

**Nuclear power plants - Instrumentation and control
important to safety - General requirement for systems
(IEC 61513:2011)**

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 61513:2013 sisaldab Euroopa standardi EN 61513:2013 ingliskeelset teksti.	This Estonian standard EVS-EN 61513:2013 consists of the English text of the European standard EN 61513:2013.
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**Nuclear power plants -
Instrumentation and control important to safety -
General requirements for systems
(IEC 61513:2011)**

Centrales nucléaires de puissance -
Instrumentation et contrôle-commande
importants pour la sûreté -
Exigences générales pour les systèmes
(CEI 61513:2011)

Kernkraftwerke -
Leittechnik für Systeme mit
sicherheitstechnischer Bedeutung -
Allgemeine Systemanforderungen
(IEC 61513:2011)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

This document (EN 61513:2013) consists of the text of IEC 61513:2011 prepared by SC 45A "Instrumentation and control of nuclear facilities" of IEC/TC 45 "Nuclear instrumentation".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2014-01-14
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-01-14

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As stated in the nuclear safety directive 2009/71/EURATOM, Chapter 1, Article 2, item 2, Member States are not prevented from taking more stringent safety measures in the subject-matter covered by the Directive, in compliance with Community law. In a similar manner, this European Standard does not prevent Member States from taking more stringent nuclear safety measures in the subject-matter covered by this standard.

Endorsement notice

The text of the International Standard IEC 61513:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61508-1:2010	NOTE Harmonized as EN 61508-1:2010 (not modified).
IEC 61508-3:2010	NOTE Harmonized as EN 61508-3:2010 (not modified).
IEC 61069-1:1991	NOTE Harmonized as EN 61069-1:1993 (not modified).
IEC 62381	NOTE Harmonized as EN 62381.
IEC 61000-6-2	NOTE Harmonized as EN 61000-6-2.
IEC 61000-6-4	NOTE Harmonized as EN 61000-6-4.
ISO 9000:2005	NOTE Harmonized as EN ISO 9000:2005 (not modified).
ISO 8402:1994	NOTE Harmonized as EN ISO 8402:1995 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60671	-	Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing	EN 60671	-
IEC 60709	-	Nuclear power plants - Instrumentation and control systems important to safety - Separation	EN 60709	-
IEC 60780	-	Nuclear power plants - Electrical equipment of the safety system - Qualification	EN 60780	-
IEC 60880	2006	Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category A functions	EN 60880	2009
IEC 60964	2009	Nuclear power plants - Control rooms - Design	EN 60964	2010
IEC 60965	-	Nuclear power plants - Control rooms - Supplementary control points for reactor shutdown without access to the main control room	EN 60965	-
IEC 60980	-	Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations	-	-
IEC 60987 (mod)	2007	Nuclear power plants - Instrumentation and control important to safety - Hardware design requirements for computer-based systems	EN 60987	2009
IEC 61000-4-1	-	Electromagnetic compatibility (EMC) - Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	EN 61000-4-1	-
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	-
IEC 61000-4-3	-	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	-
IEC 61000-4-4	-	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-
IEC 61000-4-6	-	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	-
IEC 61226	2009	Nuclear power plants - Instrumentation and control important to safety - Classification of instrumentation and control functions	EN 61226	2010
IEC 61500	-	Nuclear power plants - Instrumentation and control important to safety - Data communication in systems performing category A functions	EN 61500	-
IEC 61508-2	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems	EN 61508-2	2010
IEC 61508-4	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations	EN 61508-4	2010
IEC 62138	2004	Nuclear power plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions	EN 62138	2009
IEC 62340	-	Nuclear power plants - Instrumentation and control systems important to safety - Requirements for coping with common cause failure (CCF)	EN 62340	-
ISO 9001	2008	Quality management systems - Requirements	EN ISO 9001	2008
IAEA INSAG-10	1996	Defence in depth in nuclear safety	-	-
IAEA NS-R-1	2000	Safety of nuclear power plants: Design	-	-
IAEA GS-R-3	2006	The management system for facilities and activities - Safety requirements	-	-
IAEA GS-G-3.1	2006	Application for the management system for facilities and activities - Safety Guide	-	-
IAEA NS-G-1.3	2002	Instrumentation and control systems important to safety in nuclear power plants	-	-
IAEA 75-INSAG-3 Rev.1 - INSAG 12	1999	Basic safety principles for nuclear power plants	-	-

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INTRODUCTION

a) Technical background, main issues and organisation of the standard

This International Standard sets out requirements applicable to instrumentation and control systems and equipment (I&C systems) that are used to perform functions important to safety in nuclear power plants (NPPs).

