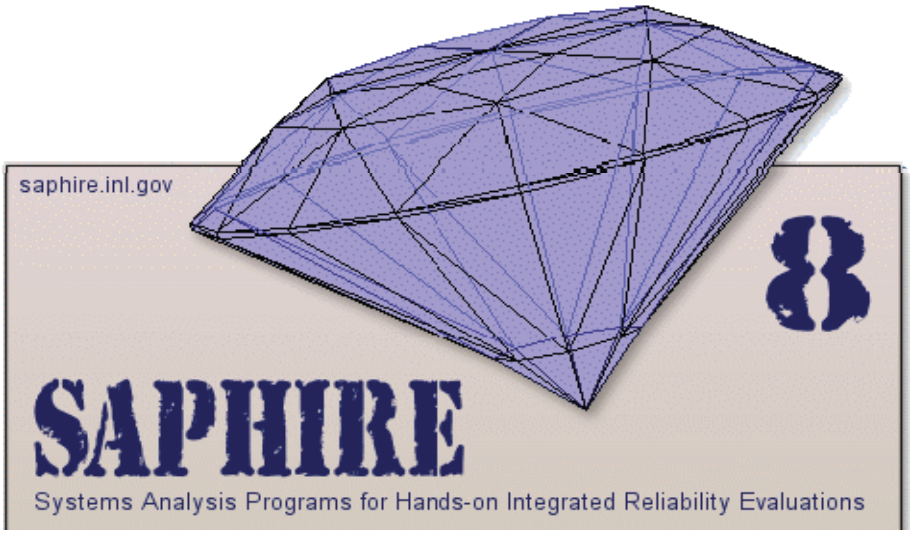
INL/EXT-09-15649

SAPHIRE 8 Software Independent Verification and Validation Plan

April 2009



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Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Acronyms

Acronym	Definition
ASP	Accident Sequence Precursor
CCB	Change Control Board
CCDP	Conditional Core Damage Probability
CDF	Core Damage Frequency
CDP	Core Damage Probability
CMP	Configuration Management Plan
CDR	Critical Design Review
ECA	Events and Condition Assessment
GEM	Graphical Evaluation Module
HTML	Hyper Text Markup Language
IDD	Interface Design Document
IDS	Interface Design Specification
IE	Initiating Event
INL	Idaho National Laboratory
IRD	Interface Requirements Document
IRS	Interface Requirements Specification
IRRAS	Integrated Risk and Reliability Analysis System
IV&V	Independent Verification and Validation
GUI	Graphical User Interface
LERF	Large Early Release Frequency
NUREG	US Nuclear Regulatory Commission Regulation
NRC	Nuclear Regulatory Commission
PDR	Preliminary Design Review
PRA	Probability Risk Assessment
QA	Quality Assurance
RTM	Requirements Traceability Matrix
SAPHIRE	Systems Analysis Programs for Hands on Integrated Reliability Evaluation
SCM	Software Configuration Management
SDD	Software Design Document
SDP	Significance Determination Process
SDP	Software Development Plan
SDS	Software Design Specification
SME	Subject Matter Expert
SQA	Software Quality Assurance
SPAR	Standardized Plant Analysis Risk
SRS	Software requirements Specification
SVVP	SAPHIRE Verification and Validation Plan
STP	Software Test Plan
STR	Software Test Results
V&V	Verification and Validation

1. Introduction

The overall goal of conducting a SAPHIRE version 8 "Independent Verification and Validation" (IV&V) activity is to provide a process to support the Nuclear Regulatory Commission (NRC) in ensuring a high-quality software development process and product through a formal process.

Use of the NRC's Standardized Plant Analysis Risk (SPAR) models may be required in some of the tests. *SPAR models are designated Official Use Only and are to be treated as not publically available.*

1.1. Purpose

The SAPHIRE team is improving the software development process by conducting IV&V activities. The SAPHIRE IV&V process echo's the development process. IV&V is beneficial to the overall development process if it is conducted once the software code base is mature such that the verification takes place shortly prior to what the end users will see in a production version.

What is the definition of IV&V and why is it performed?

Normally, IV&V is the verification and validation of a software product by an organization that is both technically and managerially separate from the organization responsible for developing the product.

- Verification is the process that determines if a product meets its requirements (Are we building the right SAPHIRE product?).

- Validation is the process that determines if a product performs its intended activities (Are we building the SAPHIRE product right?).

In general, IV&V is part of the testing process. It should echo or adapt to the characteristics of the software development methodology being followed. Since SAPHIRE 8 is an 'Object Oriented" approach, each object needs to be examined as it moves through the phases of the development cycle.

Some of the high level benefits of performing IV&V include but are not limited to:

- Visibility into development
- Improved decision criteria
- Alternate technical source
- Reduced maintenance cost
- Reduced frequency of change
- Improved software performance
- Improved confidence in the reliability of the software
- Documents the compliance between the requirements specification and the code

Past SAPHIRE IV&V processes were conducted on IRRAS versions 4 and 5. SAPHIRE version 7 was not formally tested through an IV&V process due to the use of automated tests

(some of which replicate older IV&V tests) as part of the development process. These older IV&V processes and documents will be reviewed for applicability and insights as part of the initial phase of the SAPHIRE 8 IV&V team.

1.2. Objectives and Goals

SAPHIRE 8 is being developed with a phased or cyclic iterative rapid application development methodology. Due to this approach, a similar approach should be taken for the IV&V activities on each vital software object. IV&V and SQA activities occur throughout the entire development life cycle and therefore, will be required through the full development of SAPHIRE 8. Later phases of the software life cycle, the operation and maintenance phases, are not applicable in this effort since the IV&V is being done prior to releasing Version 8.

The IV&V plan is structured around NUREG/BR-0167, "Software Quality Assurance Program and Guidelines," February 1993. The Nuclear Regulatory Research Office Instruction No.: PRM-12, "Software Quality Assurance for RES Sponsored Codes," March 26, 2007 specifies that RES-sponsored software is to be evaluated against NUREG/BR-0167. Per the guidance in NUREG/BR-0167, SAPHIRE is classified as "Level 1." Level 1 software corresponds to technical application software used in a safety decision.

Previous verification and validation of SAPHIRE have also utilized the IEEE Standard for Software Verification and Validation. The SAPHIRE testing, verification and validation (TV&V) process currently in place had also been compared to the IEEE standard. From this comparison, four key recommendations were developed:

1. Reach a consensus on the target software integrity level [1, 2, 3, or 4].

2. Create a formal Software Validation and Verification Plan document that describes which V&V activities will be performed, and which will not.

3. Utilize a functionally independent (from the developmental organization) V&V person(s) for at least some V&V functions.

4. Perform a V&V audit by a non-INL entity. This audit could be conducted once a year and could be performed by a NRC employee not directly associated with the SAPHIRE development project.

This plan is designed to satisfy recommendation 3. The SAPHIRE 8 IV&V team will be following this IV&V plan.

