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Software Quality Assurance Plan

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Software Quality Assurance Plan
for FPGA-based Safety-Related Systems

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1 Introduction

1.1. Purpose

This Nuclear Instrumentation & Control Systems Department (NICSD) Software Quality Assurance Plan (NICSD SQAP) describes the software quality assurance plan that NICSD utilizes to develop and procure the Field Programmable Gate Array (FPGA)-based safety-related Instrumentation and Control (I&C) systems for US nuclear power plant.

This NICSD SQAP defines an additional software Quality Assurance (QA) requirements that shall be applied to the systems and equipment. This NICSD SQAP complies with and supplements an existing Quality Assurance Program Description (QAPD) of Toshiba Corporation, Power Systems Company, Nuclear Energy (PSNE), AS standards of Nuclear Energy Systems & Services Division (NED), and NICSD NQ standards to implement all safety-related activities. The requirements provided herein augment the PSNE QAPD.

1.2. Background

This NICSD SQAP is developed for the FPGA-based safety-related I&C systems based on a description of Section 5 of the "Software Program Plan" (SPP) (Reference (8)), and in accordance with the NICSD Standard NQ-2038 "Preparation Procedure for Software Quality Assurance Plan" (Reference (42)).

NED procures the FPGA-based safety-related I&C equipment from NICSD in the Fuchu Complex. NICSD procures the FPGA-based modules from Power Platform Development Department (PPDD) as commercial grade items for the equipment. NICSD has a quality assurance program in accordance with 10 CFR 50 Appendix B requirements. PPDD has a quality assurance program in accordance with ISO-9001. The process for obtaining commercial grade items is described in Section 10 of the NICSD Standard NQ-2030 "Procedural Standard for FPGA Products Development" (Reference (34)). This NICSD SQAP describes the software quality assurance activities performed by NICSD, including the Commercial Grade Dedication (CGD) activities used to designate commercial grade items from PPDD for use in safety-related applications, and to determine compliance with the requirements of SPP.

As described in the "Nuclear Energy Systems and Services Division FPGA-based Safety-Related Systems Software Management Plan" (NED SMP) (Reference (9)), NED performs a limited part of the software life cycle of FPGA-based safety-related systems and, the NED SMP covers their activities including software quality assurance. Therefore this SQAP does not include NED's life cycle and their activities.

The NICSD SQAP sections are prepared to comply with the life cycle activities described in Section 13 of the "Nuclear Instrumentation & Control Systems Department Software Management Plan for FPGA-based safety-related I&C Systems" (NICSD SMP) (Reference (10)) and, using the IEEE Std 730 (Reference (2)) as a guide. Figure 13-1 of the NICSD SMP shows a simplified diagram of the process flow through the life cycle phases for the FPGA-based systems.

1.3. Scope

This NICSD SQAP shall be applied to the software quality assurance activities from the Project Planning and Concept Definition Phase through the Retirement Phase in the software life cycle for the FPGA-based safety-related I&C systems.

The "Software Program Plan" (SPP) (Reference (8)) establishes requirements and provides guidance and expectations for the design, development, implementation, safety analysis, review, testing, installation, and configuration management etc. This NICSD SQAP covers Section 5 "Software Quality Assurance Program Plan" (SQAPP) of the SPP:

Table A in Appendix B shows the compliance traceability matrix of this SQAP to the SPP.

The NICSD SQAP provides the following information:

- A description of the project software quality assurance planning measures to be used to demonstrate how the project requirements are met. NICSD's basic approach is described in this NICSD SQAP.
- A determination of the Software Integrity Level (SIL) for the types of software is covered by this SQAP. See IEEE Std.1012 (Reference (5)) for the SIL levels to be used for various types of software.

