

QUALITY ASSURANCE PROGRAMMES FOR BRAZILIAN NUCLEAR FACILITIES AND ACTIVITIES

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ABSTRACT

The requirements for quality assurance programmes for nuclear facilities and activities in Brazil are established in licensing regulations. The licensing process of Brazilian nuclear facilities and activities is fully described in standard CNEN-NE-1.04 - Licensing of Nuclear Installations [3]. Specific requirements for the preparation and implementation of quality assurance programmes are fully described in standard CNEN-NN-1.16 - Quality Assurance for Safety in Nuclear Power Plants and Other Installations [4]. Brazil is a Member State of IAEA, therefore it is also expected that Brazilian nuclear facilities and activities apply IAEA recommendations. IAEA has published in 2006 the safety requirements standard IAEA GS-R-3 – The Management System for Facilities and Activities: Safety Requirements [1], which replaces former IAEA safety standard about quality assurance, the code IAEA 50-C-Q - Quality Assurance for Safety in Nuclear Power Plants and Other Nuclear Installations [2]. The present work analyses the innovations brought by publication IAEA GS-R-3 [1] in relation to the code IAEA 50-C-Q [2] and suggests improvements to standard CNEN-NN-1.16 [4], in order to make it up to date with IAEA standards.

1. INTRODUCTION

The compulsory standard CNEN-NN-1.16 [4] specifies requirements for establishing and implementing a quality assurance programme in nuclear facilities and activities, in order to attend Brazilian licensing regulations.

For licensing purposes, the licensee shall submit his own Quality Assurance Programme (QAP) for the appreciation of the National Commission of Nuclear Energy (CNEN), as well as the QAP of his main contractors. The activities described in the QAP shall only start after the approval of the QAP by CNEN.

The Quality Assurance Programmes (QAP) shall cover the activities that influence the quality of items important to safety, developed during the management of all stages of the facility: siting, design, construction, commissioning, operation and decommissioning.

The compulsory standard CNEN-NE-1.04 [3] establishes that the licensee for the construction stage of a nuclear facility shall describe his QAP and the QAP of his main contractors in the Preliminary Safety Analysis Report (PSAR). The QAP shall be applied to items important to safety during activities of management, design, manufacturing, procurement, civil construction and electro-mechanical assembly, and shall include the assignment of an Independent Technical Supervision Organization (ITSO).

The standard CNEN-NE-1.04 [3] also establishes that the licensee for the operation stage of a nuclear facility shall present a Quality Assurance Programme (QAP) for the initial and permanent phases of the operation stage. For the initial phase of operation, the QAP shall be presented as part of the Final Safety Analysis Report (FSAR), and for the phase of permanent operation, the QAP shall be presented as a single document.

Brazil is a Member State of the International Atomic Energy Agency (IAEA), therefore it is expected that Brazilian nuclear facilities and activities follow IAEA recommendations. The IAEA standard that specifies requirements for the development and implementation of quality management systems in nuclear facilities and activities is IAEA GS-R-3 [1].

2. CHARACTERIZATION OF IAEA AND CNEN STANDARDS FOR QUALITY MANAGEMENT SYSTEMS

2.1 Standard IAEA GS-R-3 [1]

The standard IAEA GS-R-3 [1] comes from the code IAEA 50-C-QA, Quality Assurance for Safety in Nuclear Power Plants - A code of practice, published in 1978.

The code IAEA 50-C-QA of 1978 consisted of the following sections: 1 – Introduction, 2 - Quality assurance programmes, 3 – Organization, 4 - Document control, 5 - Design control, 6 - Procurement control, 7 - Material control, 8 - Process control, 9 - Inspection and test control, 10 – Non-conformance control, 11 - Corrective actions, 12 - Registers and 13 – Audits. These sections were known as the “13 principles” or “13 criteria” of IAEA quality assurance.

In 1988, the code IAEA 50-C-QA was slightly revised, designated by IAEA 50-C-QA Rev. 1, and entitled “Code for the safety of nuclear power plants: Quality assurance”.

For a best alignment with ISO 9000:1994 standards series, and to attend other nuclear installations than the nuclear power plants, the code IAEA 50-C-QA Rev. 1 was revised in 1996, and replaced by the code IAEA 50-C-Q, with the title "Code: Quality assurance for safety in nuclear power plants and other nuclear installations" [2].