This standard highlights the relations between

- the safety objectives of the NPP and the requirements for the overall architecture of the I&C systems important to safety;
- the overall architecture of the I&C systems and the requirements of the individual systems important to safety.

It is intended that the standard be used by designers, operators of NPPs (utilities), systems evaluators and by licensors.

b) Situation of the current standard in the structure of the IEC SC 45A standard series

IEC 61513 is the first level IEC SC 45A document tackling the issue of general requirements for systems. It is the entry point of the IEC SC 45A standard series.

For more details on the structure of the IEC SC 45A standard series, see item d) of this introduction.

c) Recommendations and limitations regarding the application of this standard

It is important to note that this standard establishes no additional functional requirements for safety systems.

To ensure that the standard will continue to be relevant in future years, the emphasis has been placed on issues of principle, rather than specific technologies.

d) Description of the structure of the IEC SC 45A standard series and relationships with other IEC documents and other bodies documents (IAEA, ISO)

The top-level document of the IEC SC 45A standard series is IEC 61513. It provides general requirements for I&C systems and equipment that are used to perform functions important to safety in NPPs. IEC 61513 structures the IEC SC 45A standard series.

IEC 61513 refers directly to other IEC SC 45A standards for general topics related to categorisation of functions and classification of systems, qualification, separation of systems, defence against common cause failure, software aspects of computer-based systems, hardware aspects of computer-based systems, and control room design. The standards referenced directly at this second level should be considered together with IEC 61513 as a consistent document set.

At a third level, IEC SC 45A standards not directly referenced by IEC 61513 are standards related to specific equipment, technical methods, or specific activities. Usually these documents, which make reference to second-level documents for general topics, can be used on their own.

A fourth level extending the IEC SC 45A standard series, corresponds to technical reports which are not normative.

IEC 61513 has adopted a presentation format similar to the basic safety publication IEC 61508, with an overall safety life-cycle framework and a system life-cycle framework. Regarding nuclear safety, it provides the interpretation of the general requirements of IEC 61508-1 [1]¹, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework, IEC 60880 and IEC 62138 correspond to IEC 61508-3 [2] for the nuclear application sector.

IEC 61513 refers to ISO as well as to IAEA GS-R-3 and IAEA GS-G-3.1 for topics related to quality assurance (QA).

The IEC SC 45A standards series consistently implements and details the principles and basic safety aspects provided in the IAEA code on the safety of NPPs and in the IAEA safety series, in particular the requirements document NS-R-1, establishing safety requirements related to the design of nuclear power plants, and the safety guide NS-G-1.3 dealing with instrumentation and control systems important to safety in nuclear power plants. The terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

NOTE It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, protection from chemical hazards and process energy hazards), international or national standards would be applied, that are based on the requirements of such a standard as the IEC 61508 series.

¹ References in square brackets refer to the bibliography.

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – GENERAL REQUIREMENTS FOR SYSTEMS

1 Scope

1.1 General

I&C systems important to safety may be implemented using conventional hard-wired equipment, computer-based (CB) equipment or by using a combination of both types of equipment (see Note 1). This International Standard provides requirements and recommendations (see Note 2) for the overall I&C architecture which may contain either or both technologies.

This standard highlights also the need for complete and precise requirements, derived from the plant safety goals, as a pre-requisite for generating the comprehensive requirements for the overall I&C architecture, and hence for the individual I&C systems important to safety.

This standard introduces the concept of a safety life cycle for the overall I&C architecture, and a safety life cycle for the individual systems. By this, it highlights the relations between the safety objectives of the NPP and the requirements for the overall architecture of the I&C systems important to safety, and the relations between the overall I&C architecture and the requirements of the individual systems important to safety.

The life cycles illustrated in, and followed by, this standard are not the only ones possible; other life cycles may be followed, provided that the objectives stated in this standard are satisfied.

NOTE 1 I&C systems may also use electronic modules based on complex electronic components such as ASICs or FPGA. Depending on the scope and functionality of these components, they may be treated according to the guidance for conventional electronic equipment, or similar to CB equipment. A significant part of the guidance for CB equipment is also applicable to the design of equipment with complex electronic components, including e.g. the concepts of re-using pre-existing designs, and the evaluation of design errors in software or complex hardware designs.