This NICSD SQAP addresses QA activities in the software life cycle defined in the NICSD SMP (Reference (10)). The following software are excluded from the requirements of this SQAP:

- Administrative software used for the purposes of ordering, scheduling, and project management.
- Commercial applications software for use in database management systems, word processing, and commercially purchased Computer Aided Design (CAD) systems not used for FPGA development (for example, Excel, Word, AutoCAD, and electrical schematic drawing tools).

2 Abbreviations

AS	Toshiba Nuclear Energy Systems and Services Division Work Standard
BRR	Baseline Review Report
CAD	Computer Aided Design
CDI	Commercial Dedication Instruction
CG	Commercial Grade
CGD	Commercial Grade Dedication
CGS	Commercial Grade Survey
COTS	Commercial Off-the-Shelf Software
DCR	Documents Change Request
DR	Design Review
DVR	Design Verification Report
EPC	Engineering, Procurement, and Construction
FE	Functional Element
FPGA	Field Programmable Gate Array
FTER	Final Technical Evaluation Report
Fuchu-PS	Fuchu Complex Power Systems Segment
GPM	Group Manager
I&C	Instrumentation and Control
IEEE	Institute of Electrical and Electronics Engineers
IR	Independent Reviewer
ISO	International Standardization Organization
IV&V	Independent Verification and Validation

IV&V Lead	Independent Verification and Validation Lead
NED	Nuclear Energy Systems & Services Division
NICSD	Nuclear Instrumentation & Control Systems Department
NICS-QA	Quality Assurance Group for Nuclear Instrumentation & Control Systems
NICS-QC	Quality Control Group for Nuclear Instrumentation & Control Systems
NISD	Nuclear Instrumentation Systems Development & Designing Group
NQ	Nuclear Quality
PDS	Previously Developed Software
PFT	Platform Factory Test
PM	Project Manager
PPDD	Power Platform Development Department
PRM	Process Review Meeting
PRS	Problem Reporting Sheet
PSNE	Power Systems Company, Nuclear Energy
PTER	Preliminary Technical Evaluation Report
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QC	Quality Control
QVL	Qualified Vendor List
RG	Regulatory Guide
RTM	Requirements Traceability Matrix
SCAR	Site Corrective Action Request
SCL	Software Configuration Lead
SCMP	Software Configuration Management Plan
SD	Software Development
SD Team	Software Development Team
SDL	Software Development Lead
SDOE	Secure Development and Operational Environment
SIL	Software Integrity Level
SMP	Software Management Plan
SNNR	Site Nonconformance Notice Report
SPP	Software Program Plan
SQ	Software Quality
SQA	Software Quality Assurance
SQA Team	Software Quality Assurance Team
SQAL	Software Quality Assurance Lead
SQAP	Software Quality Assurance Plan
SQAPP	Software Quality Assurance Program Plan
SS	Software Safety
SS Team	Software Safety Team
SSAR	Software Safety Analysis Report
SSL	Software Safety Lead
SSP	Software Safety Plan
SVTP	Software Validation Test Plan
SVTR	Software Validation Test Report
SVVP	Software Verification and Validation Plan
USNRC	United States Nuclear Regulatory Commission
V&V	Verification and Validation
VHDL	Very High Speed Integrated Circuit Hardware Description Language
VNNR	Vendor Nonconformance Notice Report
VVP	Verification and Validation Plan
VVR	Verification and Validation Report