The basic requirements described in the code IAEA 50-C-Q [2] were presented in three functional categories and an annex:

- I. Management** {
 - BR 1: Quality assurance programme;
 - BR 2: Training and qualification;
 - BR 3: Non-conformance control and corrective actions;
 - BR 4: Document control and registers;
- II. Performance** {
 - BR 5: Work;
 - BR 6: Design;
 - BR 7: Procurement;
 - BR 8: Inspection and testing for acceptance;
- III. Assessment** {
 - BR 9: Management self-assessment;
 - BR 10: Independent assessment;

Annex ⇒ Supplementary information on the basic requirements.

In 2006, for a best alignment with ISO 9000:2000 standards series, and to follow the evolution of the quality concept to integrated management systems concept, the code IAEA 50-C-Q [2] is replaced by the safety requirements standard IAEA GS-R-3 [1].

The standard IAEA GS-R-3 [1] defines the requirements for establishing, implementing, assessing and continually improving a management system that integrates safety, health, environmental, security, quality and economic elements, to ensure that safety is properly taken into account in all the activities of an organization. The main objective of the requirements for the management system is to ensure, by considering the implications of all actions not within separate management systems but with regard to safety as a whole, that safety is not compromised. IAEA GS-R-3 [1] consists of six sections:

Section 1 - Introduction: Background; objective; scope; structure;

Section 2 - Management System: General requirements; safety culture; grading the application of management system requirements; documentation of the management system;

Section 3 - Management Responsibility: Management commitment; satisfaction of interested parties; organizational policies; planning; responsibility and authority for the management system;

Section 4 - Resource Management: Provision of resources; human resources; infrastructure and the working environment;

Section 5 - Process Implementation: Developing processes; Process management; Generic management system processes, control of documents, control of products, control of registers, purchasing, communication, managing organizational change;

Section 6 - Measurement, Assessment and Improvement: Monitoring and measurement; self-assessment; independent assessment; management system review; non-conformances and corrective and preventive actions; improvement.

2.2 Standard CNEN-NN-1.16 [4]

In 1984, the National Commission of Nuclear Energy (CNEN) published the experimental standard CNEN-NE-1.16 - Quality assurance for nuclear power plants, which was based on the code IAEA 50-C-QA of 1978, keeping its “13 principles”. CNEN-NE-1.16 was only applicable to nuclear power plants, so in 1999 it was revised, to attend other nuclear installations than the nuclear power plants. It was designated by CNEN-NN-1.16 – Quality assurance for the safety of nuclear power plants and other installations [4].

The standard CNEN-NN-1.16 [4] specifies requirements for the establishment and implementation of quality assurance systems in Brazilian nuclear power plants, nuclear installations and radioactive installations. It also establishes how the Quality Assurance Programmes (QAP) should be prepared and submitted to CNEN approval, according to the licensing requirements established in standard CNEN-NE-1.04 [3]. It applies to all stages of a nuclear facility that performs activities that influence the quality of items important to safety. The common stages of a nuclear facility are: siting, design, construction, commissioning, operation and decommissioning.

The standard CNEN-NN-1.16 [4] consists of four sections. Sections 1 to 3 are merely introductory. Section 1 presents the standard objective and scope; section 2 presents some elementary principles and section 3 presents definitions and abbreviations used in the text. Section 4 is formed by 13 subsections, which follow the 13 principles established in the code IAEA 50-C-QA of 1978. The structure of standard CNEN-NN-1.16 [4] is the following:

Section 1 - Objective and Scope;

Section 2 - General principles: interpretations, referenced standards and documents;

Section 3 - Definitions and Abbreviations;

Section 4 - Requirements for Quality Assurance Systems and Programmes;

4.1 - Quality assurance systems: obligatorinesses and responsibilities; basic guidelines; idiom; procedures, instructions and drawings; management assessment;

4.2 - Quality assurance programmes;

4.3 - Organization: responsibilities, authorities and communications; organizational interfaces; personnel selection and training;

4.4 - Document control: document preparation, review and approval; document issuance and distribution; change control of documents;

4.5 - Design control: general requirements, design interfaces, design verification, design changes;

4.6 - Procurement control: general requirements, evaluation and selection of suppliers, control of purchased services and items;

4.7 - Control of items: identification and control of items, parts and components; handling, storage and delivery;

4.8 - Process control;

4.9 - Inspection and testing control: inspection programme; testing programme; calibration and control of measuring and test equipments inspection and testing status, and operational status of items;

4.10 - Non-conformance control: general requirements;

4.11 - Corrective actions;

4.12 - Quality assurance records: preparation of records; receipt, storage and preservation of records;

4.13 - Audits: general requirements, programming.

