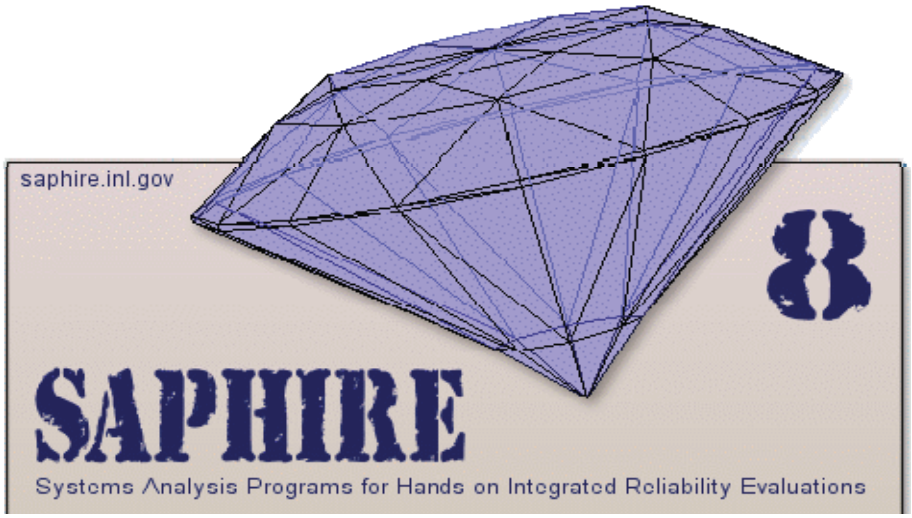
INL/EXT-10-17828

Independent Verification and Validation of SAPHIRE 8 Software Quality Assurance Plan

February 2010



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1.0 Executive Summary

The purpose of the Independent Verification and Validation (IV&V) role in the evaluation of the SAPHIRE Software Quality Assurance Plan is to assess the planned and systematic pattern of all actions necessary to provide adequate confidence that a software product conforms to established technical requirements. The IV&V team began this endeavor after the software engineering and software development of SAPHIRE had already been in production.

The requirements for IV&V review were extracted primarily from the NUREG but also included an examination of best software engineering methods provided in the IEEE Standard for Software Verification and Validation. IV&V based the evaluation upon software quality assurance guidance specified in NUREG/BR-0167, Software Quality Assurance Program and Guidelines. The evaluation criteria and the results of the assessment are identified in section 3 of this document.

Per the requirements and document outline provided in the SAPHIRE IV&V Plan, this report and all subsequent reports will be included as attachments and/or background evidence of the evaluation as well as the results of the assessment.

2.0 Background Information

NUREG/BR-0167, Software Quality Assurance Program and Guidelines, requires the development of software quality assurance activities that includes both management and technical aspects of software development and maintenance.

This report provides an evaluation of the Software Quality Assurance Plan. The Software Quality Assurance Plan is intended to ensure all actions necessary for the software life cycle; verification and validation activities; documentation and deliverables; project management; configuration management, nonconformance reporting and corrective action; and quality assessment and improvement have been planned and a systematic pattern of all actions necessary to provide adequate confidence that a software product conforms to established technical requirements; and to meet the contractual commitments prepared by the sponsor; the Nuclear Regulatory Commission.

Independent Verification and Validation (IV&V) evaluates and assesses the processes and products developed during each phase of the Software Development Life Cycle (SDLC). The SAPHIRE 8 development team is implementing a "spiral" rapid application approach to the product development. One of the roles that IV&V performs, regardless of the development methodology, is to analyze products developed throughout the development process. The intent is to provide a level of confidence to the sponsor that the quality of the software product and supporting documentation is built into the software, not tested in. Evaluating the supporting documentation for each product is one aspect of providing this level of confidence.

IV&V supports and is complementary to the Quality Assurance, Project Management, and product development activities. To achieve this support, IV&V must also evaluate the processes identified in the documentation to ensure that the development team is implementing the processes and methodology that ensures a high-level software product.

Due to the spiral approach implemented for the software development, it is expected that the Software Quality Assurance Plan will evolve as the SAPHIRE 8 product matures. Therefore, IV&V will evaluate each iteration of the Software Quality Assurance Plan.

To provide direction in the evaluation process, IV&V used the software quality assurance guidance specified in NUREG/BR-0167, Software Quality Assurance Program and Guidelines to support the requirements for the SDLC. The Project Plan requirements used for the analysis of the Software Quality Assurance Plan is included in the SAPHIRE 8 Software Independent Verification and Validation Plan (INL/EXT-09-15649). The evaluation criteria and the results of the assessment are identified in section 3 of this document.

3.0 Summary of Findings

An Independent Verification and Validation evaluation of the Software Quality Assurance Plan Document ID: INL/EXT-09-16697 for SAPHIRE 8 was performed using the evaluation criteria contained in section 3.1.1. The evaluation criteria were extracted from the guidance specified in NUREG/BR-0167, Software Quality Assurance Program and Guidelines. Section 3.1.1 refers to the guidance within the NUREG/BR-0167 Software Quality Assurance Program and Guidelines requirements the SAPHIRE 8 Software Quality Assurance Plan must satisfy. Minor corrections for the Software Quality Assurance Plan are listed in section 3.2.

3.1 NUREG/BR-0167 Findings

Refer to the SAPHIRE 8 Software Independent Verification and Validation Plan Document ID: INL/EXT-09-15649 for the substitution of Peer Review in place of Configuration Control Board (CCB).

3.1.1 Section 1.2 Scope and Applicability

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Software quality assurance is the planned and systematic pattern of all actions necessary to provide adequate confidence that a software product conforms to established technical requirements.

Section 1.1 Project Background and Objectives first sentence states "*This Quality Assurance (QA) Plan documents the QA activities that will be managed by the INL related to JCN N6423*".

JCN N6423 Revision 5, Date: 04/20/09, I. Task 9: Quality Assurance specifies that "*INL will support a variety of verification and validation (V&V) activities, including support of a NRC peer review, audits, testing, maintenance, and modifications of the SAPHIRE 8 software*"

Section 1.2 Project Scope and Organization last paragraph states "*INL will follow NRC Management Directive 11.7 "Procedures for Placement and Monitoring of Work with the Department of Energy" related to software development. This directive suggests that "all software development, modification, or maintenance tasks shall follow general guidance provided in NUREG/BR-0167 "Software Quality Assurance Program and Guidance." SAPHIRE 8 will follow the requirements for Level 1 software defined in Section 1.2 of NUREG/BR-0167. The NRC will perform an audit of the software QA implementation once a year against the requirement of NUREG/BR-0167*".

3.2 Software Quality Assurance Plan Document Findings

The following provides minor corrections for the Software Quality Assurance Plan.

1. Section 1.1 Project Background and Objectives first sentence uses the acronym "INL" for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (INL).

2. Section 1.1 Project Background and Objectives paragraph 2 first sentence uses the acronym “NRC” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (NRC).
3. Section 1.1 Project Background and Objectives paragraph 2 first sentence uses the acronym “INL” for the second time. IV&V suggests deleting the definition in front of the acronym and removing the parentheses around INL since the first occurrence of INL is in the first sentence of the section.
4. Section 1.1 Project Background and Objectives paragraph 4 uses the acronym “SPAR” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (SPAR).
5. Section 1.2 Project Scope and Organization first sentence uses the acronym “DOE” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (DOE).
6. Section 1.2 Project Scope and Organization paragraph 5 refers to “10 CFR 830 Subpart A, Nuclear Safety Management”, 10 CFR 830 Subpart A is “Quality Assurance Requirements”.
7. Section 1.2 Project Scope and Organization paragraph 7 starts “Per LWP-13610”. I believe this should be “PDD-13610”.
8. Section 1.2 Project Scope and Organization ninth paragraph last sentence “*Currently, the SAPHIRE development does not reference or require a specific documented SQA process – thus the development falls under the INL SQA process*.” SAPHIRE 8 is using this plan, Software Quality Assurance Plan Document ID: INL/EXT-09-16697. Make corrections as necessary.
9. Section 1.2 Project Scope and Organization paragraph 18 uses the acronym “RES” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (RES).
10. Section 1.2 Project Scope and Organization paragraph 19 uses the acronyms “PM” and “TM” for the first time. IV&V suggests providing the definitions in front of the acronyms and then enclosing the acronyms in parentheses (PM) (TM).
11. Section 1.3 Quality Assurance and Assessment Approach paragraph 5, the sentence “Prior to check-in, programmers must explain…” IV&V suggest changing “explain” to “document”.
12. Section 1.3 Quality Assurance and Assessment Approach paragraph 8 references the “*Acceptance Test Plan*”. Please provide the Document ID for this plan.
13. Section 1.3 Quality Assurance and Assessment Approach last paragraph uses the acronym “TV&V” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (TV&V).
14. Section 1.3 Quality Assurance and Assessment Approach last paragraph uses the acronym “V&V” for the first time. IV&V suggests providing the definition in front of the acronym and then enclosing the acronym in parentheses (V&V).

15. Section 1.5 Change Design and Testing Procedure first sentence references the "*SAPHIRE Change Design and Testing Procedure*". Please supply the Document ID for this procedure after the text "*SAPHIRE Change Design and Testing Procedure, Document ID: INL/EXT-??-?????*".

16. Section 1.5 Change Design and Testing Procedure last paragraph refers to the "*SAPHIRE Change Design and Testing Checklist*". Is this checklist within the SAPHIRE Change Design and Testing Procedure referenced in the first sentence of this section (refer to bullet item 14). Please clarify.