3 Reference Documents

- (1) USNRC, RG 1.169,
"Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants", Revision 0
- (2) IEEE Std. 730-2002,
"IEEE Standard for Software Quality Assurance Plans"
- (3) IEEE Std. 828-1990,
"IEEE Standard for Software Configuration Management Plans"
- (4) IEEE Std. 829-1983,
"IEEE Standard for Software Test Documentation"
- (5) IEEE Std. 1012-1998,
"IEEE Standard for Software Verification and Validation Plans"
- (6) Not used
- (7) Toshiba Project Document Number FA10-0301-0001,
"Project Specific Document Control Procedure", Rev.0,
- (8) Toshiba Project Document Number FA10-0501-0024
"Software Program Plan" Rev.0,
- (9) Toshiba Project Document Number FA32-3702-0005,
"Nuclear Energy Systems and Services Division FPGA-based Safety-Related Systems Software Management Plan" Rev.0,
- (10) Toshiba Project Document Number FA32-3702-1000,
"Nuclear Instrumentation & Control Systems Department Software Management Plan for FPGA-based Safety-Related Systems" Rev.1,
- (11) Toshiba Project Document Number FA32-3708-1000
"Nuclear Instrumentation & Control Systems Department Software Configuration Management Plan for FPGA-based Safety-Related Systems" Rev.1,
- (12) Toshiba Project Document Number FA32-3709-1000,
"Nuclear Instrumentation & Control Systems Department Verification and Validation Plan for FPGA-based Safety-Related Systems" Rev.2,
- (13) Toshiba Corporation Power Systems Company Nuclear Energy Regulations and Procedures 4810, "REPORTING PROCEDURE FOR DEFECTS AND NONCOMPLIANCE UNDER USNRC 10CFR21"
- (14) Toshiba Nuclear Energy Systems and Service Division AS-200A002,
"Design Verification Procedure"
- (15) Toshiba Nuclear Energy Systems and Service Division AS-200A128,
"Digital System Life Cycle Procedure"
- (16) Toshiba Nuclear Energy Systems and Service Division AS-200A129,
"Digital System Development Procedure."
- (17) Toshiba Nuclear Energy Systems and Service Division AS-200A130,
"Digital System Verification & Validation Procedure"
- (18) Toshiba Nuclear Energy Systems and Service Division AS-200A131,
"Digital System Configuration Management Procedure"
- (19) Toshiba Nuclear Energy Systems and Service Division AS-200A132,
"Digital System Safety and Hazards Analysis Procedure"

- (20) Toshiba Nuclear Energy Systems and Service Division AS-300A005
"Preparation Procedure for Source Verification Report"
- (21) Toshiba Nuclear Energy Systems and Service Division AS-300A009,
"Corrective Action Request Application Procedure"
- (22) Toshiba Nuclear Instrumentation & Control Systems Department NQ-1002,
"Standard of Organization for Fuchu-PS Nuclear Quality Assurance"
- (23) Toshiba Nuclear Instrumentation & Control Systems Department NQ-1003,
"Application of AS Standards"
- (24) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2001,
"Process Review Meeting Convening Standard"
- (25) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2003,
"Procedure for Control of Software Tools"
- (26) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2004,
"Preparation Procedure for Equipment Design Specification"
- (27) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2013,
"Preparation Guide for Verification and Validation Plan"
- (28) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2014,
"Preparation Guide for V&V Report"
- (29) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2015,
"Preparation Procedure for RTM and RTM Report"
- (30) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2019,
"Preparation Procedure for Test Specification"
- (31) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2024,
"Document Control Procedure"
- (32) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2025,
"Preparation Procedure for Procurement Document for CG Items & Services"
- (33) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2026,
"Control Procedure of supplier generated documents"
- (34) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2030,
"Procedural Standard for FPGA Products Development"
- (35) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2031,
"Procedural Standard for FPGA Device Development"
- (36) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2032,
"Procedural Standard for Functional Element Development"
- (37) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2033,
"Procedural Standard for FPGA Configuration Management"
- (38) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2034,
"Procedural Standard for Control of Software Tools Used with FPGA Based Systems"
- (39) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2035,
"Procedure for Design Change Control"
- (40) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2036,
"Procedure for Design Control"
- (41) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2037,
"Cyber Security Procedures of Safety Related Digital System"
- (42) Toshiba Nuclear Instrumentation & Control Systems Department NQ-2038,
"Preparation Procedure for Software Quality Assurance Plan"
- (43) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3005,
"Procedure for Evaluation of Suppliers"
- (44) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3006,
"Procedure for Control of Nonconforming Procurement Items and Services"
- (45) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3015,
"Test Control Procedure"

