</b>                                          | <b>400 V</b>                                                                                                   |
|           | 400V                                                  | 690V                                                                                                           |
|           | 1000V                                                 | -                                                                                                              |

**Table 1.2 Low Voltage (LV) used at ITER**

### 1.1.3 High Voltage, 3 phase, 50 Hz

Whilst defined by IEC as being **High Voltage**, i.e.  $> 1000 V_{rms}$ , the following voltage levels shall be referred to within ITER as **Medium Voltage (MV)**, i.e.  $1 \text{ kV} < V_r \leq 35 \text{ kV}$ , **Intermediate Voltage (IV)**, i.e.  $35 \text{ kV} < V_r \leq 230 \text{ kV}$  or as **High Voltage (HV)**, i.e.  $230 \text{ kV} < V_r \leq 800 \text{ kV}$ .

The levels in bold are those adopted for use by ITER:

|           | Highest voltage for equipment<br>$*V_m \text{ kV}$ | Nominal system voltage<br>$\boxtimes V_r \text{ kV } (\pm 10\%)$ |
|-----------|----------------------------------------------------|------------------------------------------------------------------|
| <b>MV</b> | 3.6                                                | 3.3                                                              |
|           | <b>7.2</b>                                         | <b>6.6</b>                                                       |
|           | 12                                                 | 11                                                               |
|           | 17.5                                               | -                                                                |
|           | <b>24</b>                                          | <b>22</b>                                                        |
| <b>IV</b> | <b>72.5</b>                                        | <b>66</b>                                                        |
|           | 123                                                | 110                                                              |
|           | 145                                                | 132                                                              |
| <b>HV</b> | 245                                                | 220                                                              |
|           | <b>420</b>                                         | <b>400</b>                                                       |

Table 1.3 Medium Voltages (MV), Intermediate Voltage (IV) and High Voltage (HV) used at ITER

## 1.2 Standard Test Voltages

### 1.2.1 Applicable IEC standards

#### IEC 60060 High-Voltage Test Techniques

International Standard **IEC 60060** defines a set of tests on equipment having its highest voltage for equipment  $V_m$  above 1kV, i.e. in the case of components and plant systems used or installed at ITER, any that are to be connected to a supply voltage higher than that classed as low voltage, must be subjected to testing.

This standard is applicable to:

- dielectric tests with direct voltage;
- dielectric tests with alternating voltage;
- dielectric tests with impulse voltage;

\*  $V_m$  represents the dielectric strength of an equipment, device or system for which it is designated

$\boxtimes V_r$  represents the nominal or rated system voltage at which an equipment, device or system shall usually operate

- tests with impulse current;
- tests with combinations of the above.

| Highest voltage for equipment<br>$V_m$ kV | Standard short-duration power frequency withstand voltage<br>kV (rms value) | Standard lightning impulse withstand voltage |
|-------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------|
| <b>7.2</b>                                | <b>20</b>                                                                   | <b>40/60</b>                                 |
| <b>24</b>                                 | <b>50</b>                                                                   | <b>95/125/145</b>                            |
| 36                                        | 70                                                                          | 145/170                                      |
| <b>72.5</b>                               | <b>140</b>                                                                  | <b>325</b>                                   |
| 245                                       | (275)/(325)/360/395/460                                                     | (650)/850/950/1050                           |

**Note:** If values in brackets are considered insufficient to prove that the required phase-to-phase withstand voltage are met, additional tests are needed.

**Table 1.4 Test Voltages**

### 1.3 Voltage Classes

The voltage class of a power circuit defines the degree of availability of the power delivery. The following classification of the power delivery circuits have been adopted at ITER:

|                  |                                                       |                                                                                                                                        |
|------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Class I</b>   | Uninterruptible DC (up to 250 V)                      | DC battery supplies; batteries charging when AC supply is available. AC supply may be Class III or Class IV depending on Safety Level  |
| <b>Class II</b>  | Uninterruptible AC (230/400 V)                        | Provided from UPS systems, will switch to alternate supply. Alternate AC supply may be Class III or Class IV depending on Safety Level |
| <b>Class III</b> | Temporarily interruptible AC (230/400 V and 6.6 kV)   | Provided from diesel motor generators, interruption for 30 s while generators start up                                                 |
| <b>Class IV</b>  | Indefinitely interruptible AC (230/400 V and 6.6 kV). | Directly provided from the electrical supply network                                                                                   |

**Table 1.5 Voltage Classes**

## 1.4 Insulation Coordination

### 1.4.1 Applicable IEC standards

#### IEC 60071 IEC Insulation Coordination

The following table shows standard insulation levels for range I ( $1\text{ kV} < V_m = 245\text{ kV}$ )

| Highest voltage for equipment ( $V_m$ )<br>kV (rms value) | Standard rated short- duration power-frequency withstand voltage<br>kV (rms value) | Standard rated lightning impulse withstand voltage<br>kV (peak value) |
|-----------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 7.2                                                       | 20                                                                                 | 40<br>60                                                              |
| 24                                                        | 50                                                                                 | 95<br>125<br>145                                                      |
| 36                                                        | 70                                                                                 | 145<br>170                                                            |
| 72.5                                                      | 140                                                                                | 325                                                                   |
| 245                                                       | (275)<br>(325)<br>360<br>395<br>460                                                | (650)<br>(750)<br>850<br>950<br>1050                                  |

**Note:** If values in brackets are considered insufficient to prove that the required phase-to-phase withstand voltage are met, additional tests are needed.

**Table 1.6 Insulation Withstand Voltages**

## 1.5 Standard Current Ratings

### 1.5.1 Applicable IEC standards

#### IEC 60059 IEC Standard Current Ratings

This standard specifies standard current ratings for electrical devices, apparatus, instruments and equipment and should be applied to the designing or utilisation of systems or equipment as well as to operating characteristics. This standard does not apply to current ratings of components and parts used within electrical devices or items of equipment.

Standard current ratings in amperes have been fixed by the IEC as follows:

|        |        |        |        |       |       |       |       |       |       |
|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|
| 1      | 1.25   | 1.6    | 2      | 2.5   | 3.15  | 4     | 5     | 6.3   | 8     |
| 10     | 12.5   | 16     | 20     | 25    | 31.5  | 40    | 50    | 63    | 80    |
| 100    | 125    | 160    | 200    | 250   | 315   | 400   | 500   | 630   | 800   |
| 1000   | 1250   | 1600   | 2000   | 2500  | 3150  | 4000  | 5000  | 6300  | 8000  |
| 10000  | 12500  | 16000  | 20000  | 25000 | 31500 | 40000 | 50000 | 63000 | 80000 |
| 100000 | 125000 | 160000 | 200000 |       |       |       |       |       |       |

**Table 1.7 IEC Standard Current Ratings**

# Terminology & Acronyms

## Abstract

This part lists all terms, definitions and acronyms that may be referenced when specifying an electrical component, device or system for use by the ITER Organization.

This is an initial version of this document that has been reviewed in accordance with the ITER MQP. Review comments have in part been addressed and others will be considered in detail and addressed at the next revision.

# Contents

|            |                                                                                                                                                                                                        |          |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>1</b>   | <b><i>Terminology.....</i></b>                                                                                                                                                                         | <b>4</b> |
| <b>1.1</b> | <b>Main Definitions from IEC Standards .....</b>                                                                                                                                                       | <b>5</b> |
| 1.1.1      | Nominal System Voltage.....                                                                                                                                                                            | 5        |
| 1.1.2      | Rated Voltage/Current of Equipment.....                                                                                                                                                                | 5        |
| 1.1.3      | Highest System Voltage.....                                                                                                                                                                            | 5        |
| 1.1.4      | Highest Voltage for Equipment.....                                                                                                                                                                     | 5        |
| 1.1.5      | Insulation Coordination .....                                                                                                                                                                          | 5        |
| 1.1.6      | The Standard Short-Duration Power Frequency Voltage .....                                                                                                                                              | 5        |
| 1.1.7      | The Lightning Impulse Voltage .....                                                                                                                                                                    | 5        |
| <b>2</b>   | <b><i>Common Definitions Adopted for ITER.....</i></b>                                                                                                                                                 | <b>5</b> |
| 2.1.1      | AC/DC Charger.....                                                                                                                                                                                     | 5        |
| 2.1.2      | Batteries.....                                                                                                                                                                                         | 5        |
| 2.1.3      | Busbar.....                                                                                                                                                                                            | 6        |
| 2.1.4      | Bus Coupler.....                                                                                                                                                                                       | 6        |
| 2.1.5      | Cable.....                                                                                                                                                                                             | 6        |
| 2.1.6      | Cable Tray.....                                                                                                                                                                                        | 6        |
| 2.1.7      | Circuit Breaker .....                                                                                                                                                                                  | 6        |
| 2.1.8      | Converter .....                                                                                                                                                                                        | 6        |
| 2.1.9      | Current Transformer .....                                                                                                                                                                              | 6        |
| 2.1.10     | Diesel Generator .....                                                                                                                                                                                 | 6        |
| 2.1.11     | Disconnecter.....                                                                                                                                                                                      | 6        |
| 2.1.12     | Earth Switch.....                                                                                                                                                                                      | 7        |
| 2.1.13     | Electrical Interlock.....                                                                                                                                                                              | 7        |
| 2.1.14     | Insulators .....                                                                                                                                                                                       | 7        |
| 2.1.15     | Inverter.....                                                                                                                                                                                          | 7        |
| 2.1.16     | Load Centre.....                                                                                                                                                                                       | 7        |
| 2.1.17     | Load Tap Changer.....                                                                                                                                                                                  | 7        |
| 2.1.18     | Main Busbar .....                                                                                                                                                                                      | 7        |
| 2.1.19     | Main Distribution Board.....                                                                                                                                                                           | 8        |
| 2.1.20     | Motor Control Centre.....                                                                                                                                                                              | 8        |
| 2.1.21     | Outlet/Connector .....                                                                                                                                                                                 | 8        |
| 2.1.22     | Penetration .....                                                                                                                                                                                      | 8        |
|            | A cable transit assembly designed to implement safely the passage of cables lines through walls , floors or ceilings of areas with various environmental conditions, maintaining their integrity ..... | 8        |
| 2.1.23     | Soft Starters .....                                                                                                                                                                                    | 8        |
| 2.1.24     | Raceway.....                                                                                                                                                                                           | 8        |
| 2.1.25     | Relay .....                                                                                                                                                                                            | 8        |
| 2.1.26     | Sockets .....                                                                                                                                                                                          | 9        |
| 2.1.27     | Static Transfer Switch.....                                                                                                                                                                            | 9        |
| 2.1.28     | Sub-Distribution Board.....                                                                                                                                                                            | 9        |
| 2.1.29     | Surge Arrester .....                                                                                                                                                                                   | 9        |
| 2.1.30     | Switchgear.....                                                                                                                                                                                        | 9        |
| 2.1.31     | Transformers.....                                                                                                                                                                                      | 9        |
| 2.1.32     | UPS.....                                                                                                                                                                                               | 9        |
| 2.1.33     | Voltage Transformers.....                                                                                                                                                                              | 10       |

|          |                                         |           |
|----------|-----------------------------------------|-----------|
| <i>3</i> | <i>Acronyms .....</i>                   | <i>10</i> |
| <i>4</i> | <i>Reference and Bibliography .....</i> | <i>14</i> |

# 1 Terminology

This part of EDH (Electrical Design Handbook) outlines the terminology adopted by the ITER Organization for specific electrical components, devices or systems.

For components, devices and systems not covered by this document, the following references shall be considered to identify the proper terminology:

1. IEC dictionaries and glossaries (<http://www.electropedia.org>)
2. Electrical Installations Handbook, Executive Editor: Gunter G. Seip, John Wiley and Sons, ISBN 0-471-40435-6

In case of inconsistency between the above documents, requests for clarification shall be submitted to the ITER Electrical Implementation Division.

The ITER Organization has adopted the International System of Units, universally known as the **SI** (from the French *Système International d'Unités*), see [http://www.bipm.org/en/si/si\\_brochure](http://www.bipm.org/en/si/si_brochure). The SI prefixes are given in the table below:

| Factor           | Name  | Symbol |  | Factor            | Name  | Symbol |
|------------------|-------|--------|--|-------------------|-------|--------|
| 10 <sup>1</sup>  | deca  | da     |  | 10 <sup>-1</sup>  | deci  | d      |
| 10 <sup>2</sup>  | hecto | h      |  | 10 <sup>-2</sup>  | centi | c      |
| 10 <sup>3</sup>  | kilo  | k      |  | 10 <sup>-3</sup>  | milli | m      |
| 10 <sup>6</sup>  | mega  | M      |  | 10 <sup>-6</sup>  | micro | μ      |
| 10 <sup>9</sup>  | giga  | G      |  | 10 <sup>-9</sup>  | nano  | n      |
| 10 <sup>12</sup> | tera  | T      |  | 10 <sup>-12</sup> | pico  | p      |
| 10 <sup>15</sup> | peta  | P      |  | 10 <sup>-15</sup> | femto | f      |
| 10 <sup>18</sup> | exa   | E      |  | 10 <sup>-18</sup> | atto  | a      |
| 10 <sup>21</sup> | zetta | Z      |  | 10 <sup>-21</sup> | zepto | z      |
| 10 <sup>24</sup> | yotta | Y      |  | 10 <sup>-24</sup> | yocto | y      |

**Table 1.1 SI Prefixes**

## 1.1 Main Definitions from IEC Standards

### 1.1.1 Nominal System Voltage

The voltage by which a system is designated.

### 1.1.2 Rated Voltage/Current of Equipment

The voltage/current assigned generally by a manufacturer, for a specified operating condition of a component, device or equipment.

### 1.1.3 Highest System Voltage

The highest value of voltage which occurs under normal operating conditions at any time and any point on the system. It excludes voltage transients, such as those due to system switching, and temporary voltage variations.

### 1.1.4 Highest Voltage for Equipment

The highest rms value of phase-to-phase voltage for which the equipment is designed in respect of its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards.

The highest voltage for equipment is the maximum value of the “highest system voltage” (see above) for which the equipment may be used.

### 1.1.5 Insulation Coordination

The selection of the dielectric strength of equipment in relation to the voltages which can appear on the system for which the equipment is intended and taking into account the service environment and the characteristics of the available protective devices. The process is determined from the known characteristics of voltage surges and the characteristics of surge arresters.

### 1.1.6 The Standard Short-Duration Power Frequency Voltage

A sinusoidal voltage with frequency between 48 Hz and 52 Hz, and duration of 60 s. The voltage level is determined for specific tests.

### 1.1.7 The Lightning Impulse Voltage

An impulse voltage having a front time of 12  $\mu$ s and a time to half-value of 50  $\mu$ s. The voltage level is determined for specific tests.

## 2 Common Definitions Adopted for ITER

### 2.1.1 AC/DC Charger

A battery charger converting alternating current (AC) power into DC power, being the converter section of a UPS which charges batteries and supplies DC to the inverter.

### 2.1.2 Batteries

One or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices. A battery stores and supplies electrical energy to an electrical circuit when the normal power supply of that electrical circuit is interrupted.

### **2.1.3 Busbar**

Conductors fabricated from thick strips of copper or aluminium to conduct electricity within a switchboard, distribution board, substation, or other electrical apparatus.

### **2.1.4 Bus Coupler**

Inbuilt mechanical interlocking which connects busbar systems, where position change is via the OFF position, ensuring downstream distribution in case of failure of upstream lines. In a substation a circuit-breaker located between two busbars and which permits the busbars to be coupled; it may be associated with selectors in case of more than two busbars

### **2.1.5 Cable**

Assembly of one or more conductors and/or optical fibres, with a protective covering and possibly filling, insulating and protective material

### **2.1.6 Cable Tray**

a unit or assembly of units or sections and associated fittings forming a rigid structural system used to securely fasten or support cables and raceways. Cable trays are used to support and distribute cables.

### **2.1.7 Circuit Breaker**

A switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and carrying for a specified time during abnormal circuit conditions such as a short circuit.

### **2.1.8 Converter**

A functional unit which changes the representation of information. Examples of converters are: analog-digital converter, digital-analog converter, code converter, parallel-serial converter, serial-parallel converter.

### **2.1.9 Current Transformer**

A device that reduces current values at a point in a network where they are connected, to proportional and manageable values, whilst separating measuring instruments, meters, relays, etc. from the medium or low voltage circuit.

### **2.1.10 Diesel Generator**

A diesel generator is the combination of a diesel engine with an electrical generator (often called an alternator) to generate electrical energy. Diesel generating sets are used as emergency power-supply if the grid fails. There are four 6.6kV diesel generator sets, two seismic qualified to feed SR loads and two non-seismic qualified for IP loads.

### **2.1.11 Disconnect**

A mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements. A Mechanical switching device which, in the open position, disconnects all the poles of an electrical circuit and is equipped with a reliable contact position indicator. A closed disconnect is capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short circuit.

### **2.1.12 Earth Switch**

Mechanical switching device for earthing parts of an electrical circuit, capable of withstanding for a specified duration, electric currents under abnormal conditions such as those of a short-circuit, but not required to carry electric current under normal conditions of the electrical circuit

### **2.1.13 Electrical Interlock**

Type of circuit in which the auxiliary contacts of various devices are switched in such a ways that the circuit states are interdependent. This makes it impossible to switch on one switching device if another is already switched on.

### **2.1.14 Insulators**

A device designed to support and insulate a conductive element. A device intended for electrical insulation and mechanical fixing of equipment or conductors which are subject to potential differences.

### **2.1.15 Inverter**

Electrical energy converter that changes direct current to single-phase or polyphase alternating current

### **2.1.16 Load Centre**

The load voltage load centres are connected to the secondary 22 kV distribution switchgear through the MV/LV transformers.

They are mainly used at the load level. They are used for:

- Protecting persons and property
- Protecting electrical loads
- Protecting cables and electric lines
- Overvoltage protection
- Safety disconnection
- Monitoring and signalling
- Open and closed-loop control
- Metering, measuring and display purposes

This load centres are composed of:

- Incoming circuit breakers and coupler circuit breaker (interlocked function)
- 400V copper strip semi-busbars.
- Outgoing draw-out circuit breakers to the Local Panels and MCC.

### **2.1.17 Load Tap Changer**

The on-load tap changer is used to change the tapping connection of the transformer winding while the transformer is energized. A connection made at some intermediate point in a winding. It is used to control the voltage over the SSEN

### **2.1.18 Main Busbar**

The busbar is an assembly necessary to make a common connection for several circuits. A low-impedance conductor, to which several electric circuits can be connected

### **2.1.19 Main Distribution Board**

Assembly containing different types of switchgear and control gear associated with one or more outgoing electric circuits fed from one or more incoming electric circuits, together with terminals for the neutral and protective conductors.

They are used for up to 6300 A. They are used first and foremost for:

- Safety disconnection
- Coupling busbar sections
- Protecting busbars
- Selectivity vis-à-vis upstream protection equipment

They are primarily equipped with:

- Circuit-breakers and non-automatic circuit-breakers
- Tie circuit-breakers
- Fuses

### **2.1.20 Motor Control Centre**

MCC is a low-voltage withdrawable-unit-type switchgear station for motor feeders with a main switch and door interlock. The MCC will consist of individual cubicles housed in the correspondent switchgear placed as close as possible of the LV motors zone. The MCC shall include:

- Motor protection systems.
- Monitoring & Control devices.
- Starter devices if applicable.

### **2.1.21 Outlet/Connector**

Device which provides connection and disconnection to a suitable mating component. Conductor of electricity used for carrying current between components in an electric circuit

### **2.1.22 Penetration**

A cable transit assembly designed to implement safely the passage of cables lines through walls , floors or ceilings of areas with various environmental conditions, maintaining their integrity

### **2.1.23 Soft Starters**

The combination of the switching means necessary to start and stop a motor in combination with suitable overload protection.

### **2.1.24 Raceway**

An enclosed channel of metallic or nonmetallic materials designed expressly for holding wires, cables or busbars. Examples are electrical metallic tubing (EMT), flexible metallic tubing and nonmetallic rigid conduit.

### **2.1.25 Relay**

Switching device which brings about sudden predetermined changes in one or more electric output circuits when specific conditions that control the device arise in the electric input circuit.

### **2.1.26 Sockets**

Connector attached to an apparatus or to a constructional element or the like. Contact members of a socket may be socket contacts, pin contacts or both.

### **2.1.27 Static Transfer Switch**

Device which transfers load automatically and without disturbance between inverter and utility power

### **2.1.28 Sub-Distribution Board**

Part of an electrical installation for distributing energy to downstream loads or groups of loads

They are used up to 2500 A. They are used for:

- Safety disconnection
- Switching electrical loads, e.g. lighting systems and motors
- Protecting cables, electric lines and loads
- Back-up protection and selectivity vis-à-vis upstream and downstream protection equipment
- Overvoltage protection
- Control, metering and measuring purposes

The following devices are integrated in order to carry out these functions:

- Circuit-breakers, switch-disconnectors and fuse switch-disconnectors.
- Miniature circuit-breakers
- Fuses
- Modular built-in equipment for control, metering and measuring purposes

### **2.1.29 Surge Arrester**

A protective device designed primarily for connection between a conductor of an electrical system and earth to limit the magnitude of transient overvoltages on equipment.

### **2.1.30 Switchgear**

Electrical equipment switching devices for the purpose of carrying out one or more of the following functions: protection, control, isolation, switching and their combination with associated control, measuring, protective and regulating equipment. Also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy.

### **2.1.31 Transformers**

A device that is used to change the voltage in an alternating current (AC) circuit. Three kinds of transformers are identified taking into account the voltage level: The four main step down transformers which transform from HV (400 kV) to MV (22 kV) Oil transformers, which transform from MV (22 kV) to MV (6.6 kV) and located outside of buildings and dry transformers which transform from MV (6.6 kV) to LV (0.4 kV) and located inside buildings.

### **2.1.32 UPS**

An uninterruptible power supply (UPS) system is designed to provide conditioned power which offsets the effects of adverse normal power. A static UPS consists of:

- a battery to provide continuous source of electrical power;
- a rectifier/charger to maintain battery charge and to provide input to inverter when utility power is available;

- an inverter to provide power to load during normal operation;
- a static switch ,to transfer load automatically and without disturbance between inverter and utility power,
- a manual switch to bypass the static switch for maintenance;
- input and output isolation transformers and filters to provide appropriate isolation and disturbance attenuation; and monitors, sensors, and control circuits.

### 2.1.33 Voltage Transformers

These reduce the voltage values from the point in the network where they are connected to proportional and manageable values, whilst separating measuring instruments, meters, relays etc. from the medium or low voltage circuit.

## 3 Acronyms

A complete list of Acronyme used within ITER Organization is available at ITER Abbreviations (ITER\_D\_2MU6W5), here follows a list of those frequently used in EDH:

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| <b>AC</b>   | Alternating Current                                                    |
| <b>BO</b>   | Blackout                                                               |
| <b>CB</b>   | Circuit Breaker                                                        |
| <b>CC</b>   | Control Cubicle                                                        |
| <b>CD</b>   | Current Drive                                                          |
| <b>CMF</b>  | Common Mode Failure                                                    |
| <b>CT</b>   | Current Transformer                                                    |
| <b>CWS</b>  | Cooling Water System                                                   |
| <b>D/G</b>  | Diesel Generator                                                       |
| <b>DC</b>   | Direct Current                                                         |
| <b>DDD</b>  | Design Description Document                                            |
| <b>DP</b>   | Distribution Panel for 400 V loads located within buildings            |
| <b>EDG</b>  | Emergency Diesel Motor Generator                                       |
| <b>EDH</b>  | Electrical Design Handbook                                             |
| <b>EHV</b>  | Extra High Voltage, > 275 kV, not used at ITER                         |
| <b>ELV</b>  | Extra Low Voltage, <50 V <sub>rms</sub> or < 120 V DC (IEC Definition) |
| <b>EM</b>   | Electromagnetic                                                        |
| <b>EPS</b>  | Emergency Power Supply                                                 |
| <b>EPSS</b> | Emergency Power Supply System                                          |

|                 |                                                                                          |
|-----------------|------------------------------------------------------------------------------------------|
| <b>FDS</b>      | Fire Detection and alarm System                                                          |
| <b>FFS</b>      | Fire Fighting System                                                                     |
| <b>FO</b>       | Fibre Optic                                                                              |
| <b>FPS</b>      | Fire Protection System                                                                   |
| <b>FSS</b>      | Fire Suppression System                                                                  |
| <b>H&amp;CD</b> | Heating & Current Drive                                                                  |
| <b>HV</b>       | High Voltage, > 1000 V <sub>rms</sub> or > 1500 V (IEC Definition), 400 kV level on ITER |
| <b>HVAC</b>     | Heating, Ventilation and Air Conditioning                                                |
| <b>HVDC</b>     | High Voltage Direct Current                                                              |
| <b>I&amp;C</b>  | Instrumentation and Control                                                              |
| <b>IAEA</b>     | International Atomic Energy Agency                                                       |
| <b>ICD</b>      | Interface Control Document                                                               |
| <b>IEC</b>      | International Electrotechnical Commission                                                |
| <b>IEEE</b>     | Institute of Electrical and Electronics Engineers                                        |
| <b>IET</b>      | Institution of Engineering and Technology                                                |
| <b>IO</b>       | ITER Organization                                                                        |
| <b>IP</b>       | Investment Protection                                                                    |
| <b>IPEG</b>     | Integrated Plant Earth Grid                                                              |
| <b>IV</b>       | Intermediate Voltage, 66 kV level on ITER                                                |
| <b>LC</b>       | Load Centre                                                                              |
| <b>LCC</b>      | Local Control Cubicle                                                                    |
| <b>LEP</b>      | Local Electrical Panel                                                                   |
| <b>LOSP</b>     | Loss of Off-Site Power                                                                   |
| <b>LTM</b>      | Construction/Long Term Maintenance                                                       |
| <b>LV</b>       | Low Voltage, 5 – 1000 V <sub>rms</sub> or 120 – 1500 V DC, 400 V level on ITER           |
| <b>MCC</b>      | Motor Control Centre                                                                     |
| <b>MP</b>       | Main 400V Distribution Panel located in LC                                               |
| <b>MPCB</b>     | Magnet Power Conversion Building                                                         |
| <b>MPSSN</b>    | Magnet Power Supply Switching Network                                                    |
| <b>MV</b>       | Medium Voltage, 6.6 kV and 22 kV levels on ITER                                          |

|                   |                                                                                        |
|-------------------|----------------------------------------------------------------------------------------|
| <b>NBI</b>        | Neutral Beam Injection                                                                 |
| <b>NBPS</b>       | Neutral Beam Power Supply                                                              |
| <b>OL</b>         | Ordinary Load                                                                          |
| <b>P&amp;ID</b>   | Process and Instrumentation Diagram                                                    |
| <b>PA</b>         | Procurement Arrangement                                                                |
| <b>PBS</b>        | Plant Breakdown Structure                                                              |
| <b>PEC</b>        | Prefabricated Electric Centre                                                          |
| <b>PF</b>         | Power Factor                                                                           |
| <b>PHTS</b>       | Primary Heat Transport System                                                          |
| <b>PID</b>        | Proportional, Integral and Differential Control                                        |
| <b>PID</b>        | Project Integration Document                                                           |
| <b>PINI</b>       | Positive Ion Neutral Injector                                                          |
| <b>PLC</b>        | Programmable Logic Controller                                                          |
| <b>POS</b>        | Pulse Operation State                                                                  |
| <b>PP</b>         | Procurement Package                                                                    |
| <b>PPEN</b>       | Pulsed Power Electrical Network                                                        |
| <b>PS</b>         | Power Supply                                                                           |
| <b>PSH</b>        | Plant System Host                                                                      |
| <b>QA</b>         | Quality Assurance                                                                      |
| <b>RCC-E</b>      | Règles de Conception et de Construction des matériels Electriques des îlots nucléaires |
| <b>RF</b>         | Radio Frequency                                                                        |
| <b>RPC</b>        | Reactive Power Compensation                                                            |
| <b>RPC&amp;HF</b> | Reactive Power Compensation and Harmonic Filtering system                              |
| <b>RTE</b>        | Réseau de Transport d'Electricité (French Transmission Grid Operator)                  |
| <b>SCADA</b>      | Supervisory Control And Data Acquisition                                               |
| <b>SCS</b>        | Supervisory Control System                                                             |
| <b>SF6</b>        | Sulphur Hexafluoride                                                                   |
| <b>SIC</b>        | Safety Important Component                                                             |
| <b>SIC</b>        | Safety Important Classification                                                        |
| <b>S-ICD</b>      | System Interface Control Document                                                      |

|             |                                 |
|-------------|---------------------------------|
| <b>SR</b>   | Safety Relevant                 |
| <b>SRD</b>  | System Requirements Document    |
| <b>SSEN</b> | Steady State Electrical Network |
| <b>SSPD</b> | Steady State Power Distribution |
| <b>SSS</b>  | Steady State 400 kV Substation  |
| <b>STM</b>  | Short term Maintenance          |
| <b>STS</b>  | Short Term Standby              |
| <b>TBC</b>  | To Be Confirmed                 |
| <b>TBD</b>  | To Be Defined                   |
| <b>TCR</b>  | Thyristor Controlled Reactor    |
| <b>TCS</b>  | Test and Conditioning State     |
| <b>UPS</b>  | Uninterruptible Power Supply    |
| <b>VT</b>   | Voltage Transformer             |
| <b>WBS</b>  | Work Breakdown Structure        |

## 4 Reference and Bibliography

Electrical Installations Handbook, 3<sup>rd</sup> Edition

Ed. Günter G. Seip

Pub. John Wiley & Sons

ISBN 0-471-49435-6

Transformer Handbook

Pub. ABB Power Technologies Business Unit Power Transformers

# **Codes and Standards**

## **Abstract**

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

## Contents

|            |                                                                                                      |                 |
|------------|------------------------------------------------------------------------------------------------------|-----------------|
| <b>1</b>   | <b><i>Introduction .....</i></b>                                                                     | <b><i>3</i></b> |
| <b>2</b>   | <b><i>General Binding Rules and Guidelines .....</i></b>                                             | <b><i>3</i></b> |
| <b>3</b>   | <b><i>International Standards Related to Nuclear Safety .....</i></b>                                | <b><i>4</i></b> |
| <b>4</b>   | <b><i>Applicable Standards for Electrical Distribution Networks in Nuclear Power Plants.....</i></b> | <b><i>9</i></b> |
| <b>4.1</b> | <b>Applicable Standards by Voltage Level .....</b>                                                   | <b>10</b>       |
| 4.1.1      | HIGH VOLTAGE.....                                                                                    | 10              |
| 4.1.2      | MEDIUM VOLTAGE.....                                                                                  | 13              |
| 4.1.3      | LOW VOLTAGE.....                                                                                     | 22              |

