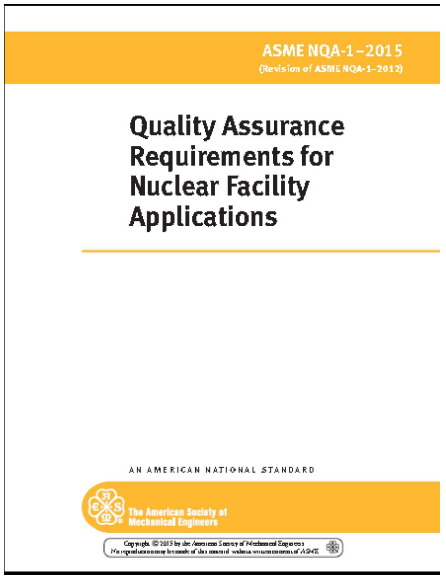
NRIC National Reactor Innovation Center

THESEUS
QA, Consulting, Training



An ASME NQA-1 Perspective of Software Used in Design and Analysis of Nuclear Facilities

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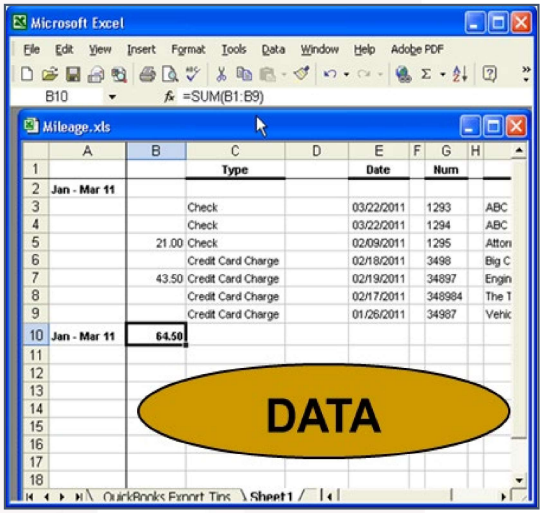
NIAC

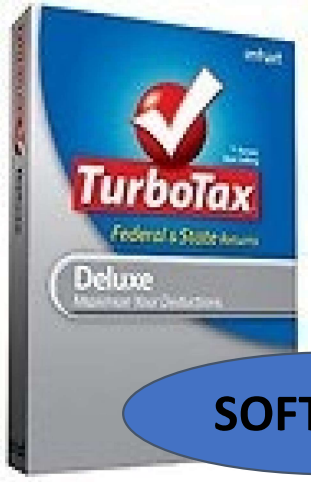
Session Topics

- Terms
- Computer Program (CPs) Basics –
- Where and What NQA-1 Parts Apply to CPs Used for Design & Analysis (D&A)
- Methods for Accepting CPs for Use of CPs – Req. 3 Sect. 401
- When Does NQA-1?
- D&A Computer Types
- References and Supplemental Slides

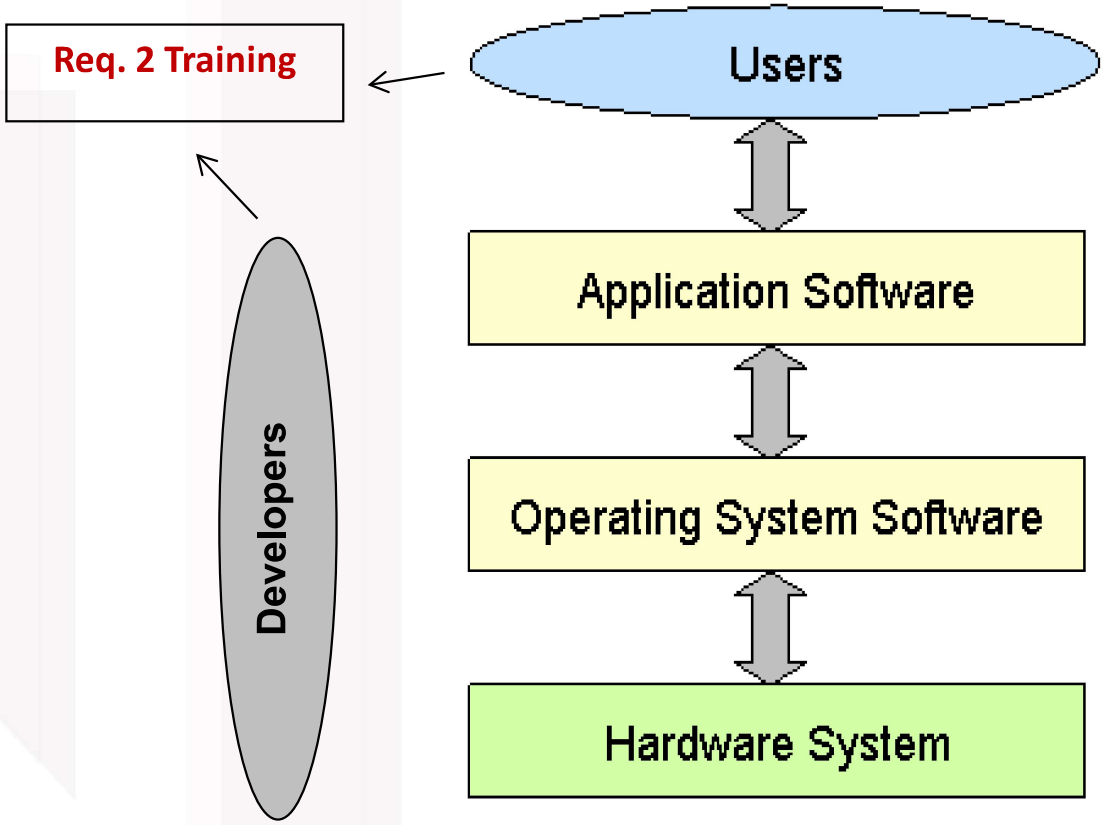
Let's Agree on Terms - ASME



COMPUTER PROGRAM



Where Do Computer Programs Reside & What Requirements of NQA-1 Appy?



Req. 3 Design Control 400 & 800
all of SQA SP 2.7
(depends on SW type)

Req. 11 Test and SP 2.7
System Software

HW Req. 8 Items and 11 Testing
SW Req. 3 & SP 2.7 CM

NQA-1 Req. 3 401 Use of Computer Program

- Each computer program used for design analysis shall be accepted for use and controlled by applying the applicable requirements of Parts I and II prior to use [*Method 1-SR or Method 2-NSR*], or the computer program's results shall be independently verified with the design analysis for each application [*Method 3*].

- The acceptance of controlled computer programs used for design analysis, and verification methods applied to the results of unproven programs, shall meet the following requirements:

  a) the computer program, or the verification method applied to the computer program results, shall be shown to produce correct solutions for the applied mathematical model within defined limits for each parameter employed. [Verification]

  b) the applied mathematical model shall be shown to produce a valid solution to the physical problem associated with the particular application. [Validation]

SUBPART 4.2.1
Guidance on Graded Application of Nuclear QA (NQA) Standard for Research and Development

Fig. 103 Technology Life Cycle

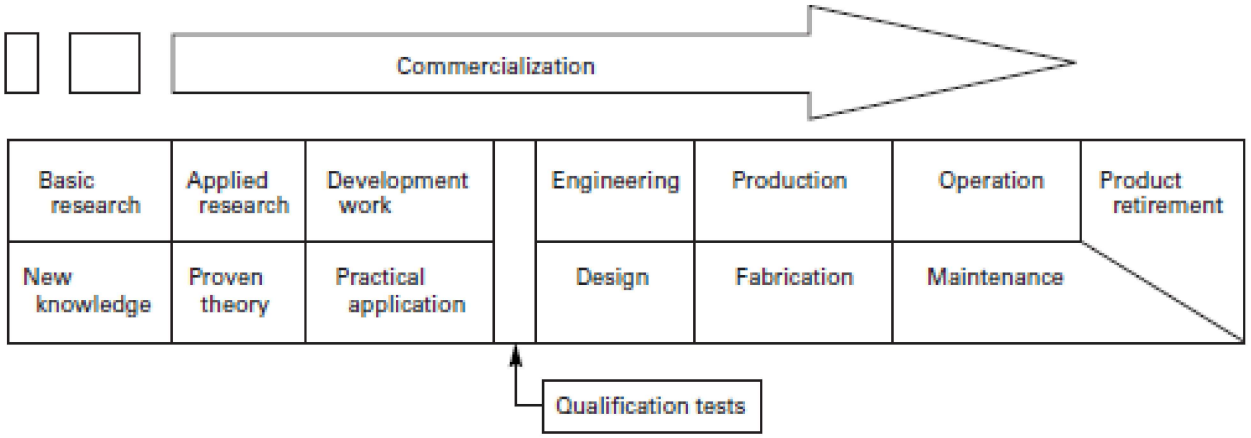


Table 600-2 Software Within Research and Development

	Tool	Deliverable
Basic	Define the software and use, configuration management, peer review	Software is not a deliverable at this stage of development
Applied	Req. 3 (401), defining the software and configuration management (e.g., 801.2 and 802 of Req. 3)	Req. 3 (800), Req. 11 (software req./para.)
Development and support	Software requirements within Parts I and II (consider guidance material, such as Sp. 3.2-2.7)	Software requirements within Parts I and II (consider guidance material, such as Sp. 3.2-2.7)

APPLYING NQA-1 TO DIFFERENT COMPUTER PROGRAMS TYPES

1. DEVELOP IN HOUSE (SR)	2. NRC (NSR)*	3. DOE (NSR)*	4. PROCURED (SR)*
SP 2.7 Sect. 400 SW Engr. Method applies. • **Depends on Org. R&D LC** • **Maybe NSR-apply good SW Engr. Practices** • **Org. determines outside of R&D then is this SR SW apply SP 400** • **300 does not apply**	SW Acquisition – SP 2.7 302. SR via CGD	SW Acquisition – SP 2.7 302. SR via CGD	SW Acquisition – SP 2.7 301 applies. This is received as SR SW
Changes: Org. makes via Sect. 400	Changes: Org. makes changes after qualifying commercial SW. SR version–SP 2.7 400	Changes: Org. makes changes after qualifying commercial SW. SR version–SP 2.7 400	Changes: Org. makes changes after qualifying commercial SW. SR version–SP 2.7 400
Focus: • **Develop SDLC** • **Internal Docs** • **Internal SCM** • **Problem Reporting** • **SW Tools (used to develop SW, e.g., (coding, Atlassian, etc.) & System SW (operating environment)**	Focus: • Docs - NRC • Internal SCM • Problem Reporting (NRC?) • SW Tools & System SW (see Develop in house	Focus: • Docs - DOE • Internal SCM • Problem Reporting from DOE & internal • SW Tools & System SW (see Developed in house)	Focus: • Qualify Supplier • Docs from Vendor • Internal SCM • Problem Reporting Internal and Supplier • SW System SW

(*) Assumes software is not going to independently verified with the design analysis for each application as allowed by Req. 3 401.

References and Supplemental Slides If Needed)