- (46) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3016,
"Software Test"
- (47) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3019,
"Procedure for Control of Nonconformance and Corrective Action"
- (48) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3020,
"Control Procedure of QA Records"
- (49) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3022,
"Internal Audit Procedure"
- (50) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3023,
"Procedure for Purchase"
- (51) Toshiba Nuclear Instrumentation & Control Systems Department NQ-4001,
"Commercial Grade Dedication"
- (52) Toshiba Fuchu Complex Power Systems D-81018,
"Procedure for Control of Cyber Security"
- (53) Toshiba Fuchu Complex Power Systems D-81030,
"Standard for Document System"
- (54) Toshiba Power Platform Development Department E-68007,
"DR control procedure"
- (55) Toshiba Power Platform Development Department E-68016,
"PPDD Procedural Standard for FPGA Products Development"
- (56) Toshiba Power Platform Development Department E-68017,
"Procedural Standard for FPGA Device Development"
- (57) Toshiba Power Platform Development Department E-68018,
"Procedural Standard for Functional Element Development"
- (58) Toshiba Power Platform Development Department E-68019,
"Procedural Standard for Configuration Management"
- (59) Toshiba Power Platform Development Department E-68027
"Test Specification Preparation Standard"

Notice: Upon application of above NED, NICSD, and other Toshiba internal standards, the latest version shall be used.

4 Management

This section describes the project's organization structure, roles, and responsibilities.

4.1. Organization

The organization's responsibility for development of the FPGA-based systems software design is described in Section 5.1 of the NICSD SMP (Reference (10)).

NICSD has two quality assurance groups. The NICS-QA group is responsible for ensuring process as Staff QA. The NICS-QC group is responsible for ensuring items as the line QA/QC group defined in the NICSD Standard NQ-1002 "Standard of Organization for Fuchu-PS Nuclear Quality Assurance" (Reference (22)). For software quality assurance activities, both of these groups work together as a Software QA (SQA) Team which is organizationally independent from the NICSD Software Development Lead (SDL) and Software Development (SD) Team. NICS-QA performs verification of the software design activities through an internal audit, Commercial Grade (CG) survey, and software surveillance of the NICSD Independent Verification and Validation (IV&V) Team. And NICS-QC performs more direct validation of items, such as oversight, witness, receiving inspection, test, and inspection. NICSD organizes an IV&V Team for the V&V of the FPGA software. The NICSD IV&V Team ensures the software design activities independently from

the NICSD SDL and SD Team. The organization and responsibility of the NICSD IV&V Team is described in the "Nuclear Instrumentation & Control Systems Department Verification and Validation Plan for FPGA-based Safety-Related Systems" (NICSD VVP) (Reference (12)).

4.2. Responsibilities

The NICSD Software QA Lead (SQAL) who is assigned by the NICSD Project Manager (PM) is responsible for conducting the activities described in the following subsections. The NICSD SQAL has an authority to assign the NICSD SQA Team members. The NICSD SQAL is responsible to provide QA trainings to NICSD personnel in the project. The NICSD SQAL shall be responsible for implementing this SQAP and, shall verify that a schedule and resources are adequate to ensure that required SQAPP of SPP (Reference (8)) and the NICSD SMP (Reference (10)) can be provided throughout the life cycle. The NICSD SQAL who is responsible for the personnel implementing this SQAP shall also verify that the processes defined in this SQAP are effective, adequate, suitable, and sufficient, by correcting and extending the SQAP as required to ensure that the SQAPP of SPP and NICSD SMP objectives are met. The NICS-QA Group Manager takes a role of the NICSD SQAL, unless the NICSD PM assigns someone else.

