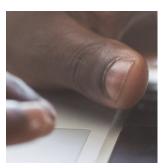
# International Nuclear I&C and Electrical System Standards Tables with URLs

Version 2, January 2024

Cooperation in Reactor Design Evaluation and Licensing Working Group











Title: International Nuclear I&C and Electrical System Standards Tables with URLs Version 2 Produced by: World Nuclear Association Published: January 2024 Report No. 2024/001

© 2024 World Nuclear Association. Registered in England and Wales, company number 01215741

This document reflects the views of industry experts but does not necessarily represent those of any of the World Nuclear Association's individual member organizations.

International Nuclear I&C and Electrical System Standards Tables with URLs brings together the nuclear power plant instrumentation and control (I&C) and electrical system standards used by the Institute of Electrical and Electronics Engineers (IEEE) and International Electrotechnical Commission (IEC) communities. Both sets of these standards are used in different parts of the world. This document is intended as a starting point for identifying similarities and conflicts between the two sets of standards with the goal informing I&C and electrical workers of the available standards and to identify potential areas where harmonization of standards might be achieved.

The IEEE standards tend to be used by the US Nuclear Regulatory Commission (NRC) and by other nuclear regulators that follow the NRC. The main NRC requirements are contained in Part 50 of the Code of Federal Regulations (CFR) Title 10, with additional recommendations given in Regulatory Guides and NUREG documents. Various standards bodies provide guidance, most notably the IEEE Nuclear Power Engineering Committee (NPEC) and the IEEE Energy Development and Power Generation Committee, as well as the IEEE Switchgear Committee, IEEE Protective Relay Committee, IEEE Transformer Committee, IEEE Low Voltage Surge Protection Device Committee, IEEE Energy Storage and Station Battery Committee, IEEE Electromagnetic Compatible Society, IEEE Industrial Automation and Control Committee, International Society of Automation, American Nuclear Society, Health Physics Society, and American Society of Mechanical Engineers.

IEC standards tend to be used by countries that follow the guidance of the International Atomic Energy Agency (IAEA). The most notable IAEA safety standard for I&C and electrical systems is IAEA SSR 2/1, Safety of Nuclear Power plants: Design. Five documents provide additional guidance to SSR 2/1: SSG-30, Safety Classification of Structures, Systems and Components in Nuclear Power Plants; SSG-34, Design of Electrical Power Systems for Nuclear Power Plants; SSG-39, Design of Instrumentation and Control Systems for Nuclear Power Plants; SSG-51, Human Factors Engineering in the Design of Nuclear Power Plants; and SSG-69, Equipment Qualification for Nuclear Installations.

IEC SC 45A (Instrumentation, control and electrical power systems of nuclear facilities) is the main subcommittee responsible for nuclear facility I&C standards. Other relevant IEC committees include SC 45B (Radiation protection instrumentation), TC 65 (Industrial process measurement, control and automation), and TC 77 (Electromagnetic compatibility).

In response to the increased need for harmonization, the IEC and IEEE enhanced their collaboration on the adoption, revision and joint development of market-relevant standards. An agreement between the two organizations was signed in October 2002, which allows for the adoption of IEEE standards by the IEC with no changes. This agreement was followed by the adoption of a joint development procedure in 2008 defining how the two organizations work to co-develop standards. IEE standards that have been adopted by the IEC and those jointly developed are referred to as 'dual logo' standards.

This document consists of tables that show the IEC and IAEA electrical and I&C nuclear standards alongside the corresponding US and NRC documents. The tables identify the safety classification of each standard; however, individual standards often support more than one safety classification. Note also that where a Regulatory Guide supports a standard, the safety classification is consistent with the Regulatory Guide and may not correspond with that of the standard.

The tables are highlighted as follows:

Black - standards developed by IEC 45A or IEEE NPEC.

Yellow - IEC 45A and/or IEEE NPEC standards that have also been accepted as CENELEC (European Committee for Electrotechnical Standardization) standards.

Light green - standards that were not developed by IEC TC 45A or IEEE NPEC.

Dark grey - standards under development.

It should be noted that some of the standards listed here are no longer current but they are retained as they are still being used by older plants or because the guidance given in these standards is still useful. It should also be noted that the NRC Regulatory Guides and NUREG documents often lag behind industrial standards. In addition, NRC Regulatory Guides conflict with many industrial standards. Therefore, US users should consult with the NRC before adopting a new standard to determine if there may be any inconsistency with the NRC's approach – the "additional information" column in the NRC's list of Regulatory Guides often identifies issues that the NRC is considering in the updates.