NOTE 2 In the following, “requirement” is used as a comprehensive term for both requirements and recommendations. The distinction appears at the level of the specific provisions where requirements are expressed by “shall” and recommendations by “should”.

1.2 Application: new and pre-existing plants

This standard applies to the I&C of new nuclear power plants as well as to I&C up-grading or back-fitting of existing plants.

For existing plants, only a subset of requirements is applicable and this subset should be identified at the beginning of any project.

1.3 Framework

The standard comprises four normative clauses (an overview is provided in Figure 1):

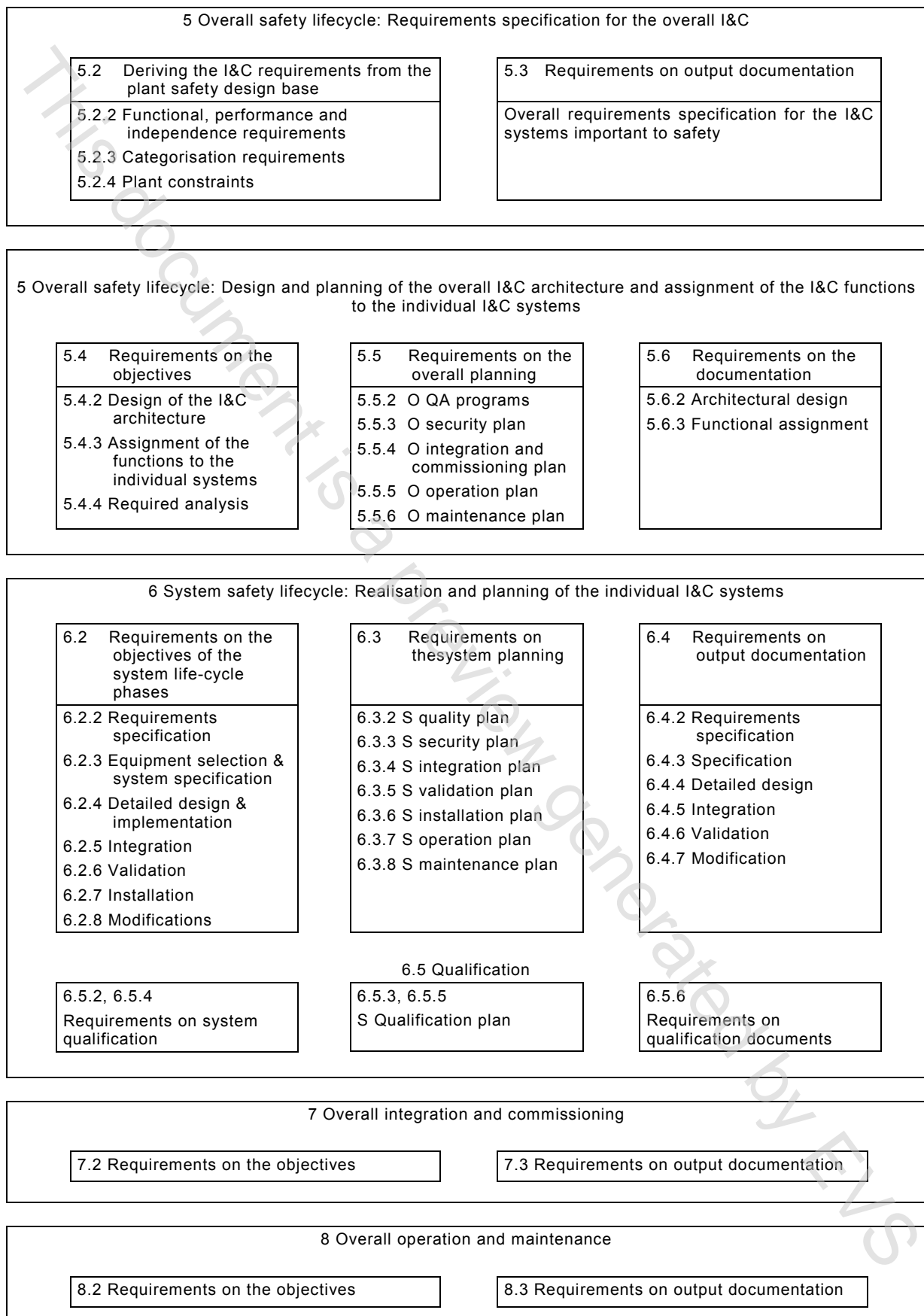
- Clause 5 addresses the overall architecture of the I&C systems important to safety:
 - defining requirements for the I&C functions, and associated systems and equipment derived from the safety analysis of the NPP, the categorisation of I&C functions, and the plant lay-out and operational context;
 - structuring the overall I&C architecture, dividing it into a number of systems and assigning the I&C functions to systems. Design criteria are identified, including those to give defence in depth and to minimize the potential for common cause failure (CCF);