4.2.1. Responsibilities for FPGA-based Safety-Related I&C Systems Life Cycle

The software life cycle of the FPGA-based safety-related I&C systems is defined in Section 13 of NICSD SMP (Reference (10)). As described in the NICSD SMP, the software life cycle is implemented by NED, NICSD, and PPDD. And as mentioned in Section 1.2 of this SQAP, the portion of the software life cycle performed by NED is outside the scope of this SQAP. NICSD performs "Project Planning and Concept Definition Phase", "Requirements Definition Phase", "System Validation Testing Phase", and "Operations and Maintenance Phase". PPDD effort is during the "Design Phase", "Implementation and Integration Phase", and "Module Validation Testing Phase". Although PPDD effort is performed under the CGD process in NICSD, it is inspected by through safety activities of NICSD as discussed and dedicated through an approved CGD process. NICSD has a responsibility to review and approve the PPDD activities through CGD and IV&V activities throughout the course of PPDD's work.

The NICSD SQAL has a responsibility to ensure that the FPGA-based safety-related I&C systems life cycle is correctly and sufficiently performed.

The NICS-QA conducts internal audits of each organization inside NICSD in accordance with the NICSD Standard NQ-3022 "Internal Audit Procedure" (Reference (49)), at least once a year. When the subject of an audit includes FPGA-based safety-related I&C systems, the NICSD SQAL should be the audit leader, or at least, the audit team shall include the NICSD SQA Team member. The audit team shall verify adequacy of the activities performed under the software life cycle, by checking objective evidence using written checklists reviewed by the NICSD SQAL. The checklists shall be based on the requirements of the procedural software plans which are the NICSD SMP, the "Nuclear Instrumentation & Control Systems Department Software Configuration Management Plan for FPGA-based Safety-Related Systems" (NICSD SCMP) (Reference (11)), the NICSD VVP (Reference (12)), and this SQAP, to the life cycle phase and activity being audited. The NICSD SQA Team shall participate in Process Review Meeting (PRM) convened in accordance with the NICSD Standard NQ-2001 "Process Review Meeting Convening Standard" (Reference (24)) to oversee the adequate activities under the life cycle. In addition to participating in the PRMs, the NICSD SQAL will conduct a software surveillance of the NICSD IV&V Team activities at the end of each life cycle phase, to confirm the correctness and sufficiency of the verification activities performed by them. In the software surveillance, the NICSD SQA Team shall review the Design Verification Reports (DVRs) prepared by Verifier and/or Independent Reviewer (IR) in accordance with the NED Standard AS-200A002 "Design Verification Procedure" (Reference (14)).

and, Verification and Validation Reports (VVRs), and Baseline Review Reports (BRRs) prepared by the NICSD IV&V Team. And if necessary, The NICSD SQAL will conduct a direct surveillance for the NICSD IV&V Team to confirm that the IV&V and Baseline Review activities are performed appropriately in accordance with applicable procedures and plans.

The NICS-QA shall conduct a CG Survey of PPDD when required by a Commercial Dedication Instruction (CDI) in accordance with the NICSD Standard NQ-4001 "Commercial Grade Dedication" (Reference (51)). The NICSD SQAL should be the CG survey leader, or at least, the CG survey team shall include the NICSD SQA Team member. In the CG Survey, the survey team shall verify capability of PPDD to control Critical Characteristics identified by the CDI. The documentation process of PPDD should be one of the Critical Characteristics for the digital items, and the CG Survey team shall verify it. This CG Survey could support the IV&V activities to verify documents prepared by PPDD in each life cycle phase, and the NICSD SQAL to confirm the results of the IV&V activities. The NICSD SQA Team shall participate in the Design Review (DR) Meeting(s) convened by the PPDD in accordance with the PPDD Standard E-68007 "DR control procedure" (Reference (54)) to oversee the PPDD work in each life cycle phase.

The NICS-QC shall be responsible to verify and validate that the products from PPDD are correctly manufactured and tested without discrepancies.