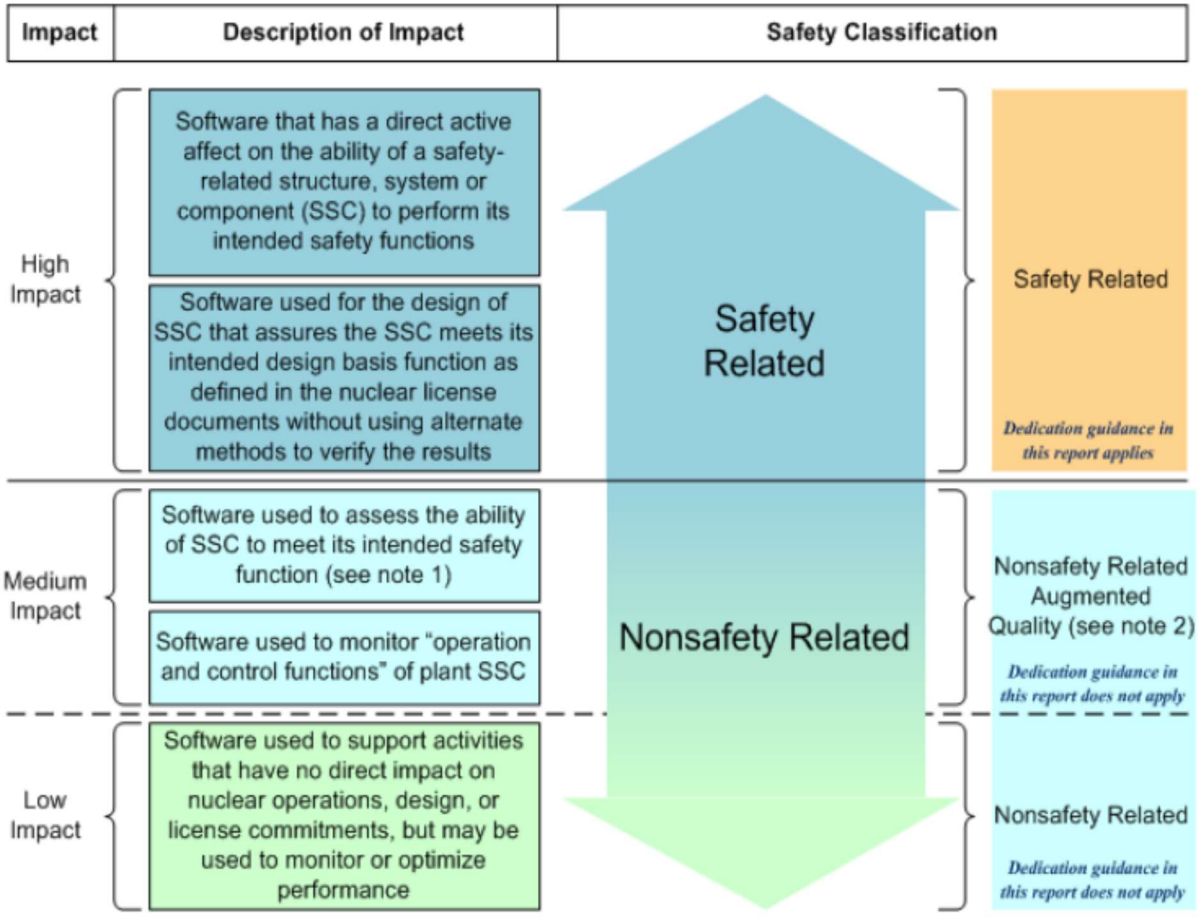
- ASME NQA-1
  - SP 3.1-3.1 Guidance – Use of CPs, Cases w/table
  - SP 3.2-2.7.1 Guidance – Aligns w/SP 2.7
  - SP 3.2-2.14 Guidance – CGD CP & SW Services
- RG 1.231 Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Safety-Related Applications for Nuclear Power Plants
- EPRI Technical Report 1025243, Guideline for the Acceptance of Commercial-Grade Design and Analysis Computer Programs Used in Nuclear Safety-Related Applications
- ESBWR Licensing Topical Report SQA Plan, ML072120426.pdf

SP 2.7 Table of Contents

Subpart 2.7 Quality Assurance Requirements for Computer Software for Nuclear Facility Applications

- 100 General
- 200 General Requirements
- 300 Software Acquisition
- 400 Software Engineering Method
- 500 Standards, Conventions, and Other Work Practices
- 600 Support Software
- 700 References

Classification Considering Impact



Note 1: It is important to recognize that software used to establish suitability of design of a safety related SSC may not be categorized as medium impact software unless alternative methods are used to verify the results.

Note 2: The term *augmented quality* is used as defined in this report and is not limited to only the non-safety-related SSCs credited for regulated events described in Section 17.5V. of NUREG-0800, *Standard Review Plan* [38].

Source: EPRI TR-1025243 & NITSL-SQA-2005-02 Rev.1

Guidance for Dedication of Computer Programs Sample Failure Modes/Consequence of Failure [EPRI & Developer]

Core Functionality	Potential Failure Mode
Accurate solution algorithm	Incorrect algorithm implementation of major formulas
Code functions are applicable	Code functions are not applicable or are used out of their applicable range
Input model constructed correctly	User modeling error
Input error detection	Wrong message, wrong response when an error is detected Software fails to detect an error when it should Software detects an error when there is none
User manuals	There is a gap or error between code manuals the source code
Defect (Developer View)	A defect that might lead to a nonconservative, misleading, or error that might not be obvious in a design or analysis.