- planning the overall architecture of the I&C systems.
- Clause 6 addresses the requirements for the individual I&C systems important to safety, particularly the requirements for computer-based systems. This includes differentiation of requirements according to the safety category of the I&C functions which are implemented;
- Clauses 7 and 8 address the overall integration, commissioning, operation and maintenance of the I&C systems.

NOTE Figure 1 outlines the structure of the standard. It does not necessarily present the timely order of activities which may be in reality partially executed in parallel, or include iterations.

Additionally, the standard provides informative annexes:

- Annex A highlights the relations between IAEA and basic safety concepts that are used throughout this standard;
- Annex B provides information on the categorisation/classification principles;
- Annex C gives examples of I&C sensitivity to CCF;
- Annex D provides guidance to support comparison of this standard with parts 1, 2 and 4 of IEC 61508. This annex surveys the main requirements of IEC 61508 to verify that the issues relevant to safety are adequately addressed, considers the use of common terms and explains the reason for adopting different or complementary techniques or terms;
- Annex E indicates modifications to be made in future revisions of daughter standards of IEC 61513 to make them consistent and to minimize overlapping contents.



Key QA: Quality Assurance; O: Overall; S: System

IEC 1895/11

Figure 1 – Overall framework of this standard

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60671, *Nuclear power plants – Instrumentation and control systems important to safety – Surveillance testing*

IEC 60709, *Nuclear power plants – Instrumentation and control systems important to safety – Separation*

IEC 60780, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

IEC 60880:2006, *Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions*

IEC 60964:2009, *Nuclear power plants – Control rooms – Design*

IEC 60965, *Nuclear power plants – Control rooms – Supplementary control points for reactor shutdown without access to the main control room*

IEC 60980, *Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations*

IEC 60987:2007, *Nuclear power plants – Instrumentation and control important to safety – Hardware design requirements for computer-based systems*

IEC 61000-4-1, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61226:2009, *Nuclear power plants – Instrumentation and control systems important to safety – Classification of instrumentation and control functions*

IEC 61500, *Nuclear power plants – Instrumentation and control important to safety – Data communication in systems performing category A functions*

IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61508-4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations*

IEC 62138:2004, *Nuclear power plants – Instrumentation and control important for safety – Software aspects for computer-based systems performing category B or C functions*

IEC 62340, *Nuclear power plants – Instrumentation and control systems important to safety – Requirements for coping with common cause failure (CCF)*

ISO 9001:2008, *Quality management systems – Requirements*

IAEA INSAG-10:1996, *Defence in Depth in Nuclear Safety*

IAEA NS-R-1:2000, *Safety of Nuclear Power Plants: Design*

IAEA GS-R-3:2006, *The Management System for Facilities and Activities Safety – Requirements*

IAEA GS-G-3.1:2006, *Application of the Management System for Facilities and Activities – Safety Guide*

IAEA NS-G-1.3:2002, *Instrumentation and Control Systems Important to Safety in Nuclear Power Plants*

IAEA 75-INSAG-3 Rev. 1 – INSAG 12:1999, *Basic Safety Principles for Nuclear Power Plants*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

application function

function of an I&C system that performs a task related to the process being controlled rather than to the functioning of the system itself

NOTE 1 See also “I&C function”, “I&C system”, “application software”.

NOTE 2 An application function is normally a subfunction of an I&C function.

3.2

application software

part of the software of an I&C system that implements the application functions

NOTE 1 See also “application function”, “application software library”, “system software”.

NOTE 2 Application software contrasts with system software.

NOTE 3 See also Figure 2.

NOTE 4 In the context of complex electronic components, the term “application logic” may be inferred instead of “application software” where appropriate throughout this standard.

3.3

application software library

collection of software modules implementing typical application functions

NOTE 1 When using pre-existing equipment, such a library is considered to be part of the system software and qualified as such.