

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE


SPONSOR: QUALITY ASSURANCE PROGRAMS & AUDITS

SPONSOR:

  
General Manager - QA/NSR

8/13/90  
Date

APPROVE:

  
General Manager - HC Operations

10/30/90  
Date

APPROVE:

  
General Manager - Salem Operations

11/7/90  
Date

-----  
**REVISION SUMMARY:**

1. Issued for Implementation. This procedure becomes effective November 1, 1991.

9304210005 15 pp.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

TABLE OF CONTENTS

<u>SECTION</u>	<u>SUBJECT</u>	<u>PAGE</u>
1.0	PURPOSE.....	1
2.0	SCOPE.....	1
3.0	RESPONSIBILITIES.....	1
4.0	BACKGROUND.....	2
5.0	PROCEDURE.....	2
5.1	Computer Software Development.....	2
5.2	Verification and Validation.....	3
5.3	System Testing.....	3
5.4	Error Reporting.....	5
5.5	System Turnover.....	5
5.6	Access Control.....	6
5.7	Computer Software Control.....	6
5.8	Computer Software Procurement.....	7
5.9	10CFR 50.59 Applicability Review.....	9
5.10	Pre-existing Computer Software.....	9
5.11	Records.....	9
6.0	DEFINITIONS.....	10
7.0	REFERENCES.....	12

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

1.0 PURPOSE

The purpose of this document is to establish responsibilities and programmatic requirements associated with the design, development, procurement, configuration control, use, validation and verification of computer software.

2.0 SCOPE

This procedure applies to critical software used for important to safety design, design analysis, process control and data base management.

3.0 RESPONSIBILITIES

- 3.1 General Manager - QA/NSR shall be responsible for periodically auditing implementation of the Nuclear Department Software Quality Assurance Program, and providing necessary support in the areas of software procurement and software QA program modifications.
- 3.2 Department Manager(s) whose organization develops or has previously developed, procures, or maintains computer software within the scope of this procedure shall:
- 3.2.1 Identify computer software that is within the scope of this procedure and is used in their department.
  - 3.2.2 Approve the use of computer software and related documentation which have been developed within their department.
  - 3.2.3 Ensure that sufficient design and approval interface controls exist during development or maintenance of computer software. Where computer software is utilized by multiple groups, singular ownership shall be established.
  - 3.2.4 Ensure that procedures to develop, control, revise, and approve, as appropriate, all required computer software and associated documentation are developed, approved and issued.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 3.2.5 Ensure the security, integrity and maintenance of developed computer software.
- 3.2.6 Maintain the departmental Computer Software Index, which identifies software utilized within that specific department level. This index should be included in a department level controlled procedure.

4.0 BACKGROUND

Computer software has become an increasingly important part of the design and operation of systems that perform complex and critical functions within the Nuclear power industry. Computer software is also relied upon to provide essential information which may be utilized during a decision making process involving the safety of station personnel and the general public. In recognizing the importance of computer software within the Nuclear Department, it has been determined that a consistent, formalized approach associated with the design, development, procurement and utilization of critical software will be adopted and implemented in accordance with requirements identified in this procedure.

5.0 PROCEDURE

This section specifies requirements to be implemented during the development, testing and procurement of critical software.

5.1 Computer Software Development

The following activities shall be completed during the development of critical software:

- 5.1.1 A Software Requirements Specification (SRS) or equivalent shall be prepared. The SRS shall define the functional requirements for the proposed system.
- 5.1.2 The SRS shall be reviewed by all affected organizations, comments resolved, and approval documented on the SRS cover page.
- 5.1.3 A software design description or equivalent shall be prepared describing the major components of the software design and how the requirements of the SRS will be implemented.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 5.1.4 Preliminary design reviews and critical design reviews shall be performed as determined necessary.
- 5.1.5 Programmer/user manuals shall be developed as applicable. These manual(s) shall be written and approved in accordance with the developing departments implementing procedures and NC.NA-AP.ZZ-0032(Q); and shall be controlled in accordance with NC.NA-AP.ZZ-0003(Q).
- 5.1.6 All source code, command files, compilers, etc., required to build the system shall be documented, and controlled.
- 5.2 Verification and Validation (V&V)
- 5.2.1 The specified computer software requirements shall be reviewed and approved prior to performing software V&V. This review shall include a determination of testability of software requirements identified in the SRS.
- 5.2.2 V&V shall ensure that all computer software requirements have been satisfied. Where computer software is developed in discrete phases, verification shall be performed between each phase to assure that requirements are correctly translated, in accordance with a procedure or plan.
- 5.2.3 Independent V&V should be accomplished by an individual or individuals other than those who developed the computer software.
- 5.2.4 The V&V plan or procedure shall describe the methods of test performance, how errors will be documented and corrected, and the degree of subsequent testing.
- 5.3 System Testing
- Upon completion of development, testing shall be performed to validate the resulting integrated system.
- 5.3.1 Testing shall be performed in accordance with a documented and approved test procedure or plan which may be part of the verification and validation plan or procedure.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

**TITLE: SOFTWARE QUALITY ASSURANCE**

- 5.3.2 The test procedure or plan shall be prepared and approved in accordance with NC.NA-AP.ZZ-0032(Q) and shall include the following as applicable:
- o A description of the purpose and scope of each level of testing to be conducted,
  - o Verification that the computer software, operating system and hardware as a whole are working correctly,
  - o Identification and description of the pre- and post-test documentation to be generated for testing, including test specification, procedures, and logs,
  - o Test methods to be used to establish compliance,
  - o Range of input parameters and their expected output, branches, sub-routines, or options tables (etc.) to be verified during testing,
  - o Identification and use of the support computer software and computer hardware to be used in testing, and
  - o Test standards and criteria for acceptance to be employed.
- 5.3.3 Testing shall be done under a "Test Environment" where there is no risk to damaging existing production file integrity. If this is not possible all precautions shall be taken to ensure a backup of any code that could potentially be damaged during testing is obtained, or is available.
- 5.3.4 Review and approval of completed test report(s) shall be documented.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

5.4 Error Reporting

5.4.1 Department instructions shall specify methods used for error reporting and corrective actions. Computer software errors shall be evaluated for substantial safety hazard in accordance with 10CFR21.

5.4.2 The documentation should provide for the following as a minimum:

- o Name of computer software and version level.
- o A description of the problem and proposed corrective action.
- o A list of all items which may be affected by the error.
- o Identification of the personnel involved in the origination and disposition of the problem report, and in the resolution of the problem.
- o An identification number and date.
- o Adequate review and evaluation of the error by affected departments.

5.5 System Turnover

5.5.1 Use of a system will be authorized by the primary user only after completion of testing and resolution of any discrepancies, unless noted discrepancies resulting from final V&V reports are reviewed to ensure that there will be no adverse effects resulting from use of the system. This review shall be documented to justify system utilization.

5.5.2 System turnover shall include all documentation identified in section "RECORDS".

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

5.6 Access Control

Computer software access shall include, as appropriate:

- 5.6.1 Adequate protection from unauthorized access to computer software.
- 5.6.2 Assurance that only the approved versions of computer software are distributed, and that changes are authorized in accordance with established procedures.
- 5.6.3 Verification that computer software was accurately transmitted from the test environment to the production environment.
- 5.6.4 Assurance that archived electronic media are maintained in a designated storage facility established to store copies of software and that the media are protected against inadvertent damage.
- 5.6.5 Measures that ensure backup copies of all software (or data) exist and are physically separated from user (production) software.
- 5.6.6 Controls which will ensure the input of data is accurate, and does not deviate from approved design documents.

5.7 Computer Software Control

- 5.7.1 Computer software revisions shall be controlled in accordance with a control system which includes:
  - o Accurate and unique identification of all versions of a computer software, and dates of production status.
  - o Controls to record the changing of computer software and related documentation.
  - o Identification numbers of computer programs and documentation.
- 5.7.2 The software documentation package shall provide documented evidence of release authorization.
- 5.7.3 Changes to any computer software which will affect multiple user departments shall have the approval of appropriate user departments prior to releasing it into production.



PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

**TITLE: SOFTWARE QUALITY ASSURANCE**

5.7.4 Measures shall be established to ensure that superseded or invalidated computer software is not available for production usage.

5.7.5 A Computer Software Index maintained by the responsible department shall contain, as a minimum, the following information:

- o Unique computer software identifier (name and version level, etc.),
- o Hardware system(s) on which the computer software is run.
- o Computer Programming language and facilities used.
- o The time of day program is normally run, if applicable.
- o User department/designated contact,
- o Brief description of the software application and its use,
- o Current revision level and date of user manual and programmer manual,
- o Vendor/source (if not PSE&G developed).

5.8 Computer Software Procurement

5.8.1 The responsible department shall assure that computer software for important to safety applications, obtained from vendors, service bureaus, or other outside organizations are requisitioned and controlled in accordance with the requirements of this procedure, and Nuclear Department Procurement Procedures. Computer software for important to safety applications shall be subject to 10CFR Part 21.

5.8.2 Software procurement documents shall clearly state the specific requirements that the computer software shall satisfy.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 5.8.3 For computer software to be developed and delivered, the extent of PSE&G review and approvals of development documents and witnessing of testing shall be determined and specified in the procurement documents.
- 5.8.4 Validation of computer software operability on the intended computer system shall be addressed in the procurement documents.
- 5.8.5 Required certifications shall be specified in the procurement documents.
- 5.8.6 A documentation package containing the following shall be required by the procurement documents as applicable:
- o The Software Requirements Specification (SRS),
  - o The Software Design Description (SDD),
  - o The Software Validation and Verification Plan (SVVP), and
  - o The Software Validation and Verification Report (SVVR) summarizing the completed SVVP. The SVVR shall include a description of the actual performance of the software relative to the specified requirements.

NOTE

Based on vendor license agreements, code application, historical use of the code in industry, these requirements may be omitted. Alternative methods may be established and approved by management to accept computer software.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

5.8.7 Where it is necessary to use non-critical software in "Important to Safety Applications" the responsible department manager shall ensure that adequate software verification, specific to the end application is performed. This shall include the performance of sufficient testing and documentation of test results to assure that the software is producing valid results. Independent review of test results shall also be performed and documented.

5.9 10CFR50.59 Applicability Review

The Department Manager shall assure that all new critical software or changes to existing software are reviewed for 10CFR50.59 applicability in accordance with the requirements of NC.NA-AP.ZZ-0059(Q).

5.10 Pre-existing Computer Software

Each department shall evaluate computer software programs that are presently in use to justify continued use. The results of the evaluation shall ensure adequacy of applicable computer software, and ensure that control of changes to applicable computer software are in accordance with this procedure.

5.11 Records

Records associated with the Software QA Program will consist of the following, and shall be retained in accordance with NC.NA-AP.ZZ-0011(Q):

5.11.1 Software Requirements Specification (SRS) or equivalent.

5.11.2 Software Design Description, Preliminary Design Review, and Critical Design Review (CDR) where applicable.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 5.11.3 Software Validation and Verification Plan (SVVP) or equivalent.
- 5.11.4 Software Validation and Verification Report (SVVR) or equivalent.
- 5.11.5 Source Code Listing for each version of the computer software used in production (where possible).
- 5.11.6 Problem/discrepancy reports, change requests, evaluations, test validations, and disposition documentation.
- 5.11.7 Final review and approval documents (Production Status Authorization).
- 5.11.8 10CFR50.59 Review and Safety Evaluation
- 5.11.9 Computer Software Index
- 5.11.10 Departmental Procedures
- 5.11.11 Software Program User Manuals
- 5.11.12 Completed Test Documentation.