## Tables

|                    |                                                     |           |
|--------------------|-----------------------------------------------------|-----------|
| <i>Table 4.1-1</i> | <i>Standards for HV Electrical Components .....</i> | <i>10</i> |
| <i>Table 4.1-2</i> | <i>Standards for MV Electrical Components .....</i> | <i>13</i> |
| <i>Table 4.1-3</i> | <i>Standards for LV Electrical Components .....</i> | <i>22</i> |

# 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

| <u>Standard</u>             | <u>Description</u>                                                                                                                                                                  |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                                        |

| <b><u>Standard</u></b>   | <b><u>Description</u></b>                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br>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                                                                                                                                  |

| <u>Standard</u>                               | <u>Description</u>                                                                                                                                           |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br><b>(Replaced by 62305-1)</b> | Protection against lightning - Part 1: General principles                                                                                                    |

| <u>Standard</u>                               | <u>Description</u>                                                                                                                                             |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IEC 61024-1-2<br><b>(Replaced by 62305-3)</b> | 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<br><b>(Replaced by 62305-4)</b>   | Protection against lightning - Part 4: Electrical and electronic systems within structures                                                                     |
| IEC 61312-4<br><b>(Replaced by 62305-4)</b>   | 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<br><b>(Replaced by 62305-2)</b>     | 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 |

| <b><u>Standard</u></b> | <b><u>Description</u></b>                                                                                                                                                              |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 9001:2004 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

## 4.1 Applicable Standards by Voltage Level

### 4.1.1 HIGH VOLTAGE

**Table 4.1-1 Standards for HV Electrical Components**

| SSEN EQUIPMENT    | Manufacturing Standard                                                      | Indoor / Outdoor Facilities | Site Installation Standard                                                                                       | Nuclear Safety | Personal Safety                                                         | Tokamak Complex | Test                                                                                                                                                                                            |
|-------------------|-----------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH VOLTAGE      |                                                                             |                             |                                                                                                                  |                |                                                                         |                 |                                                                                                                                                                                                 |
| 400 kV SWITCHYARD |                                                                             |                             |                                                                                                                  |                |                                                                         |                 |                                                                                                                                                                                                 |
| CIRCUIT BREAKER   |                                                                             |                             |                                                                                                                  |                |                                                                         |                 |                                                                                                                                                                                                 |
|                   | IEC 60071-2<br>IEC 60265-2<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102 | IEC 60068-1                 | IEC 60265-2<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>NFC 13000<br>HD 637 S1 | IEC 60068-3-3  | IEC 60479<br>IEC 61140<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102 |                 | IEC 60060 – 1<br>IEC 60068-1<br>IEC 60068-2-1<br>IEC 60068-2-2<br>IEC 60068-2-30<br>IEC 60068-3-3<br>IEC 60265-2<br>IEC 60815<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-300 |
| DISCONNECTOR      |                                                                             |                             |                                                                                                                  |                |                                                                         |                 |                                                                                                                                                                                                 |
|                   | IEC 60071-2<br>IEC 60265-2<br>IEC 62271-1<br>IEC 62271-102                  | IEC 60068-1                 | IEC 60265-2<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-102<br>NFC 13000<br>HD 637 S1                  | IEC 60068-3-3  | IEC 60479<br>IEC 61140<br>IEC 62271-1<br>IEC 62271-102                  |                 | IEC 60060 – 1<br>IEC 60068-3-3<br>IEC 60815<br>IEC 62271-1<br>IEC 62271-102                                                                                                                     |

| SSEN EQUIPMENT                          | Manufacturing Standard                                                                                               | Indoor / Outdoor Facilities | Site Installation Standard                                                    | Nuclear Safety | Personal Safety                       | Tokamak Complex | Test                                                                                                                                               |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------|----------------|---------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH VOLTAGE                            |                                                                                                                      |                             |                                                                               |                |                                       |                 |                                                                                                                                                    |
| LIGHTNING ARRESTER                      |                                                                                                                      |                             |                                                                               |                |                                       |                 |                                                                                                                                                    |
|                                         | IEC 60071-1<br>IEC 60071-2<br>IEC 60071-4<br>IEC 60071-5<br>IEC 60099-1<br>IEC 60099-4<br>IEC 60099-5<br>IEC 60672-3 |                             | IEC 61140<br>IEC 61936<br>IEC 62305-1 / NF C 17-100<br>NFC 13000<br>HD 637 S1 | IEC 60068-3-3  | IEC 60479<br>IEC 61140                |                 | IEC 60060 – 1<br>IEC 60068-3-3<br>IEC 60071-1<br>IEC 60071-4<br>IEC 60099-1<br>IEC 60099-3<br>IEC 60099-4<br>IEC 60099-5<br>IEC 60507<br>IEC 60815 |
| LINE AND BUSBARS<br>CURRENT TRANSFORMER |                                                                                                                      |                             |                                                                               |                |                                       |                 |                                                                                                                                                    |
|                                         | IEC 60071-2<br>IEC 60044-1<br>IEC 60044-6<br>IEC 60137<br>IEC 62271-1                                                | IEC 60068-1                 | IEC 61140<br>IEC 61936<br>IEC 62271-1<br>NFC 13000<br>HD 637 S1               | IEC 60068-3-3  | IEC 60479<br>IEC 61140<br>IEC 62271-1 |                 | IEC 60044-1<br>IEC 60044-6<br>IEC 60060 – 1<br>IEC 60060-2<br>IEC 60068-3-3<br>IEC 60137<br>IEC 60695-2<br>IEC 60815<br>IEC 62271-1                |
| VOLTAGE TRANSFORMER                     |                                                                                                                      |                             |                                                                               |                |                                       |                 |                                                                                                                                                    |
|                                         | IEC 60044-2<br>IEC 60071-2<br>IEC 60137<br>IEC 62271-1                                                               | IEC 60068-1                 | IEC 61140<br>IEC 61936<br>IEC 62271-1<br>NFC 13000<br>HD 637 S1               | IEC 60068-3-3  | IEC 60479<br>IEC 61140<br>IEC 62271-1 |                 | IEC 60060 – 1<br>IEC 60060-2<br>IEC 60068-3-3<br>IEC 60137<br>IEC 60695-2<br>IEC 60815<br>IEC 62271-1                                              |

| SSEN EQUIPMENT              | Manufacturing Standard                                                                                                                                                                                  | Indoor / Outdoor Facilities | Site Installation Standard                                                       | Nuclear Safety | Personal Safety                         | Tokamak Complex | Test                                                                                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------|----------------|-----------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH VOLTAGE                |                                                                                                                                                                                                         |                             |                                                                                  |                |                                         |                 |                                                                                                                                                                                                |
| EARTH SWITCH                |                                                                                                                                                                                                         |                             |                                                                                  |                |                                         |                 |                                                                                                                                                                                                |
|                             | IEC 60071-2<br>IEC 62271-1<br>IEC 62271-102                                                                                                                                                             | IEC 60068-1                 | IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-102<br>NFC 13000<br>HD 637 S1 | IEC 60068-3-3  | IEC 60479<br>IEC 61140<br>IEC 62271-102 |                 | IEC 60060 – 1<br>IEC 60060-2<br>IEC 60068-3-3<br>IEC 60815<br>IEC 62271-1<br>IEC 62271-102                                                                                                     |
| MAIN STEP-DOWN TRANSFORMERS |                                                                                                                                                                                                         |                             |                                                                                  |                |                                         |                 |                                                                                                                                                                                                |
| STEP-DOWN TRANSFORMER       |                                                                                                                                                                                                         |                             |                                                                                  |                |                                         |                 |                                                                                                                                                                                                |
|                             | IEC 60071-2<br>IEC 60076-1<br>IEC 60076-2<br>IEC 60076-3<br>IEC 60076-4<br>IEC 60076-5<br>IEC 60076-11<br>IEC 60296<br>IEC 60905<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61000-5<br>NF C 52-100 (1990) | IEC 60068-1                 | IEC 61000-5<br>IEC 61140<br>IEC 61936<br>NFC 13000<br>HD 637 S1                  | IEC 60068-3-3  | IEC 60479<br>IEC 61140                  |                 | IEC 60060 – 1<br>IEC 60068-2-6<br>IEC 60068-2-57<br>IEC 60068-3-3<br>IEC 60076-1<br>IEC 60076-2<br>IEC 60076-3<br>IEC 60076-4<br>IEC 60076-5<br>IEC 60076-11<br>IEC 61000-6-2<br>IEC 61000-6-4 |

### 4.1.2 MEDIUM VOLTAGE

**Table 4.1-2 Standards for MV Electrical Components**

| SSEN EQUIPMENT                 | Manufacturing Standard                                                                                                                                                                                                                                                                                                                                          | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                                                                                                                  | Nuclear Safety | Personal Safety                                                                                                                                                                                   | Tokamak Complex             | Test                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE                 |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
| MV 6,6 KV SWITCHGEAR (CLASS 4) |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
| SWITCHGEAR                     |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                | IEC 60044-1<br>IEC 60044-2<br>IEC 60044-8<br>IEC 60071-2<br>IEC 60079-7<br>IEC 60255<br>IEC 60265-1<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60470<br>IEC 60529<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203<br>IEC 62271-301 | IEC 60068-1                 | IEC 60265-1<br>IEC 60470<br>IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>IEC 61936<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203 | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-2-2<br>IEC 60068-2-30<br>IEC 60068-3-3<br>IEC 60079-7<br>IEC 60255<br>IEC 60265-1<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60470<br>IEC 60529<br>IEC 60721-2-1<br>IEC 60754<br>IEC 61000-4-2<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203 |

| SSEN EQUIPMENT       | Manufacturing Standard                                                                                                                                                                                                                                                                                                                                          | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                                                                                                                  | Nuclear Safety | Personal Safety                                                                                                                                                                                   | Tokamak Complex             | Test                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE       |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
| MOTOR CONTROL CENTRE |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
| MCC                  |                                                                                                                                                                                                                                                                                                                                                                 |                             |                                                                                                                                                                                                                                             |                |                                                                                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                           |
|                      | IEC 60044-1<br>IEC 60044-2<br>IEC 60044-8<br>IEC 60071-2<br>IEC 60079-7<br>IEC 60255<br>IEC 60265-1<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60470<br>IEC 60529<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203<br>IEC 62271-301 | IEC 60068-1                 | IEC 60265-1<br>IEC 60470<br>IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>IEC 61936<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203 | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-2-2<br>IEC 60068-2-30<br>IEC 60068-3-3<br>IEC 60079-7<br>IEC 60255<br>IEC 60265-1<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60470<br>IEC 60529<br>IEC 60721-2-1<br>IEC 60754<br>IEC 61000-4-2<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>IEC 62271-201<br>IEC 62271-203 |

| SSEN EQUIPMENT                                                                | Manufacturing Standard                                                                                                                                                        | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                                                      | Nuclear Safety | Personal Safety                                                                                                                                   | Tokamak Complex             | Test                                                                                                                                                               |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE                                                                |                                                                                                                                                                               |                             |                                                                                                                                                                                 |                |                                                                                                                                                   |                             |                                                                                                                                                                    |
| CIRCUIT BREAKER                                                               |                                                                                                                                                                               |                             |                                                                                                                                                                                 |                |                                                                                                                                                   |                             |                                                                                                                                                                    |
|                                                                               | IEC 60071-2<br>IEC 60079-7<br>IEC 60265-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200 | IEC 60068-1                 | IEC 60265-1<br>IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 61140<br>IEC 61958<br>IEC 62271-1<br>IEC 62271-100<br>IEC 62271-102<br>IEC 62271-105<br>IEC 62271-200<br>EN 50019 | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60079-7<br>IEC 60068-2-2<br>IEC 60068-2-30<br>IEC 60068-3-3<br>IEC 60721-2-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21 |
| Income circuit breaker<br>Coupling circuit breaker<br>Outlets circuit breaker |                                                                                                                                                                               |                             |                                                                                                                                                                                 |                |                                                                                                                                                   |                             |                                                                                                                                                                    |
| COUPLER DISCONNECTOR                                                          |                                                                                                                                                                               |                             |                                                                                                                                                                                 |                |                                                                                                                                                   |                             |                                                                                                                                                                    |
|                                                                               | IEC 60071-2<br>IEC 60079-7<br>IEC 60265-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62271-1<br>IEC 62271-102                                                    | IEC 60068-1                 | IEC 60265-1<br>IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-102<br>NFC 13000<br>NF C13.200<br>HD 637 S1                                                    | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 61140<br>IEC 62271-1<br>IEC 62271-102                                                                             | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-3-3<br>IEC 60079-7<br>IEC 60265-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 62271-1<br>IEC 62271-102      |

| SSEN EQUIPMENT                                                                                               | Manufacturing Standard                                                                                                                                 | Indoor / Outdoor Facilities | Site Installation Standard                                                                                    | Nuclear Safety | Personal Safety                                                       | Tokamak Complex             | Test                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE                                                                                               |                                                                                                                                                        |                             |                                                                                                               |                |                                                                       |                             |                                                                                                                                                                              |
| FUSES                                                                                                        |                                                                                                                                                        |                             |                                                                                                               |                |                                                                       |                             |                                                                                                                                                                              |
|                                                                                                              | IEC 60071-2<br>IEC 60079-7<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60787<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62271-1<br>IEC 62271-105 | IEC 60068-1                 | IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>IEC 62271-105<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 61140<br>IEC 62271-1<br>IEC 62271-105 | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-3-3<br>IEC 60079-7<br>IEC 60282-1<br>IEC 60282-2<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 62271-1<br>IEC 62271-105 |
| INSTRUMENTATION TRANSFORMERS                                                                                 |                                                                                                                                                        |                             |                                                                                                               |                |                                                                       |                             |                                                                                                                                                                              |
|                                                                                                              | IEC 60044-1<br>IEC 60044-2<br>IEC 60044-6<br>IEC 60071-2<br>IEC 60079-7<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62271-1                | IEC 60068-1                 | IEC 61000-5<br>IEC 61140<br>IEC 61936<br>IEC 62271-1<br>NFC 13000<br>NF C13.200<br>HD 637 S1                  | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 61140<br>IEC 62271-1                  | IEC 60754<br>IEC 61249-2-21 | IEC 60044-1<br>IEC 60044-2<br>IEC 60060 – 1<br>IEC 60068-3-3<br>IEC 60079-7<br>IEC 60216<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 62271-1     |
| Current transformers (windows type)<br><br>Voltage transformers<br><br>zero sequential toroidal transformers |                                                                                                                                                        |                             |                                                                                                               |                |                                                                       |                             |                                                                                                                                                                              |

| SSEN EQUIPMENT              | Manufacturing Standard                                                    | Indoor / Outdoor Facilities | Site Installation Standard                                                    | Nuclear Safety | Personal Safety                       | Tokamak Complex             | Test                                                                                                                                                                                                                                                                                                |
|-----------------------------|---------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------|----------------|---------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE              |                                                                           |                             |                                                                               |                |                                       |                             |                                                                                                                                                                                                                                                                                                     |
| RELAYS                      |                                                                           |                             |                                                                               |                |                                       |                             |                                                                                                                                                                                                                                                                                                     |
|                             | IEC 60071-2<br>IEC 60255<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4 | IEC 60068-1                 | IEC 61000-5<br>IEC 61140<br>IEC 61936<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3  | IEC 60079-7<br>IEC 60479<br>IEC 61140 | IEC 60754<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-2<br>IEC 60068-3-3<br>IEC 60255-5<br>IEC 60255-11<br>IEC 60754<br>IEC 61000-4-2<br>IEC 61000-4-3<br>IEC 61000-4-4<br>IEC 61000-4-5<br>IEC 61000-4-6<br>IEC 61000-4-8<br>IEC 61000-4-10<br>IEC 61000-4-12<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>EN 55022 |
| MEDIUM VOLTAGE POWER CABLES |                                                                           |                             |                                                                               |                |                                       |                             |                                                                                                                                                                                                                                                                                                     |

| SSEN EQUIPMENT                                                                                    | Manufacturing Standard                                                                                                                                                                                                                                                                                            | Indoor / Outdoor Facilities | Site Installation Standard                                                    | Nuclear Safety                          | Personal Safety                                    | Tokamak Complex                             | Test                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE                                                                                    |                                                                                                                                                                                                                                                                                                                   |                             |                                                                               |                                         |                                                    |                                             |                                                                                                                                                                                                                                                           |
|                                                                                                   | IEC 60038<br>IEC 60055-2<br>IEC 60071-2<br>IEC 60183<br>IEC 60228<br>IEC 60287<br>IEC 60304<br>IEC 60502<br>IEC 60840<br>(ABOVE 36KV)<br>IEC 60949<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>NF C 32070<br>NF C 32323<br>HD 308<br>HD 620S1<br>HD 632 S1<br>(above 36 kV)<br>HD 632.16<br>(above 36 kV) | IEC 60068-1                 | IEC 61000-5<br>IEC 61140<br>IEC 61936<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60079-7<br>IEC 60446<br>IEC 60479<br>IEC 61140 | IEC 60754<br>IEC 61249-2-21<br>EN 50267-2-1 | IEC 60055-1<br>IEC 60332-1<br>IEC 60332-2<br>IEC 60332-3-24<br>IEC 60502<br>IEC 60754<br>IEC 60811<br>IEC 60840<br>(ABOVE 30KV)<br>IEC 61034<br>IEC 61000-6-2<br>IEC 61000-6-4<br>EN 50266-2-4<br>EN 50267-2-1<br>EN 50267-2-3<br>NFC 20454<br>NF C 32070 |
| MV SWITCHGEAR (CLASS 3) SR (*)                                                                    |                                                                                                                                                                                                                                                                                                                   |                             |                                                                               |                                         |                                                    |                                             |                                                                                                                                                                                                                                                           |
| (*) Comply with the standards shown above but it has to be into account safety relevant condition |                                                                                                                                                                                                                                                                                                                   |                             |                                                                               | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 |                                                    | IEC 60754<br>IEC 61249-2-21                 |                                                                                                                                                                                                                                                           |
| EMERGENCY POWER SUPPLY                                                                            |                                                                                                                                                                                                                                                                                                                   |                             |                                                                               |                                         |                                                    |                                             |                                                                                                                                                                                                                                                           |
| DIESEL GENERATOR WITH AUXILIARIES                                                                 |                                                                                                                                                                                                                                                                                                                   |                             |                                                                               |                                         |                                                    |                                             |                                                                                                                                                                                                                                                           |

| SSEN EQUIPMENT | Manufacturing Standard                                                                                                            | Indoor / Outdoor Facilities | Site Installation Standard                                                                 | Nuclear Safety                          | Personal Safety                       | Tokamak Complex | Test                                                         |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------|-----------------|--------------------------------------------------------------|
| MEDIUM VOLTAGE |                                                                                                                                   |                             |                                                                                            |                                         |                                       |                 |                                                              |
|                | IEC 60034<br>IEC 60071-2<br>IEC 60529<br>IEC 60950<br>IEC 61131-3<br>IEC 62305-3<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4 | IEC 60068-1                 | IEC 60950<br>IEC 61000-5<br>IEC 61140<br>IEC 61936<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60079-7<br>IEC 60479<br>IEC 61140 |                 | IEC 60060 – 1<br>IEC 60529<br>IEC 61000-6-2<br>IEC 61000-6-4 |
| Main motor     |                                                                                                                                   |                             |                                                                                            |                                         |                                       |                 |                                                              |
| Generator      |                                                                                                                                   |                             |                                                                                            |                                         |                                       |                 |                                                              |
| Control Panels |                                                                                                                                   |                             |                                                                                            |                                         |                                       |                 |                                                              |
| MOTORS         |                                                                                                                                   |                             |                                                                                            |                                         |                                       |                 |                                                              |

