

Methods of Software Quality Assurance under a Nuclear Quality Assurance Program

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1. Introduction

This paper addresses a substantial implementation of a software quality assurance under a nuclear quality assurance program. The relationship of the responsibility between a top-level nuclear quality assurance program such as ASME/NQA-1 and its lower level software quality assurance is described. Software quality assurance activities and software quality assurance procedures during the software development life cycle are also described.

2. The establishment and its review of a Software Quality Assurance Plan

It addresses the software quality assurance activities in the software development life cycle. According to the goal of a software quality in a nuclear quality assurance program such as ASME/NQA-1, quality objectives from the high position Nuclear Quality Assurance(NQA) should be established. The quality staffs in a Software Quality Assurance(SQA) organization make preparations for the software quality assurance plan for the purpose of a quality measurement. First of all, a software quality assurance plan shall be well defined. It is very important for the SQA to review the tools of the environment, methodologies and techniques. The integrated review meeting at a high-level position NQA and a low order SQA should be held in the beginning phase. It should be based on the implementation suitability as to whether the contents of a software quality plan and the criteria of the Code and Standard are actually applicable in the development life cycle process or not.

2.1. QA activities in the Requirement Phase

The software development team submits to the Software Requirement Specification(SRS) for the NQA through an inside peer review on the design output of a SRS after the requirement analysis phase is completed. According to the technical activity procedure, a formal review meeting can be held. The NQA evaluates the correctness, consistency and the completeness according to the Code & Standard as a managerial review as shown

in Table 1. Main checking viewpoints are a quality objective, and a review & audit procedure and inspection applied to the software quality assurance plan. The NQA in the requirement phase uses the Software Verification and Validation(SVV) results of the thirty party. Which will be the licensing suitability analysis, technical review, Fagan inspection and simulation etc. The SQA have to perform the inspection technique such as a in-process audit. Through checking, when the quality problems were discovered, the development team should be able to make a correction and confirmation under the NQA policy and directions.

2.2 Quality assurance activities in the design phase

The quality review results shall be recorded and approved as quality assurance record documents.

After the design phase is completed, the development team submits to the Software Design Specification(SDS) for the NQA through an inside review and examination. Review meeting can be held according to the quality assurance procedure in a higher level NQA. NQA is responsible for the decision whether the warranty of the quality attributes were reflected in the functional requirements in the design phase, or not whether the design entities are reasonable in the development technology approach or not.

The NQA team in the design phase uses the SVV results of the thirty party. Which will be the licensing suitability analysis, technical review, Fagan inspection and simulation etc. The SQA have to perform the inspection technique such as a preliminary design review and in-process audit as shown in Table 1.

Through checking, when the quality problems were found, the development team should be able to make a correction and confirmation according to the corrective action results under the NQA program.

2.3 QA activities in the implementation phase

The development team should follow the software development guideline and the software development procedure related to the Code & Standard. The development team submits the Software Implementation

Specification(SIS) for the NQA through an inside review after the completion of the source code. Review meeting can be held according to the higher level NQA Procedure. The NQA confirms the acceptability based on the SVV result reports from the unit testing results and the resulting analysis. If the program codes have a defect or the unit test results are insufficient, a corrective action has taken by the development team. It can use the SVV results after the in-process audit by the SQA.

2.4 QA activities in the testing phase

2.4.1 Integration Testing Phase

After the integration testing by the development team is completed, an inside peer review should be performed. The problem and corrective action from the integration testing results and analysis table should be submitted to the NQA. A review meeting by the NQA should be held on it. It will be focused on the items of warranty of the quality attributes examined, a list of testing results with a checklist. Especially, whether the integration testing level is a proper one or not. NQA can recommend the development team to continue tuning the integration testing if an insufficient corrective action is discovered from the integration testing results. It can use the SVV results for the functional configuration audit by the SQA.

2.4.2 System Testing phase

After the system testing by the development team is completed, an inside peer review should be performed. In the same way as the of unit testing and integration testing. The defects, the problems and corrective actions list should be submitted to the NQA if any. The review meeting should be held according to the nuclear quality assurance procedure by the NQA. It will be focused on the quality objective goal as a quality management in the system testing. After the review of the system testing results, NQA should inspect and follow-up the testing results with a checklist as to whether the system testing may achieve enough original objectives, or not whether the system testing level was proper for the physical configuration audit and the performance based audit by the SQA or not. After comparing the expected value and resulted value by the NQA, it is required to take the necessary actions for the development team. It must be confirmed the resulting by the NQA on system testing results. It can use the SVV results for the physical configuration audit and the performance based audit by the SQA. In summary, software quality assurance activities under the NQA are recommended as shown in Table 1

SWLC	Software Development Baselines	Recommended Software QA Activities
Requirements	SQAP, SVVP, SRS	. SRS review . In-process audit . SW Test Plan Review . Managerial Review
Design	Preliminary Design Description	. Preliminary Design Review, . In-process Audit
	Software Design Description	. Detailed Design Review
Implementation	Code Listing, Other Documentation(Code Implementation Specification)	. In-Process Audit
Test	Test Documentation	. Functional Configuration Audit
Installation and Checkout	Deliverable items, Installation Report etc, SVVR	. Physical Configuration Audit . Performance-based Audit
	User Documentation	. User Documentation Review

Notes : SWLC : Software Development Life Cycle, SW: Software, SRS : Software Requirement Specification, SVVP : Software Verification and Validation Plan, SQAP : Software Quality Assurance Plan, SVVR : Software Verification and Validation Report. QA : Quality Assurance.

3. Conclusion

A clearly defined division of the responsibility between a nuclear quality assurance program and a software quality assurance activities has been shown. It also established the type of review and audit process in a SQA, which are the development structure, and the scope, organization's responsibility and the authority of the nuclear quality assurance program. Especially, it suggested improved software quality assurance activities in the software development life cycle.

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Table 1 : Software Quality Activities under a Nuclear QA Program