2013 International Nuclear Atlantic Conference - INAC 2013
Recife, PE, Brazil, November 24-29, 2013
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: 978-85-99141-05-2

The 18 Basic Requirement of Quality Assurance for American design NPP

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ABSTRACT

On April 17th, 1969, the Atomic Energy Commission (AEC) published in the U.S. Federal Register (FR), Volume 34, Number 73, a proposed amendment to 10CFR50 to insert Appendix B - "Quality assurance criteria for Nuclear Power Plant ". This Appendix was officially approved on June 27th, 1970 and published in the FR, volume 35, number 125. Appendix B is the Quality Assurance document for U.S. nuclear facilities. This document establishes eighteen basic requirements (BR) to design, construction, manufacture and operation of structures, systems and components (SSC) related to safety.
The 18 BR describe "what" shall be done, but not "how" to do. In order to standardize the actions of nuclear facilities during 10 CFR 50 App B implementation, the industry has developed some documents, the main ones are: ASME NQA-1 (Quality Assurance Requirements for Nuclear Facility Applications) and the series ANSI N 45.2 (Quality Assurance Program Requirements for Nuclear Facilities). Both documents are approved by the NRC (Nuclear Regulatory Commission). The NRC is the licensing body of U.S. nuclear facilities. In Brazil, the licensing body is CNEN ("Comissão Nacional de Energia Nuclear"). This paper describes the 18 BR for American Designed Nuclear Power Plant (NPP), applicable to Angra 1 NPP.

1. INTRODUCTION

Angra 1 NPP was designed and built by Westinghouse, the rules of the U.S. NRC (United States Nuclear Regulatory Commission) are adopted in conjunction with the rules of CNEN. This statement is based on the requirements of the CNEN NE 1.04 [1] standard: "6.5.1 - Items must be designed, manufactured, assembled, built, tested and inspected in accordance with standards compatible with the importance of the safety function to be performed.
6.5.2 - In applying the provisions of section 6.5.1, shall be adopted current Brazilian codes and standards. When Brazilian standards could not be used, preferably, Codes, Guides and Recommendations of the International Atomic Energy Agency shall be used and, in their lack, international standards shall be used, provided that such rules and regulations are accepted by CNEN."
This article will discuss about the Quality Assurance Standards applicable to Angra 1 NPP. The Quality Assurance Standard for Brazilian NPP is CNEN NN 1.16 [2]. This standard meets the 18 BR described in 10 CFR 50 Appendix B [3], as will be demonstrated in this article.

2. RESULT AND DISCUSSION

The Code of Federal Regulations (CFR) is a codification of general and permanent rules published in the Federal Register by the executive department and / or agencies of the U.S. Federal Government.
The code is divided into 50 titles - each title is an area of federal regulation. The following are some examples of these titles:

Title 1 - General Provisions
Title 3 - The President
Title 10 - Energy
Title 18 - Conservation of energy and water sources
Title 25 - Indians
Title 50 - Wildlife and sea

Each title is divided into chapters - some take the name of its responsible agencies. Taking the example of Title 10 (Energy), it is divided into the following chapters:

I - Nuclear Regulatory Commission - NRC (Parts 0-199)
II - Department of Energy (Parts 20-699)
III - Department of Energy (Parts 700-999)
X - Department of Energy (General Provisions) (Parts 1000-1099)
XVII - Table of defending the safety of nuclear power plants (Parts 1700-1799)
XVIII - Interstate Commission of the North Side Low radiation loss (Part 1800)

In addition, Title 10 is divided into four volumes, as shown below.