Clicking in any box in the tables will take the user to further information given by the responsible standards organization. In the case of the NRC, the user will be taken directly to the documents in question. No further analysis or conclusions are provided in this document.

International Nuclear I&C and Electrical System Standards Tables with URLs is produced by the CORDEL Digital Instrumentation & Control Task Force (DICTF) of World Nuclear Association. The document is regularly revised to incorporate evolutions and updates to the relevant I&C standards.

Errors and omissions should be sent to CORDEL@world-nuclear.org.

#### Acknowledgement

The CORDEL Working Group of World Nuclear Association would like to convey its gratitude to: Gary Johnson, Independent Expert and former Senior Safety Officer at the IAEA, for collecting and providing the information in these comparison tables; the IEEE and IEC for agreeing to use the respective information for this publication; Johannes Pickelmann, Chair of the DICTF and Mark Burzynski, member of the DICTF for their work in reviewing the publication; and World Nuclear Association colleague Richard Petrie for his assiduous work in designing this reference tool.

Area Tables		Page
Overarching	Overarching Documents	3
Safety Fundamentals	Safety Fundamentals	4
	Reliability, Hazards Analysis, and Operational Programs	5
	Human Factors Engineering	6
Qualification of Electrical and Electronic Equipment	Qualification of Electrical and Electronic Equipment	7
Seismic Qualification	Seismic Qualification	8
Lightning Protection	Lightning Protection	9
Human Factors Engineering - Control Rooms	Human Factors Engineering - Control Rooms	10
Electromagnetic Interference	Electromagnetic Interference	11
Electrical Systems	Electrical Systems	12
Electrical Supporting Systems	Electrical Supporting Systems	13
I&C Systems Outside of Containment	I&C Systems Outside of Containment	14
In-Containment Monitoring	In-Containment Monitoring	15
Security	Security	16
Accident Monitoring	Accident Monitoring	17
Electrical Equipment	Electrical Equipment	18
I&C Components	I&C Components	19
Sensors	Sensors	20
Development of Digital Components and Systems	Development of Digital Components and System	21
Digital Platforms	Digital Platforms	22
Radiation Monitoring - Systems and Effluents	Radiation Monitoring - Systems and Effluents	23
Equipment Installation	Equipment Installation	24
Instrument Performance and Setpoint Analysis	Instrument Performance and Setpoint Analysis	25
Aging Management and Modernization	Aging Management and Modernization	26
Archaic but Possibly Useful for non LWRs and SMRs	Archaic but Possibly Useful for non LWRs and SMRs	27

## Key to tables

#### Basic Safety Classification of I&C and Electrical Systems

IEEE and US Standards			Inte	ernational Standards
Non Safety		Systems Impo	rtant to Safety	Non Safety
		Safety S	Systems	
		Relationships be	tween standards	
	Dual logo standard	IEEE/IEC XXXXX or IEEE XXXX IEC		IEEE standard adopted by IEC
		IEEE or US	IEC Standard	Standards are approximately the same
		IEEE or US	IEC Standard	
		Standard		Scopes are different but overlap
	Reg Guide X.XX	IEEE or US Standard	IEC Standard	Reg. Guide, IEEE, and IEC standards are similar but IEC standard is not endorsed
	Reg Guide X.XX	IEEE or US Standard	IEC Standard	Reg. Guide endorses both US and IEC standard
		IEEE, Other US or IEC sta	ndard under development	

#### Notes

- 1. To allow for compact presentation of this material, the standard names given in this document are shortened by omitting the full name of the standards organization and safety classification.
- 2. The boxes generally include a URL in small text. These will take you to the standards organization website for the standard. For NRC documents the URL returns the actual document.
- 3. NRC Reg Guides that endorse IEEE and IEC standards are highlighted in blue.
- 4. Green text indicates standards that were not developed by IEC SC45A, IEEE NPEC.
- 5. This document gives an overview of where to find related standards. It is not designed to make a detailed comparison of each standard.
- 6. Errors and questions should be reported to CORDEL@world-nuclear.org Your comments will be taken into account in the following revision of the document.