The IV&V plan follows the Table 1, "IV&V Tasks Based on NUREG/BR-0167" given at the end of this document. A checklist has been developed to implement the Table 1 tasks and products, and is attached. The checklist provides comprehensive coverage of NUREG/BR-0167 V&V activities. A comparison of the checklist to the NUREG/BR-0167 Table 3-1, "Verification and Validation Activities by Major Life Cycle Activity," shows that V&V activities associated with Requirements Definition, Design, Implementation, Qualification Testing, and Installation and Acceptance Testing are planned to be checked. Since SAPHIRE 8 is not yet in maintenance

or operations, the V&V activities are not yet applicable. However, if schedule and budget permit, the IV&V will also check on plans to maintain the software. In addition to the life cycle phases given in NUREG/BR-0167 Table 3-1, the checklist covers the software project plan, project tracking and oversight, configuration management, and risk management which are included elsewhere in the NUREG. Furthermore, tasks and products associated with both NUREG/BR-0167 and IEEE STD 1012-2004 are included in this IV&V effort as shown in Table 1 of this plan. Therefore, this IV&V plan comprehensively covers NUREG/BR-0167 and includes some tasks and products associated with the IEEE STD 1012-2004.

Since the testing phase comes after the other phases, it is important that the IV&V remain within schedule and budget to ensure the testing activities specified in the plan will be completed. Potential deviations from the plan will be brought to the NRC's attention. Additional activities may be pursued if schedule and budget permits.

The IV&V is complemented by other V&V activities. The NRC's internal peer review will review requirements and design documents, and will test a beta version of the software. In addition, beta testers are testing the software and NRC audits are performed against NUREG/BR-0167.

The comparison report found that SAPHIRE TV&V practices most closely satisfied the IEEE standard's Level 1 tier, and in some cases the practices were felt to match higher level tiers.

The actual integrity level of a software project should be decided upon via mutual agreement between the customer and the code developers The IEEE V&V describes a set of life cycle processes (e.g., management, development, maintenance) to which the standard applies. It notes that only those life cycle processes used by a software project need comply with the standard. Table 1 below briefly describes the life cycle processes defined in the IEEE standard, and their applicability to SAPHIRE project.

The IEEE development portion of the IEEE life cycle process closely corresponds to the NUREG/BR-0167 software life cycle description. This NUREG recognizes that each software project must tailor the life cycle processes to fit the scope of effort, using cost-effective management and judgment.

Table of IEEE standard life cycle and applicability to the SAPHIRE development process.

Life cycle process	**Description**	**Used by SAPHIRE?**
Management	Overall handling of the software project	Yes
Acquisition	Request for proposal; selection of a supplier; acceptance of software product	Limited applicability
Supply	Proposal preparation; development of project plans; delivery of product	Limited applicability
Development	Requirements analysis; design; coding; integration; testing; installation and acceptance	Yes
Operation	Operation of the product and support to users	Yes
Maintenance	Modifications due to problems or need for improvement	Yes

IEEE software integrity levels.

Error Consequence	Likelihood of occurrence of an operating state that contributes to the error			
	Reasonable	**Probable**	**Occasional**	**Infrequent**
Catastrophic	4	4	4 or 3	3
Critical	4	4 or 3	3	2 or 1
Marginal	3	3 or 2	2 or 1	1
Negligible	2	2 or 1	1	1

IEEE definitions of consequence.

Consequence	Definitions
Catastrophic	Loss of human life, complete mission failure, loss of system security and safety, or extensive financial or social loss.
Critical	Major and permanent injury, partial loss of mission, major system damage, or major financial or social loss.
Marginal	Severe injury or illness, degradation or secondary mission, or some financial or social loss.
Negligible	Minor injury or illness, minor impact on system performance, or operator inconvenience.

SAPHIRE is at IEEE integrity level "1", the lowest. If one examines the IEEE software integrity level table, SAPHIRE can be assigned an IEEE-1012 level of 1 and still be critical to supporting the decision-making process. Because SAPHIRE is not the only tool used to support the decision-making process it should not be classified as "Catastrophic." Furthermore, no metrics to support an IEEE-1012 classification higher than a "1" currently exist. The results of any calculation information from SAPHIRE depend largely on how a model has been implemented by a user. A process exists to analyze all errors reported by the user community.

The IEEE standard levels are based on considerations of 1) the likelihood of occurrence of an operating state that contributes to the error, and 2) error consequence. IV&V activities in this plan which correspond to the IEEE software standard should be done at the level 1 tier. More rigorous reviews may be considered at higher levels for life cycle activities such as "Implementation" and/or "Test" if the schedule and budget permit. Therefore, the IV&V plan, while based on the governing document, NUREG/BR-0167, also considers how the review activities and products correspond to the current IEEE software standard.
The NUREG/BR-0167 also requires an IV&V test report upon completion of the development efforts. For meeting NUREG/BR-0167 requirements, there also needs to be an SQA interface with the development team. This individual will also interface with the IV&V representative.

Each developer is responsible for ensuring that the code they create has met the criteria discussed in the NUREG/BR-0167. According to the contract that the INL holds with the NRC, SAPHIRE 8 is supposed to be brought up to "state of the art" software. This means that activities that are called out in the NUREG/BR-0167 not currently being performed by the developers should be modified so that they are brought in compliance. If required, additional support tasks may need to be incorporated into the development process. Some tasks are the responsibility of the developers to incorporate into their code. Other tasks could be done by support personnel such as a software technician. A subject matter expert familiar with PRA modeling techniques needs to be available for consultation. Due to finite programmer resources supporting the SAPHIRE

effort, automated analysis tools may be purchased to support QA and IV&V activities and improve the analysis process.

A distinction needs to be made for clarification of IV&V activities. Verification and validation activities encompass all activities that the developers and testers, software quality assurance representatives and independent auditors perform to ensure a quality software application (see Figure 1 for an overview of typical testing activities). Each participant has specific roles and responsibilities based on the function being performed by the individuals. In this plan, it was attempted to delineate the expected inputs and outputs between the developers and SAPHIRE 8 team members as compared to the IV&V team members.

For each functional area, the tasks outlined in the NUREG/BR-0167 Software Quality Assurance Program and Guidelines will be noted. If, upon review, an item is found to be lacking, an action plan will be implemented to take corrective action and monitored until corrected or explained. Not every item listed will be applicable to each major functional area. Further, not all comments will need to be resolved prior to a general release of SAPHIRE 8 – minor issues and recommendations may be addressed during a later release of the software. The NRC will make these determinations.

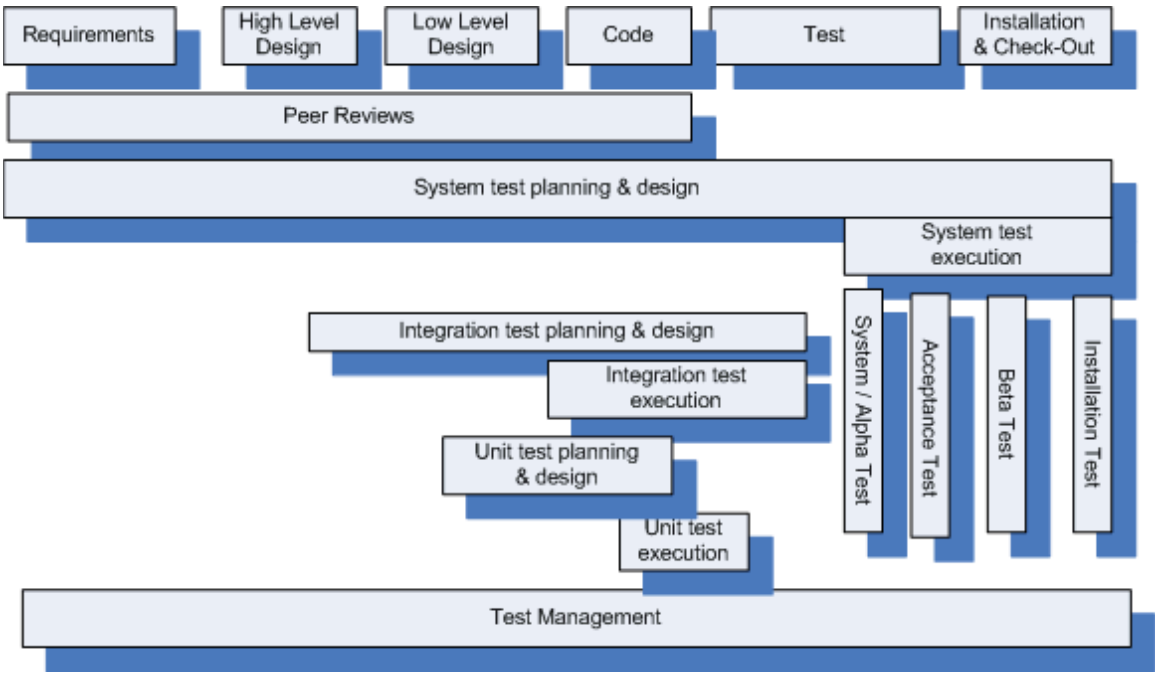


Figure 1. General Testing Activities and the Software Life Cycle.

Figure 1 maps the basic phases of software development and the types of testing possible during the life cycle of a software application development effort. The SAPHIRE 8 development team is not performing every type of test that is indicated in the figure. The SAPHIRE team has selected certain test phases as the most effective approached to the testing effort. See Table 1 IV&V Tasks Based on NUREG/BR-0167 for the specific test phases to be performed. The IV&V Team will witness all or a portion of the tests and inspect the results of the tests performed by the development team. Additional analysis and indication of needed test effort may be required by the IV&V Team as part of the overall verification and validation effort and to

provide customer confidence in the new software release. See Table 1 IV&V Tasks Based on NUREG/BR-0167 for a break out of specific products required for by the development team and the IV&V team to support the SAPHIRE 8 V&V effort .

2. Referenced Documents and Sources

Applicable sources of information that will be available to the IV&V team include:

- Access to personnel staffing the development team
- Source code stored in the revision control system
- Beta test feedback stored in the change log system
- NRC Form 173s
- NRC Form 189s
- General INL project information (e.g., monthly reports)
- Automated tests and QA results
- SAPHIRE Verification and Validation Plan, Volumes 1 and 2
- Module design documentation
- SAPHIRE 8 New Features and Capabilities document
- User feedback checklists
- Design review documentation
- Past IV&V reports, including prioritization of key features
- SAPHIRE 8 Source code.
- SAPHIRE 8 Software Requirements, Design and Test documentation
- NUREG/BR-0167 Software Quality Assurance Program and Guidelines
- NUREG/BR-0167 SQA Audit Check Sheet
- IEEE-1012 2004 Standard
- SAPHIRE Modeling & Analysis Software Compliance to Requirements - Assessment Checklist

3. IV&V Overview

This section discusses the project organization, schedules, resource allocation and tools, techniques, and methodologies.

3.1. Organization of IV&V Activities

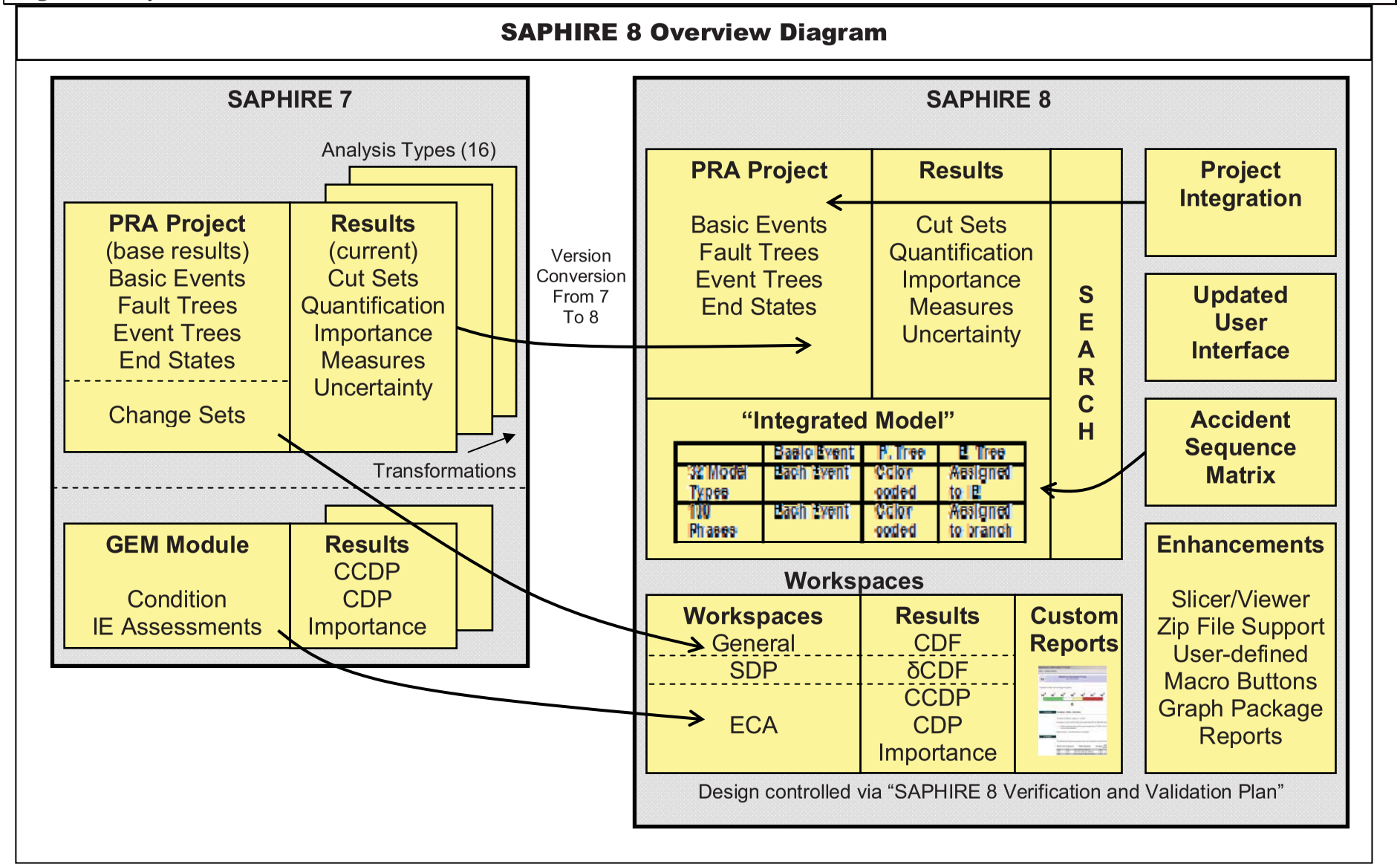
The Table 1, "IV&V Tasks Based on NUREG/BR-0167," provides the list of activities to be performed by life cycle phase. As can be seen in this table, certain activities also correspond to activities in the IEEE software standard. The checklist developed for the NRC audits of SAPHIRE can be found in the Revision Control System (RCS). This checklist may be useful for the IV&V team to consult, but does not replace the activities and products given in the table which are to be completed.