4.2.2. Responsibilities for Using FEs

As described in Section 11 of the NICSD SMP (Reference (10)), NICSD treats the FPGA logic as "Previously Developed Software (PDS)", and treats the Functional Elements (FEs), which constitute the FPGA logic, as "Commercial Off-the-Shelf Software (COTS)." Both of FPGA logic and FEs are developed by PPDD. NICSD procures the FPGA-based modules which include the FPGA logic comprised of FEs from PPDD. NICSD will not modify any FPGA logic and FEs of its own accord. The specific requirements for using FEs are described in Section 11.1 of this SQAP. The procedure for control of FEs developed by PPDD is documented in the PPDD Standard E-68018 "Procedural Standard for Functional Element Development" (Reference (57)).

The NICSD IV&V Team is responsible to ensure that all documentation including records and associated data regarding FEs, which demonstrates the traceability to products, are prepared and controlled in PPDD and they have no nonconformance.

The NICSD SQA Team is responsible to ensure the adequacy of FE controlled by PPDD in accordance with their procedures throughout the CG Survey and the oversight of PPDD.

The NICSD SQA Team is also responsible for overseeing the NICSD IV&V Team activities over PPDD as described in Section 4.2.1.

4.2.3. Responsibilities for Using Software Tools

The NICSD SDL is responsible to list all software tools for NICSD use in the NICSD SMP (Reference (10)).

The NICSD SDL controls software tools used for software development and implementation in accordance with the NICSD Standard NQ-2034 "Procedural Standard for Control of Software Tools Used with FPGA Based Systems" (Reference (38)). The NICSD PM or the NISD GPM and/or SDL verifies that all of used software tools are listed in the NICSD SMP.

The NICSD SDL is responsible to specify the software tools and their revisions to be used for manufacturing of FPGA modules for the FPGA-based safety-related I&C systems in a job order to PPDD.

The NICSD SQA Team shall be responsible to ensure that the CGD based procurement process is correctly conducted and the acceptance of the product is performed correctly.

4.2.4. Responsibilities for Test Equipment Software

The NICSD SDL is responsible for identifying and verifying the Test Equipment software used for special testing for commercial grade items, hardware acceptance testing, and factory acceptance testing. The NICSD IV&V Lead is responsible for identifying and verifying the Test Equipment software used for software testing including FPGA Testing, Module Validation Testing, and System Validation Testing. The NICSD SDL and NICSD IV&V Lead verify that testing documents specify the identification of Test Equipment software. The NICSD SDL and NICSD IV&V Lead is responsible to confirm that the specified Test Equipment software is used at each test. The NICSD IV&V Team shall also confirm the usage of the Test Equipment software at the FPGA testing and Module Validation Testing through oversight of PPDD test activity. The NICS-QC test personnel shall use the Test Equipment software as specified by the test documents. The NICSD SDL and NICSD IV&V Lead are responsible for reviewing the test reports.

The NICSD SQA Team shall be responsible to ensure that adequate control is in place and used for the Test Equipment software. The CG Survey team that assigned by the NICS-QA Group Manager shall verify an adequacy of the PPDD control process of Test Equipment software when it is identified as a Critical Characteristic of FPGA module. The NICS-QA Group Manager shall approve the CG Survey report when acceptable. The NICSD SQA Team shall also check the results of verification of the procurement documents and testing documents performed by the NICSD SD Team and NICSD IV&V Team.

If NICSD or PPDD uses any Test Equipment software, the following activities shall be performed:

- Defining the Test Equipment software functions required in the project
- Establishing the Test Equipment software acceptance criteria
- Establishing the procedure to use the Test Equipment software
- Training and recording for a personnel to use the Test Equipment software.

These activities shall be described in appropriate Test Documents.

For PPDD activities, NICSD has a responsibility to review and approve the PPDD activities through CG survey, and through V&V activities to be performed throughout the course of PPDD's work. The V&V activities are described in the NICSD VVP (Reference (12)). The V&V activities in general include oversight to PPDD activities, in-process monitoring and, document reviews, etc.