# **Overarching Documents**

Non Safety	Systems Impor	tant to Safety	Non Safety
	Safety S	ystems	
USNRC 10 CFR 5  Domestic licensing of production ar		IAEA SSR 2/1 Rev. 2 Safety of nuclear power plants: Design	
		IAEA SSG 30 Safety classification of structures systems and components in nuclear p	ower plants
		IAEA SSG 34  Design of electric power systems for nuclear power plants	
		IAEA SSG 39 Design of instrumentation and control systems for nuclear power p	<u>blants</u>
		IAEA SSG 51  Human factors engineering in the design of nuclear power plan	<u>ts</u>
		IAEA SSG 69 Equipment qualification for nuclear installations	
		National regulations	
	IEEE 603-2018 Standard criteria for safety systems		
	IEEE 279-1971 Criteria for protection systems		
		IEC 61508:2020 Functional safety of electrical/electronic/programmable electronic safety-related systems Part 1, Part 2, Part 3, Part 4, Part 5, Part 6, Part 7.	
<ul><li>Notes</li><li>1. IEEE 603-1991, IEEE-297-1968 and IEEE-297 are incorporated into the requirements of 10 CFR 50. Each plant must comply with one of these depending upon the date of</li></ul>		IEC 61513:2011 Instrumentation and control systems important to safety - General requirements for systems	
the plant's construction permit. For plants having per the requirements analogous to the IEEE-603 add IEE	rmits issued before January 1, 1971	IEC 63046:2020 Electrical power system - General requirements	
licensing documents.  2. The scopes of IAEA SSG39 and IEC 61513 are quite different from IEEE 603 but together they address most, if not all, of the requirements given in IEEE 603.  3. Within IEC, IEC 61513 is considered to be a nuclear specific implementation of IEC 61508, the IEC industrial safety guides. IEC 61508 has seven parts.		IEC TR 63335:2021 Specific features of small modular reactors and needs regarding star	ndards
		IEC TR 63400:2021 Structure of the SC 45A standards series	

#### Safety Fundamentals

Non Safety Systems Important to Safety Non Safety

#### Safety Systems

	226 n of I&C and electrical systems	IEC 61226:2020 Categorization of function and classification of systems	
Reg Guide 1.201 Rev. 1 2006  Guidelines for categorizing systems, structures, and components according to safety significance	IEEE 1819-2016 Risk-informed categorization of electrical and electronic equipment	IEC TR 61838:2009 Use of probabilistic safety assessment for the classification of functions	
Reg Guide 1.75 2005  Criteria for independence of electrical safety systems	IEEE 384-2018 Independence of 1E equipment and circuits	IEC 60709:2018 Separation	
Reg Guide 1.53 2003 Application of the single failure criterion	IEEE 379-2014  Application of the single failure  criterion		
Reg Guide 1.22 1972 Periodic testing of protections system actuations and functions	IEEE 338-2022	IEC 60671:2007	
Reg Guide 1.118 1995 Periodic testing of electrical power and protection system	Criteria for periodic surveillance testing	Surveillance testing	
		IEC 62340:2007  Requirements for coping with common cause failure	
IEC/IEEE 63160			

IEC/IEEE 63160

Common cause failure, system failure, systems analysis and diversity

Reg Guide 1.81 1975 Shared emergency and shutdown electric systems for multi unit plants

Notes RG 1.81 is concerned with system interactions. Sharing of onsite power systems at multi-unit power plant sites generally results in a reduction in the number and capacity of the onsite power sources to levels below those required for the same number of units located at separate sites. The reduced capacity could cause undesirable interactions. Examples of such interactions are (1) the interconnection of engineered safety feature (ESF) control circuits of each unit such that failures and maintenance or testing operations in one unit affect the availability of ESF in other units, (2) coordination required between unit operators in order to cope with an accident in one unit and safe shutdown of the remaining unit(s), and (3) system overload conditions as a consequence of real accident in a unit coincident with a false or spurious accident signal in another unit.

# Reliability, Hazards Analysis, and Operational Programs

Non Safety	Systems Important to Safety		
	Safety	y Systems	
IEEE 352-2016			EC TR 62987:2015 and effects analysis and related methods
Principles of reliability an	alysis	Failure n	IEC 60812:2018 nodes and effects analysis

IEEE 577-2022

Reliability analysis in the design and operation of safety systems

IEEE 805-1984 Recommended practice for system identification in nuclear power plants and related facilities	IEC TR 63192:2019  Hazard analysis: A review of new current approaches
Reg Guide 1.23 2007  Meteorological monitoring programs for nuclear power plants	IEC TR 63468:2023  Instrumentation and control, and electrical power systems – Artificial Intelligence applications

ISA-67.14.01-2000

Qualifications and certifications of instrument and control technicians in nuclear facilities

#### Notes

IEC 60812 Was developed by IEC TC 56 but the TC45A standard 61226 includes it a normative reference.

# **Human Factors Engineering**

Non Safety	Systems Important to Safety			
	Safety S	Systems		
	NUREG-0711 Rev 3 Human factors engineering program review model			
	IEEE 1786-2022  Human factors applications of computerized operating procedure systems		446:2016 outer based procedures	
	IEEE 845-1988  Evaluation of human-system performance			_
	IEC 63260:2020 Guide for incorporating human factors and human reli		sk assessments	
	IEEE 1707-2015 Investigation of events			
<u>V</u>	IEEE 2411-2021 alidation of system designs and integrated system operations			
Designing	IEEE 1289-1998 and developing computer-based displays for monitoring and control of nuclear facilities			
		Human factors engineering - App	IEC 63351 Dication to the design of human machi	ne Interfaces

# Qualification of Electrical and Electronic Equipment

Non Safety		Systems Impo	rtant to Safety	Non Safety
		Safety S	Systems	
Reg Guide 1.89 2023  Environmental qualification of electrical equipment  Reg Guide 1.209 2007  Qualification of safety related-computer based I&C	IEC/IEEE 60780-323:2016  Electrical equipment important to safety-qualification  IEC Webstore			
Reg Guide 1.211 2009 Qualification of safety related cables and field splices		83-2015 ical cables and splices		
	Reg Guide 1.156 2023  Qualification of connection  assemblies	IEEE 572-2019 Qualification of 1E connection assemblies		
Reg Guide 1.40 2010 Qualification of continuous duty safety related motors		34-2006 ous duty 1E motors		
Reg Guide 1.73 2013  Qualification tests for safety related  actuators		82-2019 ety related actuators		
		27-2019 of equipment		
		IEEE C37.82-2017  Qualification of switchgear  assemblies		
		IEEE C37.105-2010 Qualification protective relays and auxiliaries		
		IEEE 638-2013 Qualification of transformers		
Reg Guide 1.213 2009 Qualification of safety-motor control centers		49-2006 or control centers		
Reg Guide 1.210 2008 Qualification of battery chargers and inverters	Qualification of static batter	50-2017 ries, chargers, inverters, and power supplies		
Reg Guide 1.158 2018 Qualification of vented lead acid storage batteries		35-2022 acid storage batteries		
		IEEE 420-2013  Design and qualification of control boards panels, and racks		
		IEEE 1682-2023 Qualification of fiber optic cables, and optical fiber splices for use in safety systems		

## Seismic Qualification

Non Safety		Systems Impo	rtant to Safety		Non Safety
		Safety S	Systems		
	Reg Guide 1.100 2020 Seismic qualification of electrical and, active mechanical equipment and functional qualification of active mechanical equipment	ASME Q-1-2023 Qualification of active mechanical equipment  IEEE C37.81-2017 Seismic qualification of class 1E metal-enclosed power switchgear assemblies	IEC/IEEE 60980-344:2020 nent important to safety - Seismic qualific  IEC Webstore	eation	
<u>S</u>	IEEE C37.98-2023 eismic qualification testing of protectiv				
	IEEE C57.114-199 Seismic guide for power transfer				

## **Lightning Protection**

Non Safety	Systems Important to Safety				
	Safety S	Systems			
	IEEE 665-1995 Generating station grounding				
Reg Guide 1.204 2005 Lightning Protection	IEEE 1050-2004 Instrument and control equipment grounding				
	IEEE 666-2007  Design guide for electric power service systems				
	IEEE C62.23-2017 Surge Protection				

**Notes** Lightning protection requirements apply to all systems - including non-safety systems.

Reg Guide 1.204 endorses IEEE 665-1991, IEEE 1051-1996, IEEE 666-1991, and IEEE C62.23-2001.

IEEE 663 and IEEE 1050 are endorsed by both Reg Guide 1.180 and Reg Guide 1.204 hence they are shown twice in this document.

# **Human Factors Engineering - Control Rooms**

Non Safety	Systems Important to Safety				
	Safety Systems				
	IEEE 1023-2020  Recommended practice for the application of human factors engineering to systems, equipment, and facilities	IEC TR 63 Control rooms-Huma	3214:2019 In factors engineering		
		IEC 618 Design of control rooms - Fund			
	IEEE 567-1980 <u>Trial-use guide criteria for the design of the control room complex</u>	IEC 609 Control room	<mark>64:2018</mark> ms - Design		
NUREG-0700 R3 2020		IEC 617 Main control room - Verificat	71:1995 tion and Validation of design		
Human system interface design review	IEEE 1289-1998 Guide to the application of human factors engineering in the design of computer-based monitoring and control displays	IEC 617 Control rooms - Application of	72:2009 of visual display units (VDUs)		
guidelines		IEC 612 Control rooms - 0			
		IEC 622 Main control room - Alarm	41:2004 functions and presentation		
			IEC 60965:2016 Supplementary control room for reactor shutdown without access to the main control room		

IEC 63435

Operational management data processing and operator supporting system

## Electromagnetic Interference

Non Safety	Systems Important to Safety						
	Safety Systems						
	IEEE P2425 Electromagnetic compatibility testing of electrical, instrumentation, and control		003:2020 tromagnetic compatibility				
		EC 61000 Series magnetic compatibility					
Reg Guide 1.180 2019	MIL-STD-461G 2015  Requirements for the Control of Electromagnetic Interference  Characteristics of Subsystems  and Equipment						
Evaluating electromagnetic and radio	IEEE C62.41-1991 Surge voltages in Low-voltage AC power circuits						
frequency Interference in safety instrumentation	IEEE C62.45-2002 Surge testing for equipment connected to low voltage AC power circuits						
and control systems	IEEE 473-1985 Electromagnetic site survey						
	IEEE 518-1982 Installation of electrical equipment to minimize noise inputs to controllers from external sources						
	IEEE 1050-2004  Instrument and control equipment grounding						
	IEEE 665-1995 Generating station grounding						

Notes Reg Guide 1.180 endorses MIL-STD-461E, and IEEE 1050-1996

Although the Reg Guide deals only with safety systems, all plant EMI sources must be dealt with to protect against safety system failure. IEC 61000 series has 113 parts. Reg. Guide 1.180 and IEEE 62003 identify the specific parts to be considered. IEEE 665 and IEEE 1050 are endorsed by both Reg Guide 1.180 and Reg Guide 1.204 hence they are shown twice in this document.

# **Electrical Systems**

Non Safety		Systems Impo	ortant to Safety		Non Safety
		Safety	Systems		
	Reg Guide 1.93 20 <sup>-</sup> Availability of electrical power		Coordination and	IEC 63298 d interaction with the electrical grid	
	Reg Guide 1.32 2004 Criteria for power systems	IEEE 308-2020 Class 1E power sources			
			Electric	IEC 62855:2016 al power systems analysis	
			Static uninterruptib	IEC 61225:2019 le DC and AC power supply systems	
			AC interru	IEC 63272 ptible power supply systems	
	IEEE 76 <u>Preferred</u> po				
	IEEE 179 Preferred power	92-2017 supply reliability			
	Reg Guide <u>Station b</u>				

## **Electrical Supporting Systems**

Non Safety

Safety Systems

IEEE 628-2020
Design, Installation, and qualification of raceway systems

IEEE 690-2018
Design and installation of cable systems

IEC 63423
Cable assemblies for harsh environment

IEEE 833-2005
Protection of electric and equipment from water

IEEE 741-2022
Protection of power systems and equipment

# I&C Systems Outside of Containment

Non Safety		Systems Impo	ortant to Safety		Non Safety
		Safety S	Systems		
				497:1988 al Interlocks	
Reg Guide 1.12 2017 Instruments for earthquakes	ANSI/ANS-2.2-2016 Earthquake instrumentation				
				s186:2021 smic trip systems	
		Reg Guide 1.62 2010  Manual instrumentation of protective function			
		Reg Guide 1.47 2010 Bypass of inoperable status indication			
	NUREG-0835 1981 Human factors acceptance criteria for safety parameter display system				
				IEC 60960:1988  Functional design criteria for safety parameter display system	
	ANS 3.7.2-1979 Emergency control centers			IEC 62954:2019 Requirements for emergency responses facilities	

**In-Containment Monitoring** Non Safety Non Safety Systems Important to Safety Safety Systems Reg Guide 1.133 1981 IEC 60988:2009 Loose-part detection program for Acoustic monitoring system for the primary system of LWRs detection of loose parts IEC 61502:1999 PWR - Vibration monitoring of internal structures IEC 60910:2022 Containment monitoring instrumentation for early detection of developing deviations from normal operation in LWRs IEC 60911:1987 Measurements for monitoring adequate cooling within the PWR Core of PWR IEC 61343:1996 Measurements for monitoring adequate cooling within BWR cores Reg Guide 1.45 2008