The key functional areas of focus for the IV&V team are shown in Figure 2. The team, which will be selected during the initial phase of the IV&V, will focus on vital aspects of these key areas. Vital aspects, new or carried over from the previous SAPHIRE version 7, will be included in the IV&V. Non-vital aspects should also be included in the scope of the IV&V; however, the focus should be on the vital aspects.[1]

Note that the team members will have a variety of backgrounds (e.g., QA, PRA). The SAPHIRE 8 IV&V team is looking for "functional" independence (from the SAPHIRE development project) for team members. Consequently, INL staff that work on other NRC projects or that have used SAPHIRE in the past can be considered for the IV&V team.

[1] For the V&V of SAPHIRE Version 5 (as described in NUREG/CR-6116 Volume 9), a “vital feature” was defined as those that (a) affected the results of a PRA and (b) are essential for completing a PRA analysis.

Figure 2. Key Elements of SAPHIRE Version 8 Software and Contrast with Version 7.



The SAPHIRE 8 graphical user interface (GUI) is implemented using a modern Windows-design environment which allows for multiple, resizable forms. Functionality for the previous GEM and SAPHIRE interfaces will be accessed from within SAPHIRE 8. The GUI is coded in Delphi and object Pascal.

The GUI has a top-level main form that allows the user to choose between model development or to perform an analysis. Under the model development option, the user will be able to select a fault tree logic diagram, an event tree logic diagram, basic events, end states, or a project workspace.

When a user performs an analysis, a copy of the relational database files are created and stored in a unique workspace folder in the workspaces directory. Once the analysis is complete (i.e., saved) the relational database files will be compressed into a single .zip file. The compressed file may be shared with another user if desired. The uncompressed file may be opened at a later time and the database reviewed to inspect the analysis. Currently, three types of workspaces are available: General, SDP, and Events and Condition Assessment (ECA). The analysis process, reports, and results are customized specific to each type of workspace.

A variety of enhancements have been implemented in SAPHIRE 8. For example, SAPHIRE has a more powerful cut set slicer, supports compressed files, allows users to assign macros to on-screen buttons, contains a better graphing package, and uses HTML-based report templates.

Analysis improvements have been implemented. In SAPHIRE 7, different "types" of models were stored in select analysis type parts of the database such that aggregate results were not available. In SAPHIRE 8, the user may define up to 32 "model types" (e.g., full power internal events, low power internal events, seismic events, and flooding events) such that this information is shareable within a single project enabling aggregate (or single if needed) risk assessment.

To support the development of "integrated models" (models with multiple model types), features such as an "accident sequence matrix" are used to enable the development of external events models via a semi-automated process. The fault tree model editor has been designed to be aware of the different model types and will show the user which events (and their respective probabilities) apply to the individual model types.

In SAPHIRE 8, the user now has the ability to search (in text fields such as names and descriptions) on objects in the project database, thereby facilitating a way to quickly find information in large project.

3.2. Schedule of Activities

The IV&V functions can commence upon receipt of funding and will last approximately eight months. An approximate schedule is presented below in Schedule and Products, assuming a March start (a later start will push the timetable back by the delay time). For example, the first area targeted will be the core functionality of model construction and examination of the updated and existing SAPHIRE 8 capabilities. This includes construction of Basic Events, Fault Trees, Event Trees, and End States. Since this is the core of the SAPHIRE application and will support

any additional functionality, performance of SQA and IV&V as early as possible will insure a solid review for future use of the software.

Key Areas

1. Model Construction
2. Standard Analysis Interface
3. Workspace Analysis Interfaces
4. PRA Quantification
5. General Support Features and Capabilities

Schedule and Products

T0 – IV&V team selection and finalize IV&V plan, including prioritization of activities. Final test plan must be approved by the NRC Project Manager.

Period: March, 2009
Product: IV&V plan including comments from IV&V team

T1 – Requirements, Design, Implementation Review, IV&V assessment

Period: April – July, 2009
Products: Monthly progress reports; IV&V products in the table; draft report sections for final report. Checklist review (e.g., requirements, design, implementation, etc.), IV&V assessment.
Note: Some IV&V observation/evaluation/testing can begin.

- Checkpoint: NRC assesses progress and determines if additional IV&V time is needed

Milestone: Version 8 beta 4 ready for IV&V testing completed by end of June, 2009. NRC will review this version to ensure it is ready for IV&V testing prior to it being provided to the IV&V team in July. This version will not include algorithmic improvements for SAPHIRE calculation speed.

T2 – Test, Installation and Checkout

Period: August 2009 – January 2010
Products: Monthly progress reports; IV&V products in the table; draft report sections for final report.

- Checkpoint: NRC assesses progress and determines if additional IV&V time is needed

Product: Final Report – January 2010 or later as specified by NRC Project Manager based on NRC assessments. Checklist review (e.g., testing, installation and checkout, etc.)

Note: IV&V observation/evaluation/testing to be completed. In addition, the development team is utilizing a rapid application, spiral methodology approach for software development. Therefore some criteria in the checklist may need to be reassessed and reviewed to complete any remaining life cycle phases.

Milestone; Version 8 beta 5 ready for NRC review by end of January 1010

T3 – SAPHIRE Development Team Finalizes Version 8 for release

Period: February, 2010 – March, 2010

Management

NRC approval is necessary for

- the final IV&V plan
- changes in scope, level of effort, or schedule
- acceptance test plan developed by the development team for the vital and non-vital aspects prior to beginning the test phase (T2)
- determining which major IV&V team recommendations to resolve before releasing Version 8 (it is recognized that not all recommendations will need NRC approval for resolution)

Detailed monthly progress reports will be provided to the NRC Project Manager and Technical Monitor.

The INL SAPHIRE development team will respond to IV&V findings, as appropriate, as the IV&V review is being done. Additional time (T3) will be available to the SAPHIRE development team after completion of the Final Report to allow the team to finalize Version 8 for release.

3.3. Resource Summary

The IV&V personnel will consist of one "Full Time Employee" assigned to act as the IV&V Lead. This person is an experienced developer or QA engineer that has not developed code specifically for SAPHIRE 8.

Two additional ½ time support persons on an as needed basis for performing some the IV&V activities. This may include but is not limited to subject matter experts, software technicians or student interns. All personnel will be required to read this document and be familiar with the software development methodology. These roles may last for a few days or a few weeks depending on the need. A resume of all personnel utilized in this effort will be on file.

All test equipment needed currently resides at the INL.

3.4. Tools, Techniques and Methodologies

The tools to be utilized in the SAPHIRE 8 IV&V process are:

Windows XP Professional Desktop computer with all current security patches
SAPHIRE 8 executable installed on the Windows computer
Component Software Revision Control Software tool (CS-RCS)
SAPHIRE automated test suite
Code Healer Software Analysis Tool Version 2.5 SOCK software
Delphi 2007 Software Development Environment
MS Word Processor
SPAR models
Delphi and Modula-2 Coding Standards

Techniques and methodologies will include code review of randomly chosen source code files against the NUREG/BR-0167 standard, Code Healer analysis of randomly chosen sections of the software, tracing of randomly chosen functional areas from requirements to final test results. Possible auditing of any and all documentation pertaining to design reviews, software change processes or other pertinent SAPHIRE 8 processes and products.

4. Completion and Deliverables for the IV&V Activities

The basic high level functional areas will be examined in the order listed. This will echo the application development and provide immediate feedback while the code is still being developed and tested; and provide a solid basis for further interface and development for the next iterative cycle. See Table 1 for the high level focus areas. For the high level areas, the IV&V team will be reviewing and testing as described in the NUREG/BR-0167 and IEEE STD 1012-2004 (IEEE STD 1024-1998 has been superseded) as a secondary reference where applicable. See Section 3.2 for the high level breakdown of the SAPHIRE 8 IV&V focus.

For each functional area, the tasks outlined in the NUREG/BR-0167 Software Quality Assurance Program and Guidelines will be accounted for. If upon review an item is found to be lacking, an action plan will be implemented to take corrective action and monitored until corrected or explained. Not every item listed will be applicable to each major functional area.

Table 1 lists all the expected tasks and deliverables to support this activity. Since the IV&V echoes the development process, as each vital feature for key areas are complete, the corresponding IV&V activities should commence. If the development is delayed, the IV&V activities must be delayed as well.

The key deliverable will be the final IV&V report listing the results of the IV&V process. This report will provide input to the SAPHIRE developers in order to focus future software development. This report will focus on what modifications should be considered in order to ensure SAPHIRE Version 8 is a quality product. The NRC will review these suggestions and, in conjunction with INL feedback, prioritize the suggestions for resolution. An overview of the

IV&V process and results will also be summarized as a chapter in the SAPHIRE SVVP document.

4.1 Final Report Format

For each IV&V Review Area evaluated, the IV&V Review Report should contain the status of the SAPHIRE 8 Project, including any pertinent historical background information. The report should also contain a detailed analysis of each applicable IV&V Review Area, which answers at least the following questions:

- What are the current processes, procedures, practices and technology?
- What is good about the current processes, procedures, practices and technology?
- What about the current processes, procedures, practices, and technology needs improvement?
- What are the test results and insights?
- Is the project documentation accurate and up-to-date?
- What deviations from the IV&V plan exist and are they reported?

Here are the sections that will be presented in the SAPHIRE 8 Software Independent Verification and Validation Review Report

- Section 1 Executive Summary
- Section 2 Background Information
- Section 3 Project Summary
- Section 4 Summary of Findings
- Section 5 Summary of Analysis
- Section 6 Summary of Recommendations
- Section 7 Summary of Best Practices
- Section 8 Summary of Lessons Learned
- Attachment 1: List of Personnel Contacted
- Attachment 2: List of Documents Reviewed
- Attachment 3: List of Software Test Tools and Tool Descriptions
- Attachment 4: Detailed Findings and Recommendations Table
- Attachment 5: Project Best Practices
- Attachment 6: Project Lessons Learned

Note – IV&V will generate independent tests and review developer test processes, test suite , and test results as specified in this plan.

Table 1 IV&V Tasks Based on NUREG/BR-0167

Life cycle Phase	Tasks performed by IV&V based on Developer Tasks/Requirements	Inputs to IV&V from Development Team	IV&V Products
Project Plan	Project Plan - Compliance to NUREG/BR-0167$_1$	• SAPHIRE 8 Project Plan$_1$	Results of document review$_1$
Requirements	Requirements Traceability Analysis: • Analysis of Software Requirements Specification (SRS)$_3$ • Analysis of Interface Requirements$_3$ • IV&V Development of Initial SVVP in parallel with Developer Tasks$_3$	• SRS$_3$ • Interface Requirements Specification(IRS)$_3$ • Requirements Traceability Matrix(RTM)$_3$ • Acceptance Test Plan$_3$	Report Results of Traceability Analysis$_3$ Report Results of Requirements and Interface Document reviews$_3$ Status Report$_1$ High Level System Test Plan$_3$ Software Validation and Verification Plan(SVVP)$_3$
Design	• Participation in Preliminary Design Review (PDR)$_3$ • Assess traceability of design to requirements$_3$ • Assess interfaces$_3$ • Assess Documents to appropriate Standards$_3$ • Participate in Critical Design Review (CDR)$_3$	• SRS$_3$ • Software Design Specification (SDS)$_3$ • Iinterface Design Specification(IDS)$_3$ • RTM$_3$ • Results of PDR$_3$ • Results of CDR$_3$ • Configuration Management Plan$_3$ • Change Control process & reporting convention is finalized$_3$	Anomaly Reports of Traceability & interfaces$_3$ Anomaly reports of documentation to Standards$_3$ Update SVVP$_3$ Results of Configuration Management Plan review$_1$
Configuration Management	• Configuration Management Methodology$_1$ • Baselines established and under Change Control$_3$	• Updated Configuration Management Plan$_3$ • Control Board charter$_1$	Results of Configuration Management Plan review$_1$ Roles and Responsibilities of Control Board$_1$

Life cycle Phase	Tasks performed by IV&V based on Developer Tasks/Requirements	Inputs to IV&V from Development Team	IV&V Products
Implementation	If changes made to SRS, SDS, and/or IRS, re-validate through requirements, design, and interface prerequisites: • Evaluate RTM to ensure traceability of requirements from source to design to software requirements spec$_3$ • Evaluate regression test results$_3$ • Review CMP requirements against information in Status Accounting (Access Database or other mechanism for tracking - configuration and change control)$_3$	Updated SDS, SRS, IRD as needed (if changes were made) • RTM$_3$ • Source code of new modules/units$_3$ • Results from regression testing of modules that may be affected by new code$_3$ • User Documentation$_3$ • Status Accounting$_3$	Reports of updated documentation, results of traceability assessments, regression tests$_3$ Evaluate coding standards and that there are complete and correct **comments in all affected modules of the source code**$_1$ Update SVVP (as needed)$_3$
Test **Static Analysis Tests**	• Evaluate Test Plans prior to test$_3$. • Ensure Test case identifiers map to design components to software requirements (RTM)$_3$ • User Documentation is accurate (user's functionality maps to testing, etc.)$_3$ • Review CMP requirements against information in Status Accounting$_3$ • Review automated test suite$_3$ • Some or all: Performance, Path, Static Analysis, Memory Link, Coverage, Trending, Complexity, Functional •Others determined by IV&V team	RTM STP User Docs (if updated) Access to Configuration Management "Library" and Change Control Reviews, etc. Baseline source code$_3$ Software executable compiled in debug mode. A copy of the *.map file created during build process	Reports of status of RTM, test cases, test scenarios, and test procedures, results of testing, and user manuals/documentation Updated SVVP issued Reports on metrics produced from static analysis and techniques and tools