5 Documentation

This section identifies the documentation governing the development, verification and validation of the software. Table-A of the NICSD SMP (Reference (10)) describes an outline of the output document required for software life cycle activities. This section addresses the QA related documentation.

5.1. Software Plans

The NICSD SD Team and Software Safety (SS) Team prepare an NICSD SMP including Software Safety Plan (SSP), the NICSD Software Configuration Lead (SCL) prepares an NICSD SCMP, and

the NICSD IV&V Team prepares an NICSD VVP respectively. The NICS-QA shall verify that these software plans are prepared in accordance with applicable requirements in the SPP. Revisions to these software plans will be recommended in a verification conducted by the NICS-QA using the measure of corrective action requirement, and also the internal audit team will make such recommendation as necessary at the conclusion of each audit.

Revision of these software plans shall be in accordance with Section 16 of the NICSD SMP (Reference (10)).

5.2. Audits, Surveillances and Commercial Grade Surveys

The NICS-QA will conduct the Internal Audit for each organization in the NICSD once a year as defined in NQ-3022 (Reference (49)). In addition to the NICSD Internal Audit, the NICSD SQAL also conducts the NICSD software surveillance at the end of the every software life cycle defined in the NICSD SMP (Reference (10)).

The NICS-QA conducts an annual audit or evaluation of the performance and capability of the PPDD every year. The NICS-QA also conducts the Commercial Grade Survey (CGS) at least every 3 years for the PPDD. Additionally, the NICSD can request the NICS-QA to conduct the CGS as needed.

The V&V activities in general include oversight, in-process monitoring, document reviews, etc. The NICSD QA Team reviews the documentation of the V&V activities performed by the NICSD IV&V Team in accordance with the NICSD VVP (Reference (12)).

If required by the NICSD SD Team, the source verification performed by the NICS-QC will be applied for witness of FPGA program writing into FPGA chips, and monitoring of the DR Meeting(s) held by the PPDD. These activities will be verified recurrently for each order by the NICSD.

5.3. Report Documentation

The NICS-QA and/or the NICSD SQA Team will prepare the following reports in every audit, software surveillance, and CG Survey and evaluation. The audit reports, surveillance reports, CG Survey reports, and relating Fuchu Site Corrective Action Requests (SCARs) prepared in accordance with the NED Standard AS-300A009 "Corrective Action Request Application Procedure" (Reference (21)), shall be submitted to the NICS-QA manager for review. The Internal Audit Report, the Software Surveillance Report, and the CG survey report prepared in the life cycle phase shall be subject of baseline review of the life cycle phase as described in the "Nuclear Instrumentation & Control Systems Department Software Configuration Management Plan for FPGA-based Safety-Related Systems" (NICSD SCMP) (Reference (11)).

- **NICSD Internal Audit Report**
The NICS-QA will issue the Internal Audit Reports in accordance with NQ-3022 (Reference (49)) when they completed the annual NICSD Internal Audit.
- **Software Surveillance Reports**
These reports will be prepared for the software life cycle phases when implemented using the same format as the Internal Audit Report.
- **CGS Reports for the PPDD**
The NICS-QA will issue the Commercial Grade Survey reports in accordance with the NICSD Standard NQ-3005 "Procedure for Evaluation of Suppliers" (Reference (43)) when they conducted the CGS.
- **Source Verification Report for the PPDD**
The NICS-QC will issue the Source Verification Reports in accordance with the NED Standard AS-300A005 "Preparation Procedure for Source Verification Report" (Reference (20)) when they conduct a source verification of performance and capability of the PPDD,

such as a witness of FPGA program writing into FPGA chips, and a monitoring of the DR Meeting held by the PPDD.

6 Standards, Practices, Conventions, and Metrics

An overview of the NICSD QA Program is provided in the NