
AREVA

OVERVIEW
US EPR EQ Program

by

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> Presentation

- Overview of US EPR EQ
  - Use of OL-3 Qualified Equipment Where Practical
  - Planned Use of 80% US Qualified Equipment
- Scope of Work
- Summary of EQ Tasks
- Open Items and Concerns

> Overview of EQ for US EPR

- Definition of “EQ”
  - 10CFR50.49
  - IEEE 323 & RG 1.89
  - Daughter Standards & Associated RG’s
  - At Station, EQ is Maintained by Utility Procedures

IEEE Daughter Standards & Associated RG's

IEEE Std + Year	Subject	RG-Rev-Yr	Std-Yr Ref'd by RG	Delta, Y/N
7-4.3.2-2003	Computers	1.152-2-'06	2003	N
317-2003	Penetrations	1.63-3-'87	1983	Y
323-2003	Overall Electric EQ Computer Based Systems	1.89-1-'84 1.209-0-'07	1974 2007	Y N
334-2006	Electric Motors	1.40-0-'73	1971	Y
344-2004	Seismic	1.100-2-'88	1987	Y
382-2006	Valve Actuators	1.73-0-'74	1972	Y
383-2003	Cables	1.131-1-'79	1974	Y
387-2001	EDGs	1.9-3-'93	1984	Y
420-2001	Racks & Panels	n/a		n/a
497-2002	PAM	1.97-4-'06	2002	N
535-1986	Batteries	1.158-0-'89	1986	N
572-2006	Connectors	1.156-0-'87	1985	Y
627-1980 (withdrawn)	Overall mech/elec EQ	n/a		
628-2001	Raceways	n/a		
638-2006	Transformers	n/a		
649-2006	MCCs	n/a		
650-2006	Chargers/Inverters	n/a		
1202-1991	Cable flame tests	n/a		
1205-2000	Aging	n/a		
1290-1996	Valve Actuator Applications	n/a		
C37.82-2004	Switchgear	n/a		
C37.105-1987	Protective Relays	n/a		
n/a	RFI/EMI	1.180-1-'03	n/a	n/a

IEEE Daughter Standards & Associated RG's

Summary Position for US EPR

The official program position is to either use documents that are current as of 1/1/05, or that have been issued within 6 months of DCD submittal. (RG 1.209?????)

As noted above, most of the applicable RGs are not current with the latest version of the standards, and the latest version of a standard is not endorsed by RG.

Therefore, unless a detailed review has determined that there are compelling negative reasons, it has been decided that the most current version of a RG will be followed, along with the most current version of a standard.

This position has been taken because no new requirements have been introduced, in general, and later versions have been produced for clarification purposes.

US EPR EQ Program

- NSSS
- BOP
- Electrical
- I&C
- Seismic Sequence Methodology
- Mechanical Components
  - Age Related Degradation Mechanisms (e. g. Gaskets, O-rings, Lubricants, Grease, Diaphragms, Seals)

> Scope of EQ Activities

- DC Aspects (Programmatic)
  - FSAR 3.10 (SRP 3.10, Rev 3, 3/07)
  - FSAR 3.11 (SRP 3.11, Rev 3, 3/07)
  - AREVA Seismic & Dynamic Qualification Spec
  - AREVA Environmental Qualification Spec
  - Position on Mechanical Equipment Qualification
  - Key Inputs from Plant Design, System Engineering, Civil, Radiation Protection, Thermo Hydraulics, etc.
- COL Aspects (Implementation)
  - Equipment Selection, Use, Qualification
  - Generic Basis – AREVA
  - Plant Specific - Customer

Summary of EQ Tasks

Activity
Prepare Section 3.10, Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
Prepare Section 3.11, Environmental Qualification of Mechanical and Electrical Equipment
Coordinate development of EQ equipment list from various sources
Prepare Appendix 3D, Methodology for Qualifying EPR Safety-Related Equipment
Prepare Appendices that define equipment service conditions. For example:
Mild Environment Parameter Limits Post-Accident Equipment Operability Times EQ Program Margin Requirements Normal Operating Environments, Including Zones/Room Nos. 60 Year Normal Operating Gamma Dose/Dose Rate Abnormal Operating Environments Inside Containment Abnormal Operating Environments Outside Containment Accident Environments Mechanical Equipment Components Requiring Qualification Typical Environmental Test Profile Gamma Dose/Dose Rate Inside Containment After LOCA Beta Dose/Dose Rate Inside Containment After LOCA Gamma Dose/Dose Rate Inside Containment After a SLB Beta Dose/Dose Rate Inside Containment After a SLB Containment Temp/Press Design Conditions; LOCA Containment Temp/Press Design Conditions; MSLB Containment Temp/Press Test Envelope Outside Containment Temperature Test Envelope

Summary of EQ Tasks

Activity
Prepare Attachment A; Sample EQDP
Prepare Attachment B; Aging Evaluation Program
Prepare Attachment C; Effects of Gamma Doses Below 1E4 Rads on the Mechanical Properties of Materials
Prepare Attachment D; Accelerated Thermal Aging Parameters
Prepare Attachment E; Seismic Qualification Techniques

Mechanical Equipment Qualification Position

10CFR50, Appendix A, GDC-4, Environmental and Dynamic Effects Design Basis; basic requirement for design of SSCs important to safety.

AREVA NP position: … the mechanical equipment is designed to comply with GDC-4 by verifying the ability of the equipment to perform its required safety function(s) when exposed to postulated service conditions. The verification process is a part of the engineering design process, and evaluates both metallic and non-metallic materials to meet all postulated service conditions.

In addition to design, compliance with GDC-4 is maintained through Procurement, Maintenance, and Surveillance. Change control is also utilized to ensure that changes to qualified equipment are reviewed and approved by engineering, prior to procurement.

The Maintenance Program includes; maintenance, surveillance, and periodic testing, all in accordance with suitable regulations.

Furthermore, program data and records are reviewed in accordance with ASME Section XI to ensure that the equipment has not suffered any degradation resulting from exposure to thermal, radiation, or cyclic aging conditions.

Radiation Zones

> US EPR Radiation Zone Designations (equivalent rads γ)

Zone	60 year TID	Dose Rate
1	<100 R	<0.05 mr/hr
2	1E2 R	<0.25 mr/hr
3	1.3E3 R	<2.5 mr/hr
4	1.3E4 R	<25 mr/hr
5	5.3E4 R	<100 mr/hr
6	2.63 MR	<5 R/hr
7	263 MR	<500 R/hr
8	263 MR	>500 R/hr

Key System Design P/T

System/Component	Press, psig	Temp, °F
RCS	2535	664
PZR	2535	684
Accumulators	785	140
MHSI pump/del line	1525	250
LHSI/RHR pump/del line	1145	356
RHR suction line	915	356
Sump suction line	65	248
SG Secondary side	1435	592
Main Steam System	1435	592
Main Feedwater System	1435/1945	514/592
Containment	62	338

US EPR EQ Related Documents

- US EPR Design Certification Project Plan
- US EPR Radiation Zone Designations
- US EPR Codes & Standards List
- US EPR Environmental Qualification of Electrical Equipment
- US EPR Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
- US EPR EQ List Guidelines
- US EPR EQ Program Mechanical and Electrical Equipment Selection Guidance
- US EPR MEL DB Field Definitions
- US EPR Project Directive, Design Responsibilities

Examples of Safe Shutdown Systems

Boric Acid Makeup
Chemical and Volume Control System (CVCS)
Component Cooling Water System (CCW)
Coolant Supply and Storage System (CSSS)
Emergency Diesel Generator (EDG) and Systems
Emergency Feedwater System (EFW)
Essential Service Water System (ESW)
Extra Borating System (EBS)
HCAV Systems
Safety Grade Portion of Main Steam System (MSS)
Low Head Safety Injection/Residual Heat Removal (LHSI/RHR)
Medium Head Safety Injection (MHSI)
Power Distribution System
Reactor Boron and makeup System (RBMS)
Reactor Coolant Pump Standstill Seal Injection (RCPSSI)
Reactor Coolant System (RCS)
Safety Chilled Water System (SCWS)

Examples of SR Equipment and Components from Safe Shutdown List

Item	Function *				
	RC	RCM	DHR	PM	Support
RT Breaker	X				
EFW flow, lvl, press			X	X	
SG lvl, press			X	X	
HX temp				X	
Isol vlv, elec, SOV, MOV, etc.	X	X	X		
CVCS chg flow, temp	X	X		X	
Boric Acid tank lvl, temp	X				
EBS pump flowmeter	X				
PZR lvl, press, temp				X	
MS relief vlvs			X		X
ESW pump, strainer, filter, instr	X	X	X	X	X
CCW pump, HX, flow, lvl, temp, ΔP	X	X	X	X	X
Safety chilled water pump					X
EXP tank press					X
Chiller evaporator ΔP					X
Chiller compressor					X
Condenser fan					X
Fire damper					X
EXH fans					X

* RC – reactivity control
RCM – reactor coolant make-up
DHR – decay heat removal
PM – process monitoring
Support – equipment req'd to assist in completing functions

EQ Program

- Items for review
  - European Qualification v. US Rules
  - ISO v. Appendix B/NQA-1
  - Use of Available and Qualified US Equipment
  - Impact of New Qualification
  - Digital Equipment Qualification: EPRI TR-107330, RG 1.152, and RG 1.209
  - EMC: EPRI TR-102323 and RG 1.180
  - 10CFR50.69 – Risk Informed EQ
  - IEEE323/344
    - v. IEC 60780, 60980
    - v. RCC-E Section B
    - v. KTA-3501, 3503, 3505

Comparison between NQA-1 and ISO 9001

NQA-1	ISO 9001	Conclusion
Basic Requirement 1		
Supplement 1S-1	4.1.2.1 Responsibility and Authority	**ISO = NQA**
Organization	4.1.2.3 Management Representative	
Basic Requirement 2		
QA Program	4.2 Quality System	**ISO = NQA**
Suppl 2S-1 thru 2S-4	4.1.2.2 Verification Resources and Personnel	**ISO < NQA**
Pers Indoc & Trng	4.18 Training	
Basic Requirement 3		
Supplement 3S-1	4.4 Design Control	**ISO < NQA**
Design Control		
Basic Requirement 4		
Supplement 4S-1	4.6.2 Assessment of Subcontractors	**ISO < NQA**
Procurement Doc Ctrl	4.6.3 Purchasing Date	
	4.6.4 Verification of Purchased Product	
Basic Requirement 5		
Instructions, Procedures	4.2(b) Quality System	**ISO = NQA**
And Drawings	4.4.4(b) Design Output	
Basic Requirement 6		
Supplement 6S-1	4.5 Document Control	**ISO > NQA**
Document Control		
Basic Requirement 7		
Supplement 7S-1	4.6.1 General	**ISO < NQA**
Control of Purchased	4.6.2 Assessment of Subcontractors	
Items and Services	4.6.4 Verification of Purchased Products	
	4.7 Purchaser Supplied Product	

Comparison between NQA-1 and ISO 9001

NQA-1	ISO 9001	Conclusion
Basic Requirement 8		
Supplement 8S-1 Ident & Ctrl of Items	4.10 Inspection and Testing 4.8 Proc Ident & Traceability	**ISO < NQA**
Basic Requirement 9		
Supplement 9S-1 Control of Processes	4.9 Process Control	**ISO = NQA**
Basic Requirement 10		
Supplement 10S-1 Inspection	4.10 Inspection and Testing	**ISO < NQA**
Basic Requirement 11		
Supplement 11S-1 Test Control	4.10 Inspection and Testing	**ISO < NQA**
Basic Requirement 12		
Supplement 12S-1 Control of M&TE	4.;11 Inspection, M&TE	**ISO > NQA**
Basic Requirement 13		
Supplement 13S-1 Handl, Store, and Ship	4.15 Handling, Storage, Packaging and Delivery	**ISO ≠ NQA**
Basic Requirement 14		
Inspection, Test, and Operating Status	4.12 Inspection and Test Status	**ISO = NQA**

Comparison between NQA-1 and ISO 9001

NQA-1	ISO 9001	Conclusion
Basic Requirement 15		
Supplement 15S-1 Control of Non-Conform Items	4.13 Control of Non-Conforming Product	**ISO < NQA**
Basic Requirement 16		
Corrective Action	4.14 Corrective Action	**ISO ≠ NQA**
Basic Requirement 17		
Supplement 17S-1 QA Records	4.16 Quality Records	**ISO < NQA**
Basic Requirement 18		
Supplement 18S-1 Audits	4.1.2.2 Verif Resources & Personnel 4.17 Internal Quality Audits 4.18 Training	**ISO < NQA**
	ISO req’ts w/out specific NQA counterparts	
	4.3 Contract Review 4.19 Servicing 4.20 Statistical techniques	

US vs. European Standards

Conclusions & Recommendations; taken from a study by SC-2, presented at SC-2-04-2

IEEE 323 and RCC-E

A major effort is required to incorporate RCC-E approach into IEEE 323, since details are buried in many specific referenced standards. For example, NF M 64-001, is a separate procedure for qualification of electrical equipment, and is not contained within the body of RCC-E.

Manufacturing and commercial issues are an integral part of RCC-E, while the technical aspect of EQ is the only subject of IEEE 323.

RCC-E appears to be more of a specification than a standard and lacks the level of detail to permit a direct comparison to IEEE 323.

Micro-processor equipment is not explicitly addressed in either RCC-E or IEEE 323.

US vs. European Standards

Conclusions & Recommendations

IEEE 323 and IEC 60780

Purpose

323 is used for:

- **Qualification of Class 1E equipment prior to installation**
- **Maintaining and extending qualification**
- **Updating qualification, if required (e.g., if equipment is modified)**

60780 is used for:

- **Initial qualification of equipment**
- **Maintaining qualification preservation following modifications**

US vs. European Standards

Conclusions & Recommendations

IEEE 323 and IEC 60780

Scope of Standard

323: Describes the requirements for qualifying Class 1E equipment. Intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification if equipment is modified.

60780: Applicable to electrical equipment of safety systems, including components or equipment of any interface whose failure could adversely affect the performance of the safety system. Also applicable to non-electrical interfaces associated with a safety function.

US vs. European Standards

Conclusions & Recommendations

IEEE 323 and IEC 60780

Summary of Differences-

EMI/RFI test requirements in IEC 60780 appear to be more clearly defined because the referenced standards are binding, whereas 323 reference the Appendices of 603 and 7-4.3.2, which are for information purposes only and are not binding

IEC 60780 is more prescriptive in discussion of Type Test methods. For example, several standards are called out to be used for specific tests as appropriate.

In general, the two standards address the same qualification issues and include similar qualification procedures and methods.

323 addresses qualification from a "functional" viewpoint (ability to perform a safety function)', while IEC 60780 addresses equipment qualification from a "systemic" viewpoint (performance of the safety system)

The IEC standard explicitly states that it is applicable to non-electrical interfaces, while IEEE 323 is applicable to Class 1E equipment and interfaces

US vs. European Standards

Conclusions & Recommendations

IEEE 323 and KTA

KTA standards set the requirements, procedures, and instructions on how to achieve nuclear safety, i.e., qualification, with respect to the ALARA principle.

By their nature and developmental mandate, KTA standards and RGs are more nearly similar than are KTA standards and IEEE standards, and stress the methods and procedures required to achieve performance verification.

General comparison between IEEE and KTA revolves around IEEE 323 and KTA 3501, 3503, and 3505, with 3501 being the 'mother' document.

The three documents describe the safety technology concept of the RPS and monitoring equipment of the safety system, and includes design, manufacturing, installation, operation, testing, etc., and documentation of each activity.

KTA 3503 is intended for equipment in mild environments, while KTA 3505 is intended fore equipment in harsh environments.

Both 3503 and 3505 comprise two parts; one is theoretical, the other practical. The theoretical part includes the development of the elements of the test program, done in the second part, rather than these elements being developed 'off-line', in terms of separate specifications, procedures etc., as done in the US. The practical portion includes those elements of the program related to type-testing, including accident simulation, seismic testing, high radiation, and EMI/RFI.

Neither standard specifically addresses micro-processors based devices, but KTA 3503 is considered more applicable.