Life cycle Phase	Tasks performed by IV&V based on Developer Tasks/Requirements	Inputs to IV&V from Development Team	IV&V Products
Functional Tests	• Review developer's automated test suite$_3$ • Observe and evaluate developer's tests and test results$_3$ • Cutset level reviews	Executable Code or SAPHIRE-formatted Macros for automated test suite$_3$. Tests to be included in (but not limited to) the developer's Acceptance Test Plan: • Cutset level reviews for analysis using new features, capabilities, algorithms, and methods. • Verify the Multi-pass algorithm, the min-max algorithm, and the Figure III-D on the Significance Determination Process Step 4 "Analysis Results." • Tests specific to the application of cut set "recovery rules." • Verify algorithm modifications that could affect numerical results. • Comparison of results generated by different user interfaces$_3$	Reports of status of automatic test cases, automated test scenarios, and automated test procedures, results of automated testing$_3$, Update SVVP$_3$
Qualification / Acceptance Test	• Monitor Acceptance Test execution$_3$	Qualification/ Acceptance Test procedures$_3$	Reports of status of RTM, test cases, test scenarios, and test procedures, results of qualification/ acceptance testing$_3$ Update SVVP$_3$
Installation and Checkout	• Review Installation instructions$_3$ • Execute Installation Instructions$_3$	Installation Instructions$_3$	Final Report generation – V&V summary report, Anomaly Report, etc.$_3$

Footnote Legend:
1: Located in NUREG/BR-0167
2: Located in IEEE-1012
3: Located in NUREG/BR-0167 and IEEE-1012

The following checklist items are provided at a level of rigor that is intended to:

1) Provide sufficient information to NRC for audit purposes.

2) Update artifacts to begin a path forward for further improvements to meet good software engineering practices commensurate with NRC and industry standards.

3) Conduct IV&V in a cooperative environment with developers. It is not the intent that IV&V be conducted in an "adversarial" environment. IV&V and the developers must work as a team to be successful. Should issues arise that cannot be resolved between IV&V and the developer, the issue(s) can either be resolved by the NRC sponsor or identified in the checklist with developer and IV&V differences addressed in the comments section of the checklist.

4) Identify the IV&V test effort. IV&V will ~~not~~ conduct independent testing and also will evaluate and observe the developer's tests to ensure they are complete and accurate and that the test processes are met according to the approved documentation. The applicable IEEE integrity level is level 1; however, the IV&V may consider IEEE testing activities (or other activities) at a greater level given the schedule and budget constraints.

5) The checklist comprehensively covers NUREG/BR-0167. Some tasks performed in a "full-up" IV&V effort as identified in industry standards, such as IEEE, will not be performed. IV&V tasks will be identified in the IV&V Plan and developed in a coordinated effort with the developer and the sponsor

6) Only those checklist items that are applicable (as agreed between the developer, sponsor, and IV&V) will be evaluated. This checklist is only a guide and some of the checklist items may be N/A. However, during the assessment process, checklist items may precipitate additional items that will be incorporated into this checklist. Checklist items are also prioritized to help meet schedule and budget constraints.

7) Provide information in the comments for EVERY checklist item. Comments must identify the location (e.g., RCS) for criteria that "Pass" for use as objective evidence of the review. The intent for using the checklist is not only to identify issues (i.e., "Fail") but also any "exceptional" practices. Explanations for N/A criteria must also be identified.

8) Each of the criteria in the checklist is prioritized. High priority is "1", medium priority is "2", and low priority is "3"

This checklist does not require that the assessment items be conducted as provided in the order below.

SOFTWARE PROJECT PLAN		
Criteria Priority: 1	**Has the developer created a Software Project Plan? NUREG/BR-0167 Section 4.2 and 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Plan provide project background and objectives? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the Project Plan address plan scope and organization? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan address plan maintenance (i.e., Project Plan updates)? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the Project Plan been approved by the NRC sponsor? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Project Plan describe the approach used to plan the project? NUREG/BR-0167 Section 5.2.4.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Plan describe the approach used to track technical progress? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan describe the approach used to track conformance to the planned schedule? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan describe the approach used to track costs as related to actual work performed? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Project Plan describe the approach used to track metrics? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments

Fail		
N/A		
Criteria Priority: 3	**Does the Project Plan describe the approach used to track security? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Project Plan describe the approach to track risk? NUREG/BR-0167 Section 5.2.4.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan address the organization, tasks, and responsibilities (i.e., Show how the tasks in the SOW are assigned to responsible elements of the project organization? NUREG/BR-0167 Section 5.2.4.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan provide the initial, top-level project schedule and the rationale for arriving at this schedule? NUREG/BR-0167 Section 5.2.4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan identify project resources including staffing, software engineering environment, and support tools? NUREG/BR-0167 Section 5.2.4.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Plan address Configuration Management, specifically, project baselines, change control, baseline status, proposed changes, implemented changes, software development library, documentation and code and does it address the establishment of a change control board to review and approve (or disapprove) recommended changes? Has the Change Control Process/Procedure been finalized? NUREG/BR-0167 Section 5.2.4.6 – Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Project Plan describe how each major life-cycle task of the SOW work will be implemented? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Plan describe the nonconformance reporting and corrective action process, including nonconformance detection and reporting, impact assessment and corrective action and tracking, and tracking and management reports? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria	**Does the Project Plan identify all deliverables and the dates they are due?**	

Priority: 2	**NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Plan address standards, procedures, conventions and metrics to be used? This includes product standards, such as documentation standards and coding standards and process standards, including inspection and review procedures. NUREG/BR-0167 Section 5.2.4 – Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Software Project Plan provide information on tracking and oversight? NUREG/BR-0167 Figure 5-1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the schedule include milestones for life-cycle reviews, such as requirements reviews, preliminary design reviews, and critical design reviews for IV&V review? NUREG/BR-0167 Section 3.**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Software Project Plan map the tasks in the SOW to elements in the WBS? Has the WBS been developed and under CM control? NUREG/BR-0167 Section 1.4, Section 5.2, Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Software Project Plan provide a project schedule, such as a GANTT chart, and rationale for tasks identified in the project schedule? NUREG/BR-0167 Figure 5-1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Software Project Plan identify resources needed (equipment, personnel, tools)? NUREG/BR-0167 Section 2.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Software Project Plan describe nonconformance reporting and corrective action processes (nonconformance detection and reporting)? NUREG/BR-0167 Figure 5-1 and Section 3 of the PMP**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is an impact assessment performed on nonconformance items and corrective actions identified? NUREG/BR-0167 Section 7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**How are nonconformance items, their related reports, and corrective actions tracked (e.g., DBMS, Excel Spreadsheet, Configuration Management, etc.)?**	

	NUREG/BR-0167 Section 7	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Is the quality assessment approach and improvement approach been described? NUREG/BR-0167 Section 5.2, Section 8**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Are deliverables and dates due identified? (Also in the project schedule)? NUREG/BR-0167 Section 1.2 and Table 8.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are standards used for documentation identified and adhered to? NUREG/BR-0167 Section 5.2.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are coding convention standards identified and adhered to? NUREG/BR-0167 Section 5.2.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are code and documentation inspections and reviews identified, recorded, and under CM Control? NUREG/BR-0167 Section 3.2.3**	
Pass		Comments
Fail		
N/A		