| SSEN EQUIPMENT | Manufacturing Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                   | Nuclear Safety                                    | Personal Safety                                                    | Tokamak Complex             | Test                                                                                                                                                                                                                                                                                                                                                                                |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                             |                                                                                                                                              |                                                   |                                                                    |                             |                                                                                                                                                                                                                                                                                                                                                                                     |
|                | IEC 60034-1<br>IEC 60034-2<br>IEC 60034-5<br>IEC 60034-6<br>IEC 60034-7<br>IEC 60034-8<br>IEC 60034-9<br>IEC 60034-11<br>IEC 60034-12<br>IEC 60034-14<br>IEC 60071-2<br>IEC 60072-1<br>IEC 60072-2<br>IEC 60072-3<br>IEC 60079-0<br>IEC 60079-1<br>IEC 60079-2<br>IEC 60079-7<br>IEC 60079-14<br>IEC 60079-15<br>IEC 60079-19<br>IEC 60204-11<br>IEC 60071-2<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61241-11<br>IEC 61241-17 | IEC 60068-1                 | IEC 60034-7<br>IEC 60079-14<br>IEC 60204-11<br>IEC 61000-5<br>IEC 61140<br>IEC 61241-14<br>IEC 61936<br>NFC 13000<br>NF C13.200<br>HD 637 S1 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60034-5<br>IEC 60204-11<br>IEC 60479<br>IEC 60529<br>IEC 61140 | IEC 60754<br>IEC 61249-2-21 | IEC 60034-1<br>IEC 60034-2<br>IEC 60034-5<br>IEC 60034-9<br>IEC 60034-11<br>IEC 60034-12<br>IEC 60060 – 1<br>IEC 60071-2<br>IEC 60079-0<br>IEC 60079-1<br>IEC 60079-2<br>IEC 60079-7<br>IEC 60079-14<br>IEC 60079-15<br>IEC 60079-19<br>IEC 60204-11<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61241-11<br>IEC 61241-17<br>IEC 61249-2-21 |
| SPEED DRIVES   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                             |                                                                                                                                              |                                                   |                                                                    |                             |                                                                                                                                                                                                                                                                                                                                                                                     |

| SSEN EQUIPMENT | Manufacturing Standard                                                                                                                                                              | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                            | Nuclear Safety                                    | Personal Safety                       | Tokamak Complex             | Test                                                                                                                                                                                                     |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEDIUM VOLTAGE |                                                                                                                                                                                     |                             |                                                                                                                                                       |                                                   |                                       |                             |                                                                                                                                                                                                          |
|                | IEC 60071-2<br>IEC 60079-0<br>IEC 60079-1<br>IEC 61000-2-4<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61800-3<br>IEC 61800-4<br>EN 50178 | IEC 60068-1                 | IEC 60204-1<br>IEC 61000-5<br>IEC 61140<br>IEC 61800-1<br>IEC 61800-2<br>IEC 61800-5<br>IEC 61936<br>NFC 13000<br>NF C13.200<br>HD 637 S1<br>EN 50178 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60204-1<br>IEC 60479<br>IEC 61140 | IEC 60754<br>IEC 61249-2-21 | IEC 60060-1<br>IEC 60068-3-3<br>IEC 60079-0<br>IEC 60079-1<br>IEC 60754<br>IEC 61000-2-4<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61249-2-21<br>IEC 61800-3<br>IEC 61800-4 |

### 4.1.3 LOW VOLTAGE

**Table 4.1-3 Standards for LV Electrical Components**

| SSEN EQUIPMENT                    | Manufacturing Standard                                                                                                                                                                                                              | Indoor / Outdoor Facilities | Site Installation Standard                                                      | Nuclear Safety                                    | Personal Safety                                     | Tokamak Complex             | Test                                                                                                                                                                                                    |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                       |                                                                                                                                                                                                                                     |                             |                                                                                 |                                                   |                                                     |                             |                                                                                                                                                                                                         |
| MV / LV DISTRIBUTION TRANSFORMERS |                                                                                                                                                                                                                                     |                             |                                                                                 |                                                   |                                                     |                             |                                                                                                                                                                                                         |
|                                   | IEC 60076-1<br>IEC 60076-2<br>IEC 60076-3<br>IEC 60076-4<br>IEC 60076-5<br>IEC 60076-10<br>IEC 60076-11<br>IEC 60296<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>HD 538-2 S1<br>NF C 52-112 /<br>NF EN 50464 | IEC 60068-1<br>IEC 60364    | IEC 60076-7<br>IEC 60364<br>IEC 60905<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60068-3-3<br>IEC 60076-1<br>IEC 60076-2<br>IEC 60076-3<br>IEC 60076-4<br>IEC 60076-5<br>IEC 60076-5<br>IEC 60076-11<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21 |
| DRY TRANSFORMER                   |                                                                                                                                                                                                                                     |                             |                                                                                 |                                                   |                                                     |                             |                                                                                                                                                                                                         |
| OIL TRANSFORMER                   |                                                                                                                                                                                                                                     |                             |                                                                                 |                                                   |                                                     |                             |                                                                                                                                                                                                         |

| SSEN EQUIPMENT                                   | Manufacturing Standard                                                                                                                                                                                                                                                                                                                                                         | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                                                                  | Nuclear Safety | Personal Safety                                                                 | Tokamak Complex             | Test                                                                                                                                                                                                                                                                         |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                      |                                                                                                                                                                                                                                                                                                                                                                                |                             |                                                                                                                                                                             |                |                                                                                 |                             |                                                                                                                                                                                                                                                                              |
| LOCAL INSTRUMENTATION CONTROL, PROTECTION SYSTEM |                                                                                                                                                                                                                                                                                                                                                                                |                             |                                                                                                                                                                             |                |                                                                                 |                             |                                                                                                                                                                                                                                                                              |
| LOAD DISTRIBUTION CENTRE (CLASS 4 & 3) IP        |                                                                                                                                                                                                                                                                                                                                                                                |                             |                                                                                                                                                                             |                |                                                                                 |                             |                                                                                                                                                                                                                                                                              |
|                                                  | IEC 60269<br>IEC 60439-1<br>IEC 60529<br>IEC 60664-1<br>IEC 60715<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 60947-4<br>IEC 60947-5<br>IEC 60947-6<br>IEC 60947-7<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62208/EN 50298<br>EN 50 102<br>NF C 20-010/IEC 60529/EN 50 102<br>NF C 20-015/IEC 62262<br>NF C 20-030/IEC 61140<br>NF C 20-040/IEC 60664-4 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60439-1<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 60947-4<br>IEC 60947-5<br>IEC 60947-6<br>IEC 60947-7<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60364-4<br>IEC 60439-1<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60068-3-3<br>IEC 60439-1<br>IEC 60529<br>IEC 60664-1<br>IEC 60754<br>IEC 60947<br>IEC 61000<br>IEC 61249-2-21<br>IEC 61641<br>IEC 62262<br>NF C 63-421/IEC 60439-1<br>NF C 20-010/IEC 60529<br>NF C 20-015/IEC 62262<br>NF C 20-030/IEC 61140<br>NF C 20-040/IEC 60664-4 |

| SSEN EQUIPMENT                                                    | Manufacturing Standard                                                                     | Indoor / Outdoor Facilities | Site Installation Standard                                                        | Nuclear Safety | Personal Safety                                     | Tokamak Complex             | Test                                                                                                                                                                                                                |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------|----------------|-----------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                                       |                                                                                            |                             |                                                                                   |                |                                                     |                             |                                                                                                                                                                                                                     |
| CIRCUIT BREAKER                                                   |                                                                                            |                             |                                                                                   |                |                                                     |                             |                                                                                                                                                                                                                     |
|                                                                   | IEC 60664-1<br>IEC 60947-1<br>IEC 60947-2<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60947-1<br>IEC 60947-2<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60068-3-3<br>IEC 60439-1<br>IEC 60664-1<br>IEC 60947-1<br>IEC 60947-2<br>IEC 61000-4-2<br>IEC 61000-4-4<br>IEC 61000-4-8<br>IEC 61000-4-9<br>IEC 61000-4-10<br>IEC 61000-4-13<br>IEC 61000-6-2<br>IEC 61000-6-4 |
| Income and coupling automatic circuit breaker (double-ended type) |                                                                                            |                             |                                                                                   |                |                                                     |                             |                                                                                                                                                                                                                     |
| Circuit Breaker for outgoing circuits<br>Thermal magnetic breaker |                                                                                            |                             |                                                                                   |                |                                                     |                             |                                                                                                                                                                                                                     |

| SSEN EQUIPMENT                                                                                                                              | Manufacturing Standard                                                                                                 | Indoor / Outdoor Facilities | Site Installation Standard                                                                                    | Nuclear Safety | Personal Safety                                                  | Tokamak Complex               | Test                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                                                                                                                 |                                                                                                                        |                             |                                                                                                               |                |                                                                  |                               |                                                                                                                                                                                                                                                                                                                                                |
| PROTECTION RELAYS                                                                                                                           |                                                                                                                        |                             |                                                                                                               |                |                                                                  |                               |                                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                             | IEC 60255<br>IEC 60664-1<br>IEC 60755<br>IEC 60947-1<br>IEC 60947-5-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60755<br>IEC 60947-1<br>IEC 60947-5-1<br>IEC 60755<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60364-4<br>IEC 60479<br>IEC 60755<br>IEC 61140<br>NF C15-100 | IEC 60754-1<br>IEC 61249-2-21 | IEC 60060 – 1<br>IEC 60068-2<br>IEC 60068-3-3<br>IEC 60255-5<br>IEC 60255-11<br>IEC 60529<br>IEC 60664-1<br>IEC 60754-1<br>IEC 60755<br>IEC 61000-4-2<br>IEC 61000-4-3<br>IEC 61000-4-4<br>IEC 61000-4-5<br>IEC 61000-4-6<br>IEC 61000-4-8<br>IEC 61000-4-10<br>IEC 61000-4-12<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>EN 55022 |
| Motor Electronic protection relay<br>Undervoltage (ANSI) relay<br>DC undervoltage relay (ANSI 80)<br>Differential Relay<br>Isolation relays |                                                                                                                        |                             |                                                                                                               |                |                                                                  |                               |                                                                                                                                                                                                                                                                                                                                                |