2.3 Evolution of Quality Management System Standards along Time

Figure 1 shows the evolution of IAEA and CNEN quality management system standards along time.

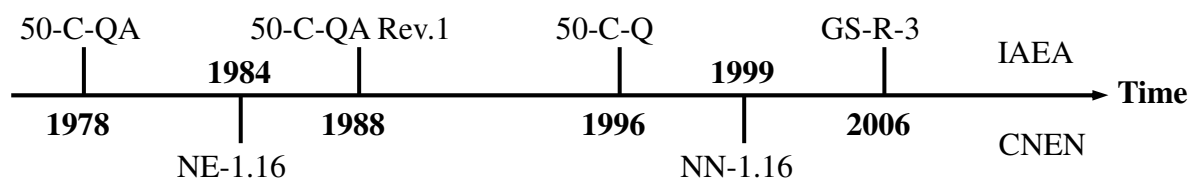


Figura 1. Evolution of IAEA and CNEN quality management system standards along time.

2.4 Innovations brought by standard IAEA GS-R-3 [1] in relation to code IAEA 50-C-Q [2]

The code IAEA 50-C-Q [2], published in 1996, was developed for nuclear power plants and other installations, with main focus on nuclear power plants. Standard IAEA GS-R-3 [1] was developed to provide general requirements for a management system that includes a complete set of nuclear facilities and activities, from limited sources of radiation sources to a nuclear energy power generating programme.

The code IAEA 50-C-Q [2] had a structure applied to quality management, work performance and assessment in nuclear power plants and other installations. The code established a grading approach of items services or processes, according to their significance to safety. The code also established guidance for work assessment, for quality management assessment by senior management, and for independent assessment, with focus on safety issues and on areas where problems were found.

Standard IAEA GS-R-3 [1] focuses quality as a component of an integrated management system. An integrated management system is defined as being a unique coherent management system where all the components, that are part of an organization, are integrated, in order to allow that the objectives of the organization are reached.

The integrated management system basically consists of safety, quality, environment, health, security and economic elements. It includes staff, equipments, organization culture, documented policies and processes. It defines the organizational structure and resources. In synthesis, the integrated management system is a set of organizational processes that describes the totality of objectives and requirements of the organization.

The consideration of the requirements of a management system separately can present a negative impact in safety. Therefore it is necessary to integrate all management elements of nuclear facilities and activities, to assure that they are not considered separately from safety issues.

Vincze (2006) [5] and Redman (2006) [6] tell that standard IAEA GS-R-3 [1] includes all the basic requirements of IAEA 50-C-Q [2], and promotes slight rewording to:

- Aid clarification;
- Better align with ISO 9001:2000;
- Reflect experience of using 50-C-Q [2];
- Make requirements relevant to all 5 IAEA Safety Standards areas: general safety (applicable to all areas), nuclear safety, radiation safety, waste safety, transport safety;

According to Vincze (2006) [5] and Redman (2006) [6], standard IAEA GS-R-3 [1] brings the following benefits:

- Integrate vision and strategy of the organization;
- Aligns the organization to deliver the overall goals and objectives;
- Implementation of continuous process improvement in all areas;
- Simplification through reduction of procedures;
- Faster reaction to changing challenges from outside or stakeholders;
- Creates synergy, consistency and decreases bureaucracy;
- Better understanding of the "big picture";

- Easier compliance, less violations, greater staff participation and ownership leading to stress reduction and better utilization of creativity;
- Better quality/risk issues, conflict resolution, and management;
- A more user-friendly and simpler management system;
- Removal of barriers between organizational units;
- Reduce administrative costs;
- Better “one house” culture throughout the organization.

3. CORRESPONDENCE BETWEEN STANDARDS IAEA GS-R-3 [1] AND CNEN-NN-1.16 [4]

Table 1 presents the correspondence between standards IAEA GS-R-3 [1] and CNEN-NN-1.16 [4].