PROJECT TRACKING AND OVERSIGHT		
Criteria Priority: 2	**Is monitoring, assessing, and reporting technical progress performed and actual results and performance tracked against the Software Project Plan? NUREG/BR-0167 Section 5.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is monitoring progress performed on an ongoing basis to maintain communications at all levels of the developer and sponsor organizations? Is there a record of this activity (reviews, reports, meetings, brainstorming sessions) and the information placed under configuration control? NUREG/BR-0167 Section 5.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Are technical progress, costs, critical target computing resources, schedule, and risks tracked quantitatively? NUREG/BR-0167 Section 5.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority:	**Does the PM determine and report schedule, cost status of variances from the baseline plan? (Is there a baseline Plan and is it under CM Control?) NUREG/BR-0167 Section 5.3**	
Pass		Comments
Fail		
N/A		
Criteria 2 Priority:	**Are corrective actions implemented when actual results and performance issues indicate significant deviations between the Software Project Plan and current schedule, including but not limited to adding staff, extending work week, and or changing the skill mix? NUREG/BR-0167 Section 5.3**	
Pass		Comments
Fail		
N/A		

SOFTWARE CONFIGURATION MANAGEMENT		
Criteria Priority: 1	**Does the Configuration Management approach/methodology identify, define and reference procedures used for establishing and maintaining project baselines? NUREG/BR-0167 Sections 2.5, 6.2, 6.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Configuration Management approach/methodology identify, define and reference procedures used for establishing and performing change control? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Configuration Management approach/methodology identify, define and reference procedures used for implementation and release of changes? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Configuration Management approach/methodology identify, define and reference procedures used for code, access, and media controls? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Configuration Management approach/methodology identify, define and reference procedures for the use, access, and maintenance of the software development library? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are all nonconformance items under CM Control? NUREG/BR-0167 Section 6 and 7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are the monthly progress reports under configuration management control? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are peer reviews and structured walkthrough documents/completed forms under configuration control? NUREG/BR-0167 Section 3.2.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the developer follow a written configuration management policy/methodology? NUREG/BR-0167 Section 6.1**	

Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are baseline documents for planning, managing and building the system (software) established and controlled (Explicitly identify project baselines for software products (source code, test cases, software specifications (standards & procedures) needed to establish & maintain stability of software activities?** **NUREG/BR-0167 Section 6.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have a naming / labeling system that: uniquely identifies all project entities (documents, software elements, and test cases), changes by revision or version (and under CM Control), unique identification of configuration/version of revised software for use?** **NUREG/BR-0167 Section 6.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are baseline documents for planning, managing and building the system (software) established and controlled?** **NUREG/BR-0167 Section 6.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a Configuration Control Board been established (as well as a Change Control Board Charter)?** **NUREG/BR-0167 Section 6.2**	
Pass		Comments
Fail		
N/A		

SOFTWARE REQUIREMENTS **It is assumed that shall and will are requirement identifications whereas should and would are "statements of fact" and not considered "testable" requirements.**		
Criteria Priority: 1	**Does the Requirements Document identify requirements that are uniquely identified, testable, and traceable through the software life cycle? NUREG/BR-0167 Section 4.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Requirements Document address the functions that the software is to perform and only what is to be performed? NUREG/BR-0167 Section 4.3.1, Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Requirements Document address time-related requirements of software operation such as speed, response time, and/or other performance requirements? NUREG/BR-0167 Section 4.3.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Requirements Document address constraints imposed on implementation activities, including but not limited to hardware platform and programming language? NUREG/BR-0167 Section 4.3.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Requirements Document address attributes of the software, such as portability, access controls, property of an object, element, or file? NUREG/BR-0167 Section 4.3.3 – Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Requirements Document identify external interfaces – interactions/communications with people, hardware, and other software? NOTE: Interfaces may be identified in a separate document, e.g., an Interface Requirements Specification. NUREG/BR-0167 Section 4.3.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Requirements Document identify internal interfaces – interactions/communications which exist between separate software components and provide a programmatic mechanism by which these components can communicate? NOTE: Interfaces may be identified in a separate document, e.g., an Interface Requirements Specification. NUREG/BR-0167 Section 2.2, Section 3.2.2.2 – Section 3.2.4.1 -Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria	**Does the Requirements Document identify assumptions, constraints, or dependencies**	

Priority: 1	**that the requirements are based upon? NUREG/BR-0167 Section 4.3, Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is each requirement uniquely identified and requirements baseline under CM control? NUREG/BR-0167 Section 6.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are the requirements verifiable (clarity increases verifiability)? NOTE: A requirement is verifiable if some method can be devised for objectively demonstrating that the software implements it. NUREG/BR-0167 Section 3.2.1.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does each statement of a requirement contain one and only one requirement? Are all requirements identified uniquely and unambiguous? (Functional, Performance, Design Constraints, Attribute, Interfaces). Do requirements state WHAT and not HOW they are implemented? Note: Interface requirements may be included in the SRS if not in a separate document. NUREG/BR-0167 Section 3.2.1.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is there a Requirements Traceability Matrix? NUREG/BR-0167 Section 3.2.1.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Requirements Traceability Matrix (RTM) provide the preliminary trace of Functional Requirements (e.g., FR-01), Performance Requirements (e.g., PR-01), Design Constraint Requirements (e.g., DCR-01), Attribute Requirements (e.g., AR-01), and Interface Requirements (e.g., IR-01) down to the unit level and do test cases map to requirements? NUREG/BR-0167 Section 3.2.1.5**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are all requirements testable? (If it is not testable, then it is not a requirement) NUREG/BR-0167 Section 1.7, Table 1-1, Section 2.1, Section 2.5.2, Table 3-1, Section 3.2.2.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is the RTM under Configuration Management and Change Control? NOTE: The RTM is a living document and should be <u>baselined</u> at the end of each life-cycle phase or when changes to requirements occur within a life-cycle phase after it has been baselined. NUREG/BR-0167 Table 1-1, Section 6, Section 6.2**	
Pass		Comments
Fail		
N/A		

Criteria Priority: 2	**Does the SRS identify the purpose and scope? NUREG/BR-0167 Section 2.2, 4.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the SRS identify what the products will and will not do? Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the SRS describe the objectives and goals? NUREG/BR-0167 Section 5.2.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the SRS describe ant constraints on memory or other system constraints? Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the SRS describe backup and recovery operations, if applicable? Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the SRS describe assumptions? (Assumptions can lead into Risks) Software Engineering Practices**	
Pass		Comments
Fail		
N/A		

SOFTWARE DESIGN and INTERFACE DESIGN		
Criteria Priority: 1	**Does the Software Design Specification (SDS) present the structure of the software such that it can be translated into code? NUREG/BR-0167 Section 4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide a description of the major elements/components of the software as related to the requirements in the SRS? NUREG/BR-0167 Section 4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide a technical description in terms of the theoretical basis? NUREG/BR-0167 Section 4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide a technical description in terms of the mathematical model? NUREG/BR-0167 Section 4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide a technical description of the data flow(s) and data structure(s)? NUREG/BR-0167 Section 4.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide the defined range of input values? NUREG/BR-0167 Section 3.2.4.1 (boundary conditions)**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the SDS provide the defined range of output values? NUREG/BR-0167 Section 3.2.4.1 (boundary conditions)**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the "Test Plan" and "Test Suite" for validating the software (by the development team) been addressed? NUREG/BR-0167 Appendix B**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the RTM been updated to map the design components back to the defined requirements and are the design components/requirements mapped to test cases? NUREG/BR-0167 Section 4.3**	
Pass		Comments
Fail		
N/A		
Criteria	**Has the acceptance criteria for specifying how to determine the validity of the software**	

Priority: 1	**provided, given the results of the test cases? NUREG/BR-0167 Section 2.6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are the test case identifiers unique/unambiguous? NUREG/BR-0167 Section 6.2, 2.6.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a data dictionary been developed? Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**If the SRS is found to require an update, has the SRS been updated, information represented correctly, completely, and accurately in the SRS? NUREG/BR-0167 Section 4.3, Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have all documents, including revised documents from the Requirements phase, been placed under Configuration Control and were Configuration Control procedures been performed completely and accurately? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have Peer Reviews, Software Requirements Reviews, Preliminary Design Reviews, Critical Design Reviews and Qualification Readiness Reviews been performed, with recorded results (usually via checklist or pre-approved form), and placed under configuration control? NOTE: IV&V activities require attendance at all major life-cycle reviews and audits. NUREG/BR-0167 Section 3.1 and 3.2.2, 3.2.3**	
Pass		Comments
Fail		
N/A		

RISK MANAGEMENT		
Criteria Priority: 3	**Is a Risk Management Plan established? NUREG/BR-167, Section 5.8**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Risk Management Plan identify, assess, document, and rank resources and schedule risks? NUREG/BR-167, Section 5.8.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a Risk Mitigation Plan been developed (or incorporated into a Risk management Plan) and is it under CM Control? NUREG/BR-167, Section 5.8.2**	
Pass		Comments
Fail		
N/A		

PROJECT TEST PLAN		
Criteria Priority: 1	**Has a Project Test Plan been initiated? NUREG/BR-0167 Section 4.9.1**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Project Test Plan identify WHAT test activities will be performed? Appendix B, Glossary (Test Plan)**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Project Test Plan identify the resources, team responsibilities, and techniques to plan, develop, and implement test activities through the life-cycle, and identify testing techniques and test phases? NUREG/BR-0167 Section 5.2.4**	
Pass		Comments
Fail		
N/A		

IMPLEMENTATION / USER DOCUMENTATION		
Criteria Priority: 1	**Have any changes been made as a result of "issues or inconsistencies" discovered during the code development? NUREG/BR-0167 Section 2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Do the code changes (if needed) require modifications to requirements, interfaces, and/or design? NUREG/BR-0167 Section 2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**If changes in requirements, design, or interfaces are made, have the appropriate documents been updated, including the RTM? NUREG/BR-0167 Section 2.4**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**If changes were needed, were the changes identified and reviewed via peer reviews, design reviews, code walkthroughs, etc.? NUREG/BR-0167 Section 3.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Were the revised documents and "review notes/checklists" placed under configuration control? (Ensure that the configuration control process follows the Configuration Management Plan procedures/processes). NUREG/BR-0167 Section 6.3**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Has an installation plan been developed (or in development/DRAFT)? Note: Installation Instructions can also be identified in a User Guide Software Engineering Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Has a schedule of installation activities been generated? NUREG/BR-0167 Section 5.2 (3)**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the Installation Plan include/address required deliverables to user/installation sites? NUREG/BR-0167 Section 4.9**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the Installation Plan identify the qualifications required (equipment and personnel) to perform the installation?**	

	Software Engineering Practices	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the Installation Plan provide installation tests and expected results (to ensure the installation was correct)? NUREG/BR-0167 – Throughout the document – References to Acceptance and Qualification Testing**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a training program /Training Plan been developed? NUREG/BR-0167 Section 4.7,**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have unit tests been developed and performed to verify the input and output for each module? NUREG/BR-0167 Table 1-1 (Unit Testing); IEEE-1008, Software Unit Testing**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have test cases, scenarios & procedures for new functionality/bug fixes been developed in preparation for in-house tests (including regression tests) for observation by IV&V? NUREG/BR-0167 Section 7.2.2**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Upon completion of code and documentation for this phase, have ALL artifacts (code, code walkthrough sheets, updated documentation, test cases, test results, etc.) placed into CM and ALL information BASELINED? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Is the User Manual complete, including: A description of User's interaction with the software, description of required training necessary to use the software, input and output specifications and formats with sample cases, limitations of the software, anticipated errors and user response to errors, error messages with workarounds (when applicable), information about user support? NUREG/BR-0167 Section 4.7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Does the User Manual provide instructions on how to install, setup, and access the application? NUREG/BR-0167 Section 2.6**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the User Manual provide a complete, consistent, correct, and adequate coverage of software functionality and is it presented in a "logical" and hierarchical order? NUREG/BR-0167 Section 2.2, Section 4.3**	
Pass		Comments

Fail		
N/A		
Criteria Priority: 3	**Does the User Manual provide screen shots, reports, examples etc. to provide end users' with typical/example outputs (for reference, help, etc.)? NUREG/BR-0167 Section 4.7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Does the User Manual provide instructions on accessing on-line help features (including User Support)? NUREG/BR-0167 Section 4.7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a Programmer's Reference Manual been generated (or included in the User's Guide)? Software Best Practices**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**If a Training Program is required (via SOW or other contractual mechanism), does the training program provide trainees with knowledge and skills to use the software? NUREG/BR-0167 Section 4.7**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the RTM been updated to reflect any changes identified during coding and has it been placed under CM Control? NUREG/BR-0167 Section 6**	
Pass		Comments
Fail		
N/A		

INSTALLATION and ACCEPTANCE		
Criteria Priority: 1	**Do all the interface requirements identified in the SRS and RTM have test procedures, etc.?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Upon completion of the interface tests, has a peer review been performed and a test report created, reviewed, issued, and placed under CM control?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Is the System Test Plan complete and under CM Control?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Does the system testing validate ALL requirements in accordance with the System Test Plan?**	
Pass		Comments
Fail		
N/A		
Criteria Priority:	**When errors are discovered during system test, are they reviewed by the development team, SQA, and IV&V?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Are the errors assigned a severity level and the necessary actions to mitigate/resolve the error(s) determined? (There must be an audit trail of all tests and their results)**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**If errors are discovered and repaired, are all modules that initiated the error(s) and units/modules with interfaces to the repaired modules retested and comments regarding the correction identified in the source code?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Are all actions used to identify, record, etc. the error and final outcome of retesting been recorded and placed under CM Control?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Did the RTM require an update and if so, did the update affect documentation developed in prior lifecycle phases?**	

Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Where revisions made to these documents, re-baselined, and placed under CM Control?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Prior to conducting acceptance testing, has the QA & IV&V representatives been notified?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has QA generated a pre-acceptance checklist?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Have structured walkthrough of checklist performed prior to acceptance testing?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 1	**Has the sponsor agreed to the level of rigor for acceptance tests?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 3	**Has a Maintenance Plan (if applicable) been developed, reviewed, approved, and placed under CM Control?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Were there errors, inconsistencies, and/or misinterpretations in the installation instructions and therefore, need modification?**	
Pass		Comments
Fail		
N/A		
Criteria Priority: 2	**Were these changes performed, document(s) updated and placed under CM control?**	
Pass		Comments
Fail		
N/A		