Table 1 - Volumes of Title 10 CFR

Volume 1 : parts 1-50 Volume 2 : parts 51-199	Chaper I (NRC)
Volume 3 : parts 200-499 e Volume 4 : parts de 500-end.	Chaperts II,III e X , XVII, XVIII

Each chapter is subdivided into parts covering specific regulatory areas.
So to cite a regulation should be used:

Title	Part	Section number	
10CFR	1	1	= 10 CFR 1.1

For the case of this paper, the interest is part of the 10 CFR 50 - Domestic licensing of production and utilization facilities, specifically, the Appendix B - Quality assurance criteria for NPP and Fuel Reprocessing plants [3].
The 10CFR50 App B [3] establishes the 18 BR for design, construction, manufacture and operation of SSC safety related. Another American Quality Assurance Standard is NQA-1 [4] which also has the 18 BR and a few extras. The NRC approved NQA-1 [4] for U.S. utilities. The NQA-1 2008/2009 addendum [4], was approved by the NRC in June 2010 through the RG 1.28. The NQA-1 (2008/2009 ad) is divided into the following parts:

Part I contains the 18 basic requirements of 10CFR50 App.B. Some of these criteria are supplemented, based on the ANSI N 45.2 series [5-15].
Part II contains requirements for specific activities: management, planning, design, software usage, contract (including the dedication of commercial items), installation, inspection, testing, among others.
Part III contains appendices not mandatory to complement Parts I and II. Part IV contains "lessons learned".

Table 2 - Overview of the differences between 10 CFR 50 App B and NQA-1

10 CFR 50 App B	NQA-1
18 criteria - what to do Has the force of law Was supported by the collection of ANSI N45.2 NRC approves ANSI N45.2 through Regulatory Guides (RG) to the "how to do"	Approved by NRC 18 basic criteria (basic requirements - BR) There are additional requirements that include programs in the series of ANSI N45.2.

Below are listed the 18 requirements of quality assurance in accordance with NQA-1 [4] and 10CFR50 App B [3].

Table 3 - 18 Basic Requirements

10 CFR 50 App B	NQA-1
I – Organization	BR 1 – Organization
II - Quality assurance program	BR 2 - Quality assurance program
III – Design control	BR 3 – Design control
IV – Procurement Document control	BR 4 – Procurement Document control
V – Instructions, procedures and drawings	BR 5 – Instructions, procedures and drawings
VI – Document control	BR 6 – Document control
VII – Control of purchase material, equipment, and services	BR 7 – Control of purchase, item and services
VIII – Identification and control of materials, parts and components	BR 8 – Identification and control of items
IX – Control of special processes	BR 9 – Control of processes
X – Inspection	BR 10 – Inspection
XI – Test Control	BR 11 – Test Control
XII – Control of measuring and test equipment	BR 12 – Control of measuring and test equipment
XIII – Handling, storage and shipping	BR 13 – Handling, storage and shipping
XIV – Inspection, test and operation status	BR 14– Inspection, test and operation status
XV – Nonconforming materials, parts, or components	BR 15 – Control of Nonconforming item
XVI – Corrective action	BR 16 – Corrective action
XVII – Quality assurance records	BR 17 - Quality assurance records
XVIII - Audits	BR 18 - Audits

According to Table 3, there are some requirements that need an explanation for clarify the difference between them.

Table 4 – The difference between BR XV and XVI :

XV – Nonconforming materials, parts, or components	XVI – Corretive action
Problem Evaluate Differentiate: discard, rework, repair or use as is Take action Check / follow up Close	Problem Evaluate Identifies the root cause, you need a: Corrective action and preventive action take action Check / follow up Close

Figure 1 shows the difference between the requirements IV (control of documents of purchase - requisition / purchase order) and VII (control items purchased), where the steps are controlled by the requisite VII are circled with dotted line and the full line are controlled by the requirement IV.

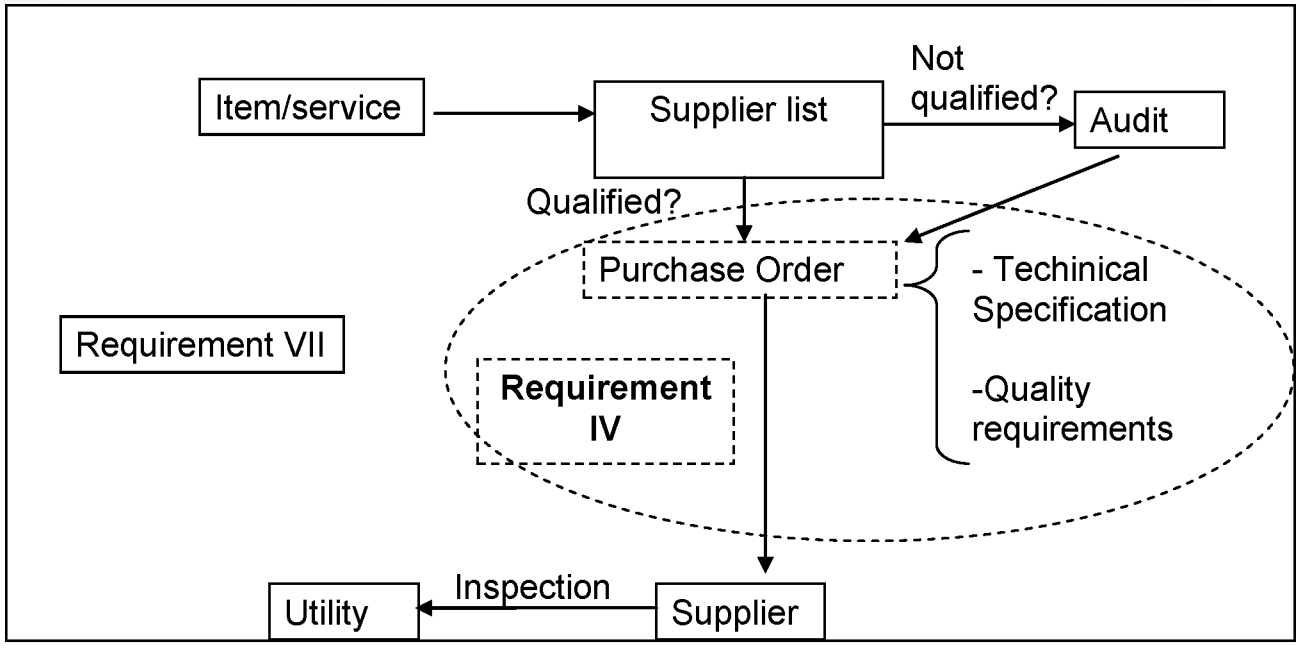

Figure 1 - Difference between requirements IV (control of documents of purchase - request) and VII (control items purchased).

NQA-1 [4] presents additional requirements, for example, the Supplement 11S-2 (1994 edition) is about quality assurance software. Where this requirement further specifies that QA software must be tested, approved and the records of these tests must be saved. The NQA-1 is the N45.2 series evolution. Historically, for industry initiative in May 1969, through the "American National Standards Commitee N45" was formed a Committee Program for Quality Assurance Requirements. The objective was to assist and expand the QA requirements for the nuclear industry – utility, suppliers, designers and builders. In 1970, another committee was formed to approve the N45.2 [5] - QA Requirements for Nuclear Facilities and other standards of this series. The first edition of these standards was approved

in 1971. These standards are approved by the NRC and are applicable to the facilities, suppliers and others safety related activities. According to ANSI (ansi.org), ANSI N 45.2 [5] were replaced by NQA-1-2008 however these standards are historical, ie, they remain valid for reference, but are not reissued.
The series of standards provides details of how to meet some of the criteria of 10 CFR 50 App B and are divided into two groups: the rules contain requirements for Quality Assurance System and technical standards.

Table 5 - ANSI N45.2 series versus the 18 BR

Norma ANSI	Basic Requirements and Supplements
ANSI N 45.2.2 [6] – Packiging, shipping, receiving, storage and handling of Items for Nuclear Power Plant. ANSI N45.2.15 [7] – Hoisting, rigging and transportation of items for Nuclear Power Plants.	XIII - Handling, storage and shipping (BR-13) VII - Control of purchase material, equipment, and services (BR-7)
ANSI N 45.2.6 [8] - Qualification for Inspection, Examination, and Testing personnel for Nuclear Power Plant.	X – Inspection (BR 10) XI – Test Control (BR 11) Supplements: NQA-1 : 1994 – 2S-1 e 2S-2 NQA-1 : 2008 – 300 e 400 do requisito 2.
ANSI N 45.2.9 [9] – Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants.	XVII – Quality assurance records (BR-17) Supplements: NQA-1 : 1994 – 17S-1 NQA-1 : 2008 – 200 e 800 do requisito 17.
ANSI N 45.2.10 [10] – Quality Assurance Terms and Definitions.	Part I - Introduction of NQA-1:1994 e 2008/2009ad.
ANSI N 45.2.11 [11] – Quality Assurance Requirements for the Design of Nuclear Power Plants.	III – Design control (BR-3) Supplements: NQA-1 : 1994 – 3S-1 NQA-1 : 2008 – 200 e 900 do requisito 3.
ANSI N 45.2.12 [12] – Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants.	XVIII – Audits (BR-18) Supplements: NQA-1 : 1994 – 18S-1 NQA-1 : 2008 – 200 e 800 do requisito 18.

ANSI N 45.2.13 [13] – Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants.	IV – Procurement Document control (BR-4) VII – Control of purchase material, equipment, and services (BR-7) Supplements: NQA-1 : 1994 – 4S-1 e 7S-1 NQA-1 : 2008 – 200 a 400 do requisito 4 e 200 a 800 do requisito 7.
ANSI N 45.2.16 [14] – Supplementary Requirements for the calibration and control of measuring and test equipment used in the construction and maintenance of Nuclear Power Generating Station.	XII – Control of measuring and test equipment (Br 12)
ANSI N 45.2.23 [15] – Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants.	II - Quality assurance program (BR-2) Supplements: NQA-1: 1994 – 2S-3 NQA-1: 2008 – 200 e 500 do requisito 2.

An important comment is about ANSI N 45.2.6 [8], which is related to the qualification and certification of Non Destructive Examinations Inspectors. Now-a-days, the requirements to be followed are:

- ASME Section III for NPP construction and
- ASME section XI and changes in accordance with 10 CFR 50.55a for NPP in operation.

Angra 1 NPP, during the steam generators replacement, in 2009, adopted the requirements of ASME Section III Edition 2001 Addenda 2002 and 2003 [16], where it was stated that the Personnel performing nondestructive examinations (NDE) shall be qualified and certified using a written practice prepared in accordance with SNT-TC-1A (1992 edition), Standard for Qualification and Certification of Nondestructive Testing Personnel. During the operation, Angra 1 NPP follow the requirements of ASME Section XI [17], for the 3rd Inservice Inspection Interval, the edition approved is 2001 add 2002/2003 [18], that defines: “Personnel performing nondestructive examinations shall be qualified and certified using a written procedure and prepared in accordance with ANSI / ASNT CP -189 (1995 edition). Certification based on SNT TC 1A, ANSI N 45.2.6 or earlier editions of ANSI / ASNT CP - 189 are accepted until recertification "(ASME Section XI, 2001 edition, addenda 2002 and 2003, subsection IWA 2300, p.15).

In Brazil, the CNEN NN 1.16 standard [2] presents 13 requirements, the 18 BR were reorganized. This standard is similar to 10CFR50 App B [3], ie, it describes the Quality Assurance Requirements for Nuclear facilities in Brazil and it has the force of law. It applies: "activities affecting quality of items important to safety, developed in each of its various stages: site selection, design, construction, commissioning, operation and decommissioning.” (CNEN NN 1.16, 2000, p.4).

Angra 1 NPP were designed and built by Westinghouse, and the Quality Assurance Program during the construction was based on 10 CFR50 App B and ANSI N 45.2 series.
The table 6 shows the comparison between the 18 BR of the 10 CFR 50 App B and the CNEN NN 1.16 requirements.

Table 6 - Comparison between the requirements of CNEN NN 1.16 and 18 BR.

10 CFR 50 App B/ NQA-1	Requisitos CNEN NN 1.16
I – Organization	4.3
II - Quality assurance program	4.2
III – Design control	4.5
IV – Procurement Document control	4.6
V – Instructions, procedures and drawings	4.1.4
VI – Document control	4.4
VII – Control of purchase material, equipment, and services	4.6.3
VIII – Identification and control of materials, parts and components	4.7
IX – Control of special processes	4.8
X – Inspection	4.9 /4.9.1
XI – Test Control	4.9/4.9.2
XII – Control of measuring and test equipment	4.9.3
XIII – Handling, storage and shipping	4.7.2
XIV – Inspection, test and operation status	4.9/4.9.4
XV – Nonconforming materials, parts, or components	4.10
XVI – Corrective action	4.11
XVII – Quality assurance records	4.12
XVIII – Audits	4.13

3. CONCLUSIONS

ELETRONUCLEAR owns a Westinghouse NPP - Angra 1. Thus, the 18 basic requirements of 10 CFR 50 App.B [3] apply. In Brazil, the licensing body - CNEN, published CNEN NN 1:16 [2] that reorganized the 18 basic requirements of CFR 10 50 App.B [3], as shown in Table 6.
In addition to these standards, there are ANSI N 45.2 [5-15] series and NQA-1 [4] which were approved by NRC.
The Angra 1 NPP Quality Assurance System meets the 18 BR of the 10 CFR 50 App B and is implemented since the design of the plant.

4. ACKNOWLEDGMENTS

Special thanks to Eletrobras Eletronuclear, to the Quality Assurance Department and to Diogo Baliza Maia.

5. REFERENCES

1. COMISSÃO NACIONAL DE ENERGIA NUCLEAR, Licenciamento de Instalações Nucleares, Norma NE 1.04 (Dezembro 2002).

2. COMISSÃO NACIONAL DE ENERGIA NUCLEAR, Garantia da Qualidade para a Segurança de Usinas Nucleoelétricas e Outras Instalações, Norma NN 1.16. (Abril 2000).

3. U.S. NUCLEAR REGULATORY COMISSION. Quality assurance criteria for Nuclear Power Plant - 10 CFR 50 appendix B. (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html, Page Last Reviewed/Updated Thursday, July 25, 2013).

4. QUALITY ASSURANCE REQUIREMENTS FOR NUCLEAR FACILITY APPLICATIONS. ASME Boiler Pressure Vessel. Norma NQA-1. Edições de 1994 e 2008 adendo 2009.

5. ANSI N 45.2 Quality Assurance Program Requirements for nuclear Facilities. 1977.

6. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.2 – Packiging, shipping, receiving, storage and handling of Items for Nuclear Power Plant. 1978.

7. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N45.2.15 – Hoisting, rigging and transportation of items for Nuclear Power Plants. 1981.

8. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.6 - Qualification for Inspection, Examination, and Testing personnel for Nuclear Power Plant. 1978.

9. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.9 – Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants. 1974.

10. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.10 – Quality Assurance Terms and Definitions. 1973.

11. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.11 – Quality Assurance Requirements for the Design of Nuclear Power Plants. 1974.

12. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.12 – Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants. 1977.

13. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.13 – Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants. 1976.

14. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.16 – Supplentary Requirements for the calibration and control of measuring and test equipment used in the construction and maintenance of Nuclear Power Generating Station. 1973.

15. AMERICAN NATIONAL STANDARDS INSTITUTE. ANSI N 45.2.23 – Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants. 1978.

16. ASME BOILER PRESSURE VESSEL. Seção III : Rules for Construction of Nuclear Facility Components.. Edition 2001 add 2002/2003.

17. ASME BOILER PRESSURE VESSEL. Seção XI : Rules for Inservice Inspection of Nuclear Power Plant Components. Edition : 2001 add 2002/2003.