Table 1. Correspondence between standards IAEA GS-R-3 [1] and CNEN-NN-1.16 [4]

IAEA GS-R-3 [1]	TOPIC	CNEN-NN-1.16 [4]
1	INTRODUCTION	
1.1-1.7	BACKGROUND	
1.8-1.9	OBJECTIVE	1.1
1.10-1.13	SCOPE	1.2
1.14	STRUCTURE	
2	MANAGEMENT SYSTEM	4.1
2.1-2.4	GENERAL REQUIREMENTS	4.1.1.4; 4.1.2; 4.1.2.2; 4.1.2.3.a; 4.3.2
2.5	SAFETY CULTURE	- x -
2.6-2.7	GRADING THE APPLICATION OF MANAGEMENT SYSTEM REQUIREMENTS	4.1.2.7; 4.1.2.8; 4.1.2.9
2.8-2.10	DOCUMENTATION OF THE MANAGEMENT SYSTEM	4.1.4; 4.4
3	MANAGEMENT RESPONSIBILITY	4.3.1
3.1-3.5	MANAGEMENT COMMITMENT	4.1.1.4
3.6	SATISFACTION OF INTERESTED PARTIES	- x -
3.7	ORGANIZATIONAL POLICIES	- x -
3.8-3.11	PLANNING	4.1.2.2; 4.1.2.3.a
3.12-3.14	RESPONSIBILITY AND AUTHORITY FOR THE MANAGEMENT SYSTEM	4.1.2.2; 4.3.1
4	RESOURCE MANAGEMENT	
4.1-4.2	PROVISION OF RESOURCES	4.1.2.3.a
4.3-4.4	HUMAN RESOURCES	4.3.3.1; 4.3.3.2
4.5	INFRASTRUCTURE AND THE WORKING ENVIRONMENT	4.1.2.10
5	PROCESS IMPLEMENTATION	
5.1-5.5	DEVELOPING PROCESSES	- x -
5.6-5.10	PROCESS MANAGEMENT	4.8
5.11	GENERIC MANAGEMENT SYSTEM PROCESSES	

IAEA GS-R-3 [1]	TOPIC	CNEN-NN-1.16 [4]
5.12-5.13	Control of documents	4.4
5.14-5.20	Control of products	4.9.1; 4.9.2; 4.9.3; 4.9.4
5.21-5.22	Control of records	4.12
5.23-5.25	Purchasing	4.6
5.26-5.27	Communication	4.3.1.1
5.28-5.29	Managing organizational change	- x -
6	MEASUREMENT, ASSESSMENT AND IMPROVEMENT	4.1.5
6.1	MONITORING AND MEASUREMENT	4.1.5.1
6.2	SELF-ASSESSMENT	4.1.5.1.a
6.3-6.6	INDEPENDENT ASSESSMENT	4.13
6.7-6.10	MANAGEMENT SYSTEM REVIEW	4.1.5
6.11-6.16	NON-CONFORMANCES AND CORRECTIVE AND PREVENTIVE ACTIONS	4.10; 4.10.1.2; 4.11
6.17-6.18	IMPROVEMENT	- x -
	REFERENCES	2.2
	GLOSSARY	3

4. COMPARISON AMONG THE REQUIREMENTS OF THE CHARACTERIZED STANDARDS

According to Table 1 presented above, we notice that most of the requirements of standard IAEA GS-R-3 [1] are contained in standard CNEN-NN-1.16 [4], except for the following topics: safety culture, satisfaction of interested parts, organizational policies, developing processes, managing organizational change and improvement.

Safety culture is the assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance.

The satisfaction of interested parties refers to attending the requirements of people with an interest or concern in ensuring the good performance and success of an organization.

The organizational policies are the intentions and global guidelines of an organization, formally expressed by top management.

The developing processes are the processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organization.

Managing organizational change refers to verifying if the organizational changes are justifiable, and classifying those changes according to their significance to safety.

Opportunities for the improvement of the management system shall be identified and actions to improve the processes shall be selected, planned and recorded.

5. CONCLUSIONS

Standard IAEA GS-R-3 [1] considers the quality management system part of an integrated management system that also integrates safety, environment, health, security and economic elements. It applies to IAEA Member States.

Standard CNEN-NN-1.16 [4] considers the quality management system independently from other elements of the management system of an organization. It applies to Brazilian nuclear facilities and activities.

Standard CNEN-NN-1.16 [4] was based on code IAEA 50-C-QA of 1978. Code IAEA 50-C-QA passed through a slight revision in 1988 (IAEA 50-C-QA Rev.1), through a significant revision in 1996 (IAEA 50-C-Q [2]) and through the revision of 2006 (IAEA GS-R-3 [1]), the most significant of all revisions. This way, and as can be seen in Figure 1, standard CNEN-NN-1.16 [4] maintains a structure that is outdated from the current structure established by standard IAEA GS-R-3 [1].

We conclude that a revision of standard CNEN-NN-1.16 [4] is necessary to include all requirements established in standard IAEA GS-R-3 [1] and to consider the quality elements integrated with other elements of the management system.

6. ACKNOWLEDGMENTS

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