6.0 DEFINITIONS

- 6.1 Computer Program - A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution as well as to execute it.
- 6.2 Computer Software - Computer programs, procedures, rules, and associated documentation and data pertaining to the operation of computer system. When used in this document, computer software may extend to any hardware components where those components (e.g., PROM, EPROM) can in anyway alter the accuracy or reliability of data output, or affect in any significant way the desired result of the computer system or programs run on the computer system.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 6.4 Critical Design Review (CDR) - A review conducted for the purpose of determining the acceptability of the detailed software design to ensure that the requirements of the Software Requirement Specification have been satisfied.
- 6.5 Critical Software - Software supporting or performing Safety Related, or Important To Safety functions, or providing data upon which decisions can be solely made regarding plant operation, design, or emergency response. Typical examples of critical software would include: MIDAS, TRIS, portions of MMIS, etc.
- 6.6 Developer - An individual, or organization, whose responsibility is to perform any or all of the following: plan, design, change, test, or produce computer software in accordance with user requirements.
- 6.7 Electronic Media - Any media capable of being directly accessed for storage and retrieved, or images by a computer system, such as magnetic tape, magnetic disks, or optical discs.
- 6.8 Hardware - Physical equipment used in data processing and acquisition.
- 6.9 Important To Safety - As defined in NC.NA-AP.ZZ-0059 (Q).
- 6.10 Preliminary Design Review - The process of analyzing design alternatives and defining the software architecture.
- 6.11 Software Design Description (SDD) - A description of the major components of the software design including data bases and internal interfaces. An expansion of this description shall be included to describe each sub-component of the major components.
- 6.12 Software Requirement Specification (SRS) - A clear and precise description of each of the essential requirements of the software and external interfaces, including functions, performances, design constraints and attributes. Each requirement shall be defined such that its achievement is capable of being objectively verified and validated by a prescribed method, (e.g., inspection, analysis, demonstration, or test).
- 6.13 Software Validation - The test and evaluation of the completed software to ensure compliance with software requirements.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

TITLE: SOFTWARE QUALITY ASSURANCE

- 6.14 Software Verification - The process of determining whether or not the product of a given phase of the software development cycle fulfills the requirements imposed by the previous phase.
- 6.15 Software Verification and Validation Plan (SVVP) - A plan that describes the methods to be utilized to perform the following:
- 6.15.1 To verify that:
- a. The requirements of the SRS are implemented in accordance with the SDD.
  - b. The design expressed in the SDD is implemented in the code.
- 6.15.2 To validate that the code, when executed, complies with requirements identified in the SRS.
- 6.16 Systems Software - Software designed for a specific computer system or family of computer systems to facilitate the operation and maintenance of the computer system and associated programs, (i.e., operating systems, compilers, utilities).
- 6.17 Testing - The process of exercising or evaluating a system or system component by manual or automated means, to verify that it satisfies specified requirements or to identify differences between expected and actual results.
- 6.18 User - An individual, or organization, who accesses computer software for the primary purpose of inputting, compiling or correlating data. Activities performed by a user should not result in alteration of computer software.
- 7.0 REFERENCES
- 7.1 ANSI - IEEE 730-1984, "Software Quality Assurance Plans".
- 7.2 ASME NQA-2a-1989, Part 2.7, "Quality Assurance Requirements of Computer Software for Nuclear Facility Applications".

PUBLIC SERVICE ELECTRIC AND GAS COMPANY  
NUCLEAR ADMINISTRATIVE PROCEDURES

**TITLE: SOFTWARE QUALITY ASSURANCE**

- 7.3 NUREG/CR-4640, "Handbook of Software Quality Assurance Techniques applicable to the Nuclear Industry".
- 7.4 ANSI - IEEE 729-1983, "IEEE Standard Glossary of Software Terminology".
- 7.5 NC.NA-AP.ZZ-0059(Q) - 10CFR50.59 "Reviews and Safety Evaluations".
- 7.6 NC.NA-AP.ZZ-0032(Q) - "Preparation, Review and Approval of Procedures".
- 7.7 NC.NA-AP.ZZ-0011(Q) - "Records Management Program".
- 7.8 NC.NA-AP.ZZ-0003(Q) - "Document Control".
- 7.9 Updated Final Safety Analysis Reports, Chapter-17