Reg Guide 1.45 2008
Guidance on monitoring and responding to reactor coolant system leakage

ANSI/ISA 67.03:1982

LWR coolant pressure boundary

and leak detection

IEC 61250:1994

Detection of leakage in coolant
systems

IEC 62117:1999

PWR-Monitoring adequate cooling within the core during shutdown

# Security

Non Safety	Systems Important to Safety			Non Safety	
		Safety S	Systems		
Reg Guide 5.71 2023		23	<u>C</u> ybe	IEC 62645:2019 ersecurity requirements	
	Cyber security programs for nuclear power reactors		IEC 62859:2016+AMD1:2-19 CSV Requirements for coordinating safety and security		
Reg Guide 5.74 2015  Managing the safety/security interface		IEC 63096:2020 Security Controls			

IEC TR 63415

Use of formal security models for I&C security architecture design and assessment

IEEE 692-2013 Criteria for security systems

# **Accident Monitoring**

Non Safety		Systems Impo	ortant to Safety		Non Safety
		Safety S	Systems		
	Reg Guide 1.97 2019 <u>Criteria for accident monitoring</u> <u>instrumentation</u>	<u>Crite</u>	IEC 497-2016, IEC/IEEE 63147:20 eria for accident monitoring instrume IEC Webstore		
			Guidance for the application of	TR 63123 IEC 63147:2017/IEEE 497-2016 in the IAEA/IEC framework	
Reg Guide 1.227 2019 Wide-range spent fuel pool level instrumentation	IEC/IEEE 63113:2021  Nuclear facilitiesInstrumentation important to safetySpent fuel pool instrumentation	Note: IEC/IEEE 63113 does It deals only with syste	not deal with safety systems. ems important to safety	IEC/IEEE 63113:2021  Nuclear facilitiesInstrumentation important to safetySpent fuel pool instrumentation	
				IEC 60951-1:2022 g for accident and post-accident conditiont 1: General requirements	<u>ns</u>
			Part 2: Equipment for continuou	IEC 60951-2:2009 s off line monitoring of radioactivity in gas and ventilation air	seous effluents
				IEC 60951-3:2022 ng for accident and post-accident condition continuous high range area gamma monito	
				IEC 60951-4:2009 g for accident and post-accident conditionuous in-line or on-line monitoring of radio process streams	
Performance s	N320-1979 specifications for reactor emergency				

radiological monitoring instrumentation

# **Electrical Equipment**

Non Safety	Systems Important to Safety No				Non Safet
		Safety S	Systems		
	Reg Guide 1.63 1987 Electrical penetration assemblies in containment structures	IEEE 317-2013 Electrical penetration assemblies in containment structures	IEC 60772:2018 Electrical penetration assemblies in containment structures		
Reg Guide 1.9 2007 Application and testing diesel generators		37-2017 applied as standby power supplies	IEC-IEEE ( Diesel generator units applie	63332-387 ed as standby power sources	
	.=== - :	20-2019 applied as standby power supplies			
Reg Guide 1.128 2007 Design and installation of vented lead-acid storage batteries		34-2019 vented lead-acid Batteries			
Reg Guide 1.212 2023 Sizing of lead- acid batteries		35-2020 acid batteries			
Reg Guide 1.129 2023 Maintenance, testing and replacement of vented lead-acid batteries		50-2020 ement of vented lead-acid batteries			
Installation, n	IEEE 1106-2015 naintenance, testing and replacement of				
Moto	IEEE 1290-2015  Motor operated valve motor application, protection, control and testing				
Therm	Reg Guide 1.106 2012  Thermal overload protection for electric motors on-motor operated valves				

Notes IEEE 387-2017 is under revision with the intent of producing an IEEE/IEC dual logo standard.

## **I&C Components**

Non Safety
Systems Important to Safety
Safety Systems
Non Safety

IEC 62988:2018

Use and selection of wireless devices

IEC 60744:2018
Safety logic assemblies used in systems performing category A functions

IEC 62808:2015 + Amendment 1 2018

Design and qualification of
isolation devices

IEC 63374
Characteristics and test methods of nuclear reactivity meters

#### Sensors

Non Safety	Systems Important to Safety	Non Safety
	Safety Systems	

#### IEC 60515:2007

Radiation detectors - Characteristics and test methods

IEC 60568:2006

In-core instrumentation for neutron fluence rate (flux) measurements

IEC 61468:2021

In-core instrumentation - characteristics and test methods of self powered neutron detectors

IEC 61501:1998

Wide range neutron fluence rate meter - mean square voltage method

IEC 60737:2010

Temperature sensors (in-core and primary coolant circuit) - characteristics and test methods

IEC 62397:2022

Resistance temperature detectors

IEC 62651:2013

Thermocouples: characteristics and test methods

IEC 62887:2018

Pressure transmitters: characteristics and test methods

# **Development of Digital Components and Systems**

Non Safety		Systems Impo	rtant to Safety		Non Safety
		Safety S	Systems		
			IEC 609 Instrumentation and control importa		
	Reg Guide 1.152 2023 Use of computers in safety systems	IEEE 7-4.3.2-2016  Criteria for programmable digital devices in safety systems	Data communications in systems performing category A functions		
	Reg Guide 1.168 2013 Verification, validation, reviews and	IEEE 1012-2016 System and software verification and validation			
	audits for digital computer software used in safety systems	IEEE 1028-2008 Standard for software reviews and audits			
	Reg Guide 1.169 2013 Configuration management plans for software used in safety systems	IEEE 828-2012 Configuration management systems and software engineering	IEC 60880:2006 Software aspects for computer based category A functions	IEC 62138:2018 Software aspects for computer based systems performing category B or C functions	
	Reg Guide 1.170 2013 Test documentation for software used in safety systems	IEEE 829-2008 Software and system test documentation			
	Reg Guide 1.172 2013 Requirements specifications for software and complex electronics used in safety systems	IEEE 830-1998 Software requirement specifications			
	Reg Guide 1.173 2013  Developing software lifecycle processes for software used in safety systems	IEEE 1074-2006  Developing a software product  lifecycle process			
	Reg Guide 1.250 2022  Dedication of commercial-grade digital I&C items for use in nuclear power plants	NEI 17-06 Revision 1 Guidance on Using IEC 61508 SIL Certification to Support the Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Related Applications			

## **Digital Platforms**

Non Safety Systems Important to Safety Non Safety Safety Systems Development of HDL progress Development of HDL progress integrated circuits for systems integrated circuits for systems performing category B or C functions performing category A functions IEC TR 63084:2017 Platform qualification for systems important to safety IEC 63413 Platform qualification IEC 62671:2013 Selection and use of industrial digital devices of limited functionality

#### Radiation Monitoring - Systems and Effluents

**Non Safety** Non Safety Systems Important to Safety Safety Systems IEC 62705:2022 Radiation monitoring systems IEC 61504:2017 Centralized systems for continuous monitoring of radiation IEC 60761-1:2002 Equipment for continuous monitoring of radioactivity in gaseous effluents IEC 60761-2:2002 Requirements for radioactive aerosol monitors including transuranic aerosols IEC 60761-3:2002 Requirements for radioactive noble gas monitors IEC 60761-4:2002 IEEE/ANS N42.18-1980 Requirements for radioactive iodine monitors Specification and performance of on-site instrumentation for continuously monitoring IEC 60761-5:2002 radioactive effluents Requirements for tritium monitors **IEC** Webstore IEC 60861:2006 Equipment for monitoring radionuclides in liquid effluents and surface waters IEC 60532:2010 Installed dose rate meters, warning assemblies and monitors - and gamma radiation of energy between 50 KeV and 7 MeV IEC 60768:2009 Equipment for continuous in-line or on-line monitoring of radioactivity in process streams for normal and incident conditions Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for normal operation and anticipated occurrences

ANSI/ANS/HPSSC-6.8.1-1981
Location and design criteria for area radiation
monitoring systems for light water nuclear reactors

Notes Radiation monitoring standards for accident and post accident conditions are listed on the accident monitoring sheet.

## **Equipment Installation**

Non Safety		Systems Impor	rtant to Safety		Non Safety
		Safety S	ystems		
	The state of the s	7.01.01-2019 nsmitter installation			
	D. v. Ovida 4 454 0000	ANSI/ISA-67.02.01-2021 Sensing line and piping and tubing		2235 2005 d final repository of nuclear fuel	
	Reg Guide 1.151 2020 Instrument sensing lines	IEEE 622-1987  Design and installation of electric  heat tracing systems			
		Reg Guide 1.11 2010 Instrument lines penetrating the primary reactor containment			
	Reg Guide 1.30 1972  Quality assurance requirements for the installation, inspection and testing of 1E power instrumentation and control equipment	IEEE 336-2020 Installation, inspection and testing of 1E power instrumentation and control equipment			
		Reg Guide 1.68 2013 Initial test programs for water cooled nuclear power plants			
		Reg Guide 1.68.1 2012 Initial test program of condensate and feed systems for light water reactors			
		Reg Guide 1.68-2 2020 Initial startup test program to demonstrate remote shutdown capability			

Reg Guide 1.41 1973 Pre operational testing of redundant onsite electric power systems

Notes Reg Guide 1.151 endorses ISA-67.02.02 1999
Reg Guide 1.30 endorses ANSI/IEEE N45.2.4-1972 which has been succeeded by IEEE 336-19

# Instrument Performance and Setpoint Analysis

Non Safety		Systems Impo	ortant to Safety	Non Safety
		Safety :	Systems	
		ISA S67.06.01-2023 Performance monitoring for instrument channels	IEC 62385:2007  Methods for assessing the performance of instrument channels	
	Reg Guide 1.105 2021 Setpoints	ANSI/ISA-67.04.01-2018 <u>Setpoints</u>	IEC 61888:2002  Determination and maintenance of trip setpoints	
		ISA-RP67.04.02-2010  Methodologies for the determination of setpoints		
		57.04.08 1996 sequenced actions		
		67.04.09 2005 to setpoint determination		
		498-1990 measuring and test equipment		

# Aging Management and Modernization

Non Safety	Systems Important to Safety				
	Safety Systems				
		IEC TR 62096:2009  Guidance for the decision on modernization			
IEEE 1205 Assessing monitoring, and mitigating a		IEC 62342:2007 Management of ageing			
		IEC 62765-1:2015  Management of ageing: Pressure transmitters			
		IEC 62675-2:2019  Management of ageing: Temperature sensors			
		IEC 62465:2010  Management of electrical cabling			
	IEC/IEEE 626 Electrical condition monitoring - Electrical				
	IEC/IEEE 629 Electrical equipment condition more				
	IEC/IEEE 62582-3:2012 Electrical equipment condition monitoring - Part 3: Elongation at break				
	IEC/IEEE 62582-4:2011 Electrical equipment condition monitoring - Part 4: Oxidation induction techniques				
	IEC/IEEE 62582-5:2015 Electrical equipment condition monitoring - Part 5: Optical time domain reflectometry				
	IEC/IEEE 62582-6:2019  Electrical equipment condition monitoring methods - Part 6: Insulation resistance				

**Notes** The IEC 62582 series may apply to any components that involve electrical insulation.

## Archaic but Possibly Useful for Non-Light Water Reactors or Small Modular Reactors

Non Safety	Systems Important to Safety	Non Safety
	Safety Systems	
	General principl	IEC 60231:1967 es of nuclear reactor instrumentation IEC 60231A:1969
	General principl	es of nuclear reactor instrumentation
	Principles of instrumentati	IEC 60231B:1972 on of direct cycle boiling water power reactors
	Instrumentation of c	IEC 60231C:1974 gas-cooled graphite-moderated reactors
	Principles of instrur	IEC 60231D:1975 mentation for pressurized water reactors
	IEC 60231E:1977  Principles of instrumentation of high temperature indirect cycle gas power reactors (HTGR)	
		IEC 60231F:1977 am generating, direct cycle, direct cycle, heavy-water moderated reactors
		IEC 60231G:1977

Liquid metal fast cooled reactors

World Nuclear Association
Tower House
10 Southampton Street
London WC2E 7HA
United Kingdom

+44 (0)20 7451 1520 www.world-nuclear.org info@world-nuclear.org

This document brings together the nuclear power plant instrumentation & control and electrical system standards used by the Institute of Electrical and Electronics Engineers (IEEE) and International Electrotechnical Commission (IEC) communities. Both sets of standards are used in different parts of the world. This document is intended as a starting point for identifying similarities and conflicts between the two sets of standards to facilitate harmonization.

This document consists of tables that show the IEC and IAEA electrical and I&C nuclear standards alongside the corresponding IEEE and NRC documents. The tables also show documents that have no equivalent.

The tables provide a basic view of the correspondence between related standards without offering further analysis or conclusions. Clicking in any box in the tables will take the user to further information given by the responsible standard organization. In the case of NRC, the user will be taken directly to the documents in question. This document will be regularly revised following future evolutions and updates of the relevant I&C standards.

The Cooperation in Reactor Design Evaluation and Licensing (CORDEL) Working Group promotes the development of a worldwide regulatory environment where internationally-accepted standardized reactor designs, certified and approved by a recognised competent authority in the country of origin, can be widely deployed without major design changes due to national regulations.