| SSEN EQUIPMENT                                                      | Manufacturing Standard                                                                                           | Indoor / Outdoor Facilities | Site Installation Standard                          | Nuclear Safety | Personal Safety                                                                 | Tokamak Complex             | Test                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------|----------------|---------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                                         |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |
| INSTRUMENT TRANSFORMERS                                             |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |
|                                                                     | IEC 60044-1<br>IEC 60044-2<br>IEC 60664-1<br>IEC 61000-5<br>NF C 42502                                           | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 |                | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100                             | IEC 60754<br>IEC 61249-2-21 | IEC 60044-1<br>IEC 60044-2<br>IEC 60664-1<br>IEC 60754<br>IEC 61249-2-21<br>NF C 42502                                                                                                                                                       |
| Potential transformers                                              |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |
| Current transformers                                                |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |
| METERING UNIT (Comprise all components)                             |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |
|                                                                     | IEC 60051<br>IEC 60359<br>IEC 60529<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62053 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 |                | IEC 60364-4<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>IEC 61010-1<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60529<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-4-2<br>IEC 61000-4-3<br>IEC 61000-4-4<br>IEC 61000-4-5<br>IEC 61000-4-6<br>IEC 61000-4-8<br>IEC 61000-4-11<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61010-1<br>IEC 61249-2-21<br>EN 55011 |
| Voltmeter<br>Ammeter<br>Communication bus<br>communication protocol |                                                                                                                  |                             |                                                     |                |                                                                                 |                             |                                                                                                                                                                                                                                              |

| SSEN EQUIPMENT                                                                                    | Manufacturing Standard | Indoor / Outdoor Facilities | Site Installation Standard | Nuclear Safety                          | Personal Safety | Tokamak Complex             | Test |
|---------------------------------------------------------------------------------------------------|------------------------|-----------------------------|----------------------------|-----------------------------------------|-----------------|-----------------------------|------|
| LOW VOLTAGE                                                                                       |                        |                             |                            |                                         |                 |                             |      |
| LOAD DISTRIBUTION CENTRE (CLASS 3) SR (*)                                                         |                        |                             |                            |                                         |                 |                             |      |
| (*) Comply with the standards shown above but it has to be into account safety relevant condition |                        |                             |                            | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 |                 | IEC 60754<br>IEC 61249-2-21 |      |

| SSEN EQUIPMENT | Manufacturing Standard                                                                                                                                                                                                                                                                                                                                                                                                                       | Indoor / Outdoor Facilities | Site Installation Standard                                                                                        | Nuclear Safety                                    | Personal Safety                                                                                  | Tokamak Complex             | Test                                                                                                                                                                                                                                                                                                                                                                              |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE    |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                             |                                                                                                                   |                                                   |                                                                                                  |                             |                                                                                                                                                                                                                                                                                                                                                                                   |
| MOTORS         |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                             |                                                                                                                   |                                                   |                                                                                                  |                             |                                                                                                                                                                                                                                                                                                                                                                                   |
|                | IEC 60034-1<br>IEC 60034-2<br>IEC 60034-5<br>IEC 60034-6<br>IEC 60034-7<br>IEC 60034-8<br>IEC 60034-9<br>IEC 60034-11<br>IEC 60034-12<br>IEC 60034-14<br>IEC 60072-1<br>IEC 60072-2<br>IEC 60072-3<br>IEC 60079-0<br>IEC 60079-1<br>IEC 60079-2<br>IEC 60079-7<br>IEC 60079-14<br>IEC 60079-15<br>IEC 60079-19<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61241-11<br>IEC 61241-17 | IEC 60068-1<br>IEC 60364    | IEC 60034-7<br>IEC 60079-14<br>IEC 60204-1<br>IEC 60364<br>IEC 61000-5<br>IEC 61241-14<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60034-5<br>IEC 60204-1<br>IEC 60364-4<br>IEC 60034-5<br>IEC 60479<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60034-1<br>IEC 60034-2<br>IEC 60034-5<br>IEC 60034-9<br>IEC 60034-11<br>IEC 60034-12<br>IEC 60071-2<br>IEC 60079-0<br>IEC 60079-1<br>IEC 60079-2<br>IEC 60079-7<br>IEC 60079-14<br>IEC 60079-15<br>IEC 60079-19<br>IEC 60204-11<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61241-11<br>IEC 61241-17<br>IEC 61249-2-21 |

| SSEN EQUIPMENT | Manufacturing Standard                                                                                                                                                                           | Indoor / Outdoor Facilities | Site Installation Standard                                                                                                  | Nuclear Safety                                    | Personal Safety                                                    | Tokamak Complex             | Test                                                                                                                                                                                                                  |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE    |                                                                                                                                                                                                  |                             |                                                                                                                             |                                                   |                                                                    |                             |                                                                                                                                                                                                                       |
| SPEED DRIVES   |                                                                                                                                                                                                  |                             |                                                                                                                             |                                                   |                                                                    |                             |                                                                                                                                                                                                                       |
|                | IEC 60079-0<br>IEC 60079-1<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61800-1<br>IEC 61800-2<br>IEC 61800-3<br>IEC 61800-5<br>IEC 61241-0<br>IEC 61241-1<br>EN 50178 | IEC 60068-1<br>IEC 60364    | IEC 60204-1<br>IEC 60364<br>IEC 61000-5<br>IEC 61140<br>IEC 61800-1<br>IEC 61800-2<br>IEC 61800-5<br>EN 50178<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60204-1<br>IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60079-0<br>IEC 60079-1<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-2-4<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61241-0<br>IEC 61241-1<br>IEC 61249-2-21<br>IEC 61800-1<br>IEC 61800-2<br>IEC 61800-3<br>IEC 61800-5 |

| SSEN EQUIPMENT                                              | Manufacturing Standard                                                                                                                                                                                                                | Indoor / Outdoor Facilities | Site Installation Standard                                                                     | Nuclear Safety | Personal Safety                                                                                | Tokamak Complex             | Test                                                                                                                                                                  |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                                 |                                                                                                                                                                                                                                       |                             |                                                                                                |                |                                                                                                |                             |                                                                                                                                                                       |
| LOW VOLTAGE MOTOR CONTROL CENTRE (CLASS 4 & 3) (as an Unit) |                                                                                                                                                                                                                                       |                             |                                                                                                |                |                                                                                                |                             |                                                                                                                                                                       |
|                                                             | IEC 60269<br>IEC 60439<br>IEC 60529<br>IEC 60664-1<br>IEC 60715<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 60947-4<br>IEC 60947-5<br>IEC 60947-6<br>IEC 60947-7<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>EN 50102 | IEC 60068-1<br>IEC 60364    | IEC 60269-2<br>IEC 60269-3<br>IEC 60364<br>IEC 60439<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60269-2<br>IEC 60269-3<br>IEC 60364-4<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60068-3-3<br>IEC 60269<br>IEC 60439-1<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61641<br>IEC 61249-2-21<br>IEC 61641<br>IEC 61249-2-21 |

| SSEN EQUIPMENT                                    | Manufacturing Standard                                                                                                                                                                                                                        | Indoor / Outdoor Facilities | Site Installation Standard                                                        | Nuclear Safety                          | Personal Safety                                     | Tokamak Complex | Test                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                                       |                                                                                                                                                                                                                                               |                             |                                                                                   |                                         |                                                     |                 |                                                                                                                                                                                                                                                                                                                                               |
| EMERGENCY POWER SUPPLY                            |                                                                                                                                                                                                                                               |                             |                                                                                   |                                         |                                                     |                 |                                                                                                                                                                                                                                                                                                                                               |
| DIRECT CURRENT SYSTEM (class I)                   |                                                                                                                                                                                                                                               |                             |                                                                                   |                                         |                                                     |                 |                                                                                                                                                                                                                                                                                                                                               |
|                                                   | IEC 60038<br>IEC 60146-2<br>IEC 60664-1<br>IEC 60896-11<br>IEC 60896-21<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61056-1<br>IEC 61056-2<br>IEC 61660-1<br>IEC 62040-3<br>EN 55022 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 |                 | IEC 60254-1<br>IEC 60254-2<br>IEC 60664-1<br>IEC 60896-11<br>IEC 60896-21<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61000-4-2<br>IEC 61000-4-4<br>IEC 61000-4-5<br>IEC 61000-4-8<br>IEC 61000-4-9<br>IEC 61000-4-10<br>IEC 61000-4-13<br>IEC 61000-4-17<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62040-2<br>EN 55022<br>NF C 58-311 |
| 125 Vdc lead-acid accumulator, Stationary battery |                                                                                                                                                                                                                                               |                             |                                                                                   |                                         |                                                     |                 |                                                                                                                                                                                                                                                                                                                                               |

| SSEN EQUIPMENT          | Manufacturing Standard                                                                                                                  | Indoor / Outdoor Facilities | Site Installation Standard                                                         | Nuclear Safety                          | Personal Safety                                     | Tokamak Complex | Test                                                                                                                                                                                               |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE             |                                                                                                                                         |                             |                                                                                    |                                         |                                                     |                 |                                                                                                                                                                                                    |
|                         | IEC 60038<br>IEC 60664-1<br>IEC 60896-11<br>IEC 60896-21<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61056-1<br>IEC 61056-2 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100                                | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 |                 | IEC 60254-1<br>IEC 60254-2<br>IEC 60664-1<br>IEC 60896-11<br>IEC 60896-21<br>IEC 61000-4-17<br>IEC 61000-6-2<br>IEC 61000-6-4<br>NF C 58-311                                                       |
| 400 Vac/250 Vdc charger |                                                                                                                                         |                             |                                                                                    |                                         |                                                     |                 |                                                                                                                                                                                                    |
|                         | IEC 60146-2<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62040-3<br>EN 55022                                  | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100                                | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 |                 | IEC 60664-1<br>IEC 61000-4-4<br>IEC 61000-4-5<br>IEC 61000-4-17<br>IEC 61000-6-4<br>IEC 62040-2<br>EN 55022<br>NF C 58-311                                                                         |
| Dc circuit breakers     |                                                                                                                                         |                             |                                                                                    |                                         |                                                     |                 |                                                                                                                                                                                                    |
|                         | IEC 60664-1<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61660-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4                | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61000-5<br>IEC 61140 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100 |                 | IEC 60664-1<br>IEC 60947-1<br>IEC 60947-2<br>IEC 60947-3<br>IEC 61000-4-2<br>IEC 61000-4-4<br>IEC 61000-4-8<br>IEC 61000-4-9<br>IEC 61000-4-10<br>IEC 61000-4-13<br>IEC 61000-6-2<br>IEC 61000-6-4 |

| SSEN EQUIPMENT                         | Manufacturing Standard                                                                                                                                                 | Indoor / Outdoor Facilities | Site Installation Standard                                           | Nuclear Safety                          | Personal Safety                                                                       | Tokamak Complex | Test                                                                                                      |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                            |                                                                                                                                                                        |                             |                                                                      |                                         |                                                                                       |                 |                                                                                                           |
| REGULATED UNINTERRUPTIBLE SYSTEM (UPS) |                                                                                                                                                                        |                             |                                                                      |                                         |                                                                                       |                 |                                                                                                           |
|                                        | IEC 60664-1<br>IEC 60950-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62040-1-1<br>IEC 62040-1-2<br>IEC 62040-2<br>IEC 62040-3<br>IEC 60950-1<br>EN 55022 | IEC 60068-1<br>IEC 60364    | IEC 60364-1<br>IEC 60364-4<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>IEC 62040-1-1<br>IEC 62040-1-2<br>NF C15-100 |                 | IEC 60664-1<br>IEC 61000-4-17<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62040-2<br>IEC 62040-3<br>EN 55022 |
| Static inverter                        |                                                                                                                                                                        |                             |                                                                      |                                         |                                                                                       |                 |                                                                                                           |
|                                        | IEC 60146-2<br>IEC 60664-1<br>IEC 60950-1<br>IEC 61000-5<br>IEC 62040-1<br>IEC 62040-3<br>EN 55022                                                                     | IEC 60364                   | IEC 60364-1<br>IEC 60364-4<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60980<br>IEC 60780 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>IEC 62040-1-1<br>IEC 62040-1-2<br>NF C15-100 |                 | IEC 60664-1<br>IEC 61000-6-2<br>IEC 61000-6-4                                                             |
| Static transfer switch                 |                                                                                                                                                                        |                             |                                                                      |                                         |                                                                                       |                 |                                                                                                           |

| SSEN EQUIPMENT              | Manufacturing Standard                                                                                                                                                                              | Indoor / Outdoor Facilities | Site Installation Standard                                                                       | Nuclear Safety                          | Personal Safety                                                                                | Tokamak Complex | Test                                                                                                  |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                 |                                                                                                                                                                                                     |                             |                                                                                                  |                                         |                                                                                                |                 |                                                                                                       |
|                             | IEC 60146-1-1<br>IEC 60146-1-3<br>IEC 60146-2<br>IEC 60439-1<br>IEC 60439-2<br>IEC 60439-3<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 62310-1<br>IEC 62310-2<br>EN50178 | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 60439-1<br>IEC 60439-2<br>IEC 60439-3<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60439-1<br>IEC 60479<br>IEC 60529<br>IEC 61140<br>IEC 62310-1<br>NF C15-100 |                 | IEC 60439-1<br>IEC 60664-1<br>IEC 61000-6-2<br>IEC 61000-6-4                                          |
| Batteries (open vs. closed) |                                                                                                                                                                                                     |                             |                                                                                                  |                                         |                                                                                                |                 |                                                                                                       |
|                             | IEC 60896-11<br>IEC 60896-21<br>IEC 61056-1<br>IEC 61056-2<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4                                                                                         | IEC 60068-1<br>IEC 60364    | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100                                              | IEC 60068-3-3<br>IEC 60780<br>IEC 60980 | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100                                            |                 | IEC 60664-1<br>IEC 60695-11-10<br>IEC 60695-11-20<br>IEC 61000-4-17<br>IEC 61000-6-2<br>IEC 61000-6-4 |

| SSEN EQUIPMENT                     | Manufacturing Standard                                                                                                                                                                                                                                                                                                       | Indoor / Outdoor Facilities                                  | Site Installation Standard                          | Nuclear Safety                                    | Personal Safety                                                  | Tokamak Complex                           | Test                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                        |                                                                                                                                                                                                                                                                                                                              |                                                              |                                                     |                                                   |                                                                  |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| LV POWER CABLES AND CONTROL CABLES |                                                                                                                                                                                                                                                                                                                              |                                                              |                                                     |                                                   |                                                                  |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                    | IEC 60227<br>IEC 60228<br>IEC 60245<br>IEC 60287-1-1<br>IEC 60304<br>IEC 60664-1<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61210<br>IEC 62440<br>HD 22.9.S3<br>HD 21.5 S 3<br>HD 21.3 S 3<br>HD 22.4S4<br>HD 22.6S2<br>HD 308<br>HD 361<br>HD 603 S1<br>NF C 30202<br>NF C 32070<br>NFC 32102.13<br>NF C 32323 | IEC 60068-1<br>IEC 60364<br>IEC 60364-5-52<br>IEC 60364-4-43 | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) | IEC 60364-4<br>IEC 60446<br>IEC 60479<br>IEC 61140<br>NF C15-100 | IEC 60754-1<br>NF C 32070<br>EN 50267-2-1 | IEC 60055<br>IEC 60093<br>IEC 60227<br>IEC 60243<br>IEC 60245<br>IEC 60250<br>IEC 60331<br>IEC 60332-1<br>IEC 60332-2<br>IEC 60332-3<br>IEC 60664-1<br>IEC 60684-2<br>IEC 60754-1<br>IEC 60754-2<br>IEC 60811<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61034-1<br>IEC 61034-2<br>IEC 61210<br>EN 50266-1<br>EN 50266-2-2<br>EN 50266-2-3<br>EN 50266-2-4<br>EN 50266-2-5<br>EN 50267-1<br>EN 50267-2-1<br>EN 50267-2-2<br>NF C 20454<br>NF C 32070<br>NF C 32076 |

| SSEN EQUIPMENT                    | Manufacturing Standard                                                                                                                          | Indoor / Outdoor Facilities                                                | Site Installation Standard                          | Nuclear Safety                                    | Personal Safety                                                                                    | Tokamak Complex             | Test                                                                                                                                |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                       |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
| CABLE TRAYS                       |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
|                                   | IEC 61537<br>NF P 92507<br>EN 10327<br>EN 12329<br>EN 12330<br>EN 10088-2                                                                       | IEC 60068-1<br>IEC 60364<br>EN 10327<br>EN 12329<br>EN 12330<br>EN 10088-2 | IEC 60364                                           | IEC 60068-3-3<br>IEC 60780 (SR)<br>IEC 60980 (SR) |                                                                                                    | IEC 60754-1<br>NF C 32070   | EN 10327<br>EN 10088-2                                                                                                              |
| LIGHTING SYSTEM                   |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
| LIGHTING                          |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
| Metal halide lamps                |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
|                                   | IEC 60664-1<br>IEC 60927<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61167<br>IEC 61347-1<br>IEC 61347-2-1<br>IEC 61547<br>EN 55015 | IEC 60068-1<br>IEC 60364<br>IEC 60364-7-714                                | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3                                     | IEC 60364-4<br>IEC 60479<br>IEC 61347-1<br>IEC 61347-2-1<br>IEC 61140<br>IEC 61347-1<br>NF C15-100 | IEC 60754<br>IEC 61249-2-21 | IEC 60068-3-3<br>IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61167<br>IEC 61249-2-21<br>IEC 61547<br>EN 55015 |
| High-pressure sodium vapour lamps |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |
|                                   | IEC 60662<br>IEC 60664-1<br>IEC 60923<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61347-2-9<br>IEC 61547<br>EN 55015                | IEC 60068-1<br>IEC 60364<br>IEC 60364-7-714                                | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3                                     | IEC 60364-4<br>IEC 60479<br>IEC 61140<br>NF C15-100                                                | IEC 60754<br>IEC 61249-2-21 | IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 61547<br>EN 55015                               |
| Fluorescent lamps                 |                                                                                                                                                 |                                                                            |                                                     |                                                   |                                                                                                    |                             |                                                                                                                                     |

| SSEN EQUIPMENT               | Manufacturing Standard                                                                                                                                                    | Indoor / Outdoor Facilities                 | Site Installation Standard                          | Nuclear Safety | Personal Safety                                                                                                           | Tokamak Complex             | Test                                                                                                  |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------|
| LOW VOLTAGE                  |                                                                                                                                                                           |                                             |                                                     |                |                                                                                                                           |                             |                                                                                                       |
|                              | IEC 60081<br>IEC 60664-1<br>IEC 60901<br>IEC 60929<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61195<br>IEC 61347-1<br>IEC 61347-2-3<br>IEC 61547<br>EN 55015 | IEC 60068-1<br>IEC 60364<br>IEC 60364-7-714 | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60364-4<br>IEC 60479<br>EN 60901<br>IEC 61140<br>IEC 61195<br>IEC 61199<br>IEC 61347-1<br>IEC 61347-2-3<br>NF C15-100 | IEC 61249-2-21<br>IEC 60754 | IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 61547<br>EN 55015 |
| High frequency ballast lamps |                                                                                                                                                                           |                                             |                                                     |                |                                                                                                                           |                             |                                                                                                       |
|                              | IEC 60081<br>IEC 60664-1<br>IEC 60901<br>IEC 60929<br>IEC 61000-5<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61347-1<br>IEC 61347-2-3<br>IEC 61547<br>EN 55015<br>EN 50294  | IEC 60068-1<br>IEC 60364<br>IEC 60364-7-714 | IEC 60364<br>IEC 61000-5<br>IEC 61140<br>NF C15-100 | IEC 60068-3-3  | IEC 60364-4<br>IEC 60479<br>EN 60901<br>IEC 61140<br>IEC 61347-1<br>IEC 61347-2-3<br>NF C15-100                           | IEC 61249-2-21<br>IEC 60754 | IEC 60664-1<br>IEC 60754<br>IEC 61000-6-2<br>IEC 61000-6-4<br>IEC 61249-2-21<br>IEC 61547<br>EN 55015 |

**Disclaimer**

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

### **References**

This ITER Technical Report may contain references to internal technical documents. These are accessible to ITER staff and External Collaborators included in the corresponding ITER Document Management (IDM) lists. If you are not included in these lists and need to access a specific technical document referenced in this report, please contact us at [ITR.support@iter.org](mailto:ITR.support@iter.org) and your request will be considered, on a case by case basis, and in light of applicable ITER regulations.