Verify – to establish the truth, accuracy, or reality of

Validate – to support or corroborate on a sound or authoritative basis
Verification and Validation in a Regulated Software Environment

Quality Assurance Requirements for Nuclear Facility Applications (NQA-1)

• NQA-1 is a consensus standard managed by ASME for addressing the requirements of 10CFR50 Appendix B

• NQA-1 Subpart 2.7 is the portion specifically related to computer software for nuclear facility applications
Verified Use of Computer Programs

Computer programs shall be verified to show that it produces correct solutions for the encoded mathematical model within defined limits for each parameter employed.

Encoded mathematical model shall be shown to produce a valid solution to the physical problem associated with the particular application.
Verified Development of Software

Software design verification must be performed by competent personnel other than those who developed and documented the original design, ensure correctness, verify traceability to design requirements, and include review of test results.

Software verification method includes any one or a combination of design reviews, alternate calculations, and tests performed during computer program development.
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Results of design verification must be documented with the identification of the verifier included and must be completed prior to approval of the program’s use.

Computer program testing must be performed and in accordance with Test Control Requirements.
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Test Control Requirements

Tests required to collect data must be planned and executed

Characteristics to be tested and methods to be employed must be specified
Test results must be documented

• Computer program test procedures must provide for demonstration of adherence to the documented requirements

• Computer programs used in design must provide for assuring that the program produces correct results
Test Control Requirements (continued)

• In-use tests must be developed and documented to permit confirmation of acceptable performance of the program in the operating system

• In-use test procedures must be performed after the program is installed on a different computer or when there are significant changes in the operating system
Test Control Requirements (continued)

• Test results must be documented and evaluated by a responsible authority to ensure that test requirements have been satisfied

• Test plans, test cases, and test results must be documented, reviewed, and approved prior to computer program use

• Test records must be maintained to indicate the ability of the program to satisfactorily perform its intended function or to meet its documented requirements
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Tests are selected from published papers which have been refereed and text books

Problems from benchmark publications of ASME, ASCE, NAFEMS and others along with NUREGs such as 1677 and 6645 are run to assure correctness and compliance

Customer problems are also selected for testing
Benchmark Examples
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Tests includes:

- Feature tests
- Regression tests
- Acceptance tests
- Verification tests
- V & V database of tests for development use
- Error correction tests
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Acceptance Testing

• Must demonstrate that the computer program adequately and correctly performs all intended functions (design requirements)

• Must be performed independently
Acceptance Testing (continued)

Must demonstrate that the computer program:

- Properly handles abnormal conditions and events as well as credible failures

- Does not perform adverse unintended functions

- Does not degrade the system either by itself, or in combination with other functions or configuration items
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Acceptance Testing (continued)

Acceptance testing must be performed prior to approval for its use

Acceptance testing must be planned and performed for all software design requirements
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Verification and Validation Standards Committee

- V&V 10 - Verification and Validation In Computational Solid Mechanics
- V&V 20 - Verification and Validation In Computational Fluid Dynamics and Heat Transfer
- V&V 30 - Verification and Validation In Computational Integrated System Thermal Fluids Behavior
- V&V 40 - Verification and Validation In Computational Methods for Medical Devices

The V&V standards are also consensus standards managed by ASME for Verification and Validation of Software
Verification
The process of determining that a computational model accurately represents the underlying mathematical model and its solution

Validation
The process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model
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Only users of the software can validate its use
Summary

• Software design verification evaluates the technical adequacy of the design approach and ensure internal completeness, consistency, clarity, and correctness of the software design and verifies that software design is traceable to the software design requirements.

• Software design verification includes review of test results.

• Software design verification is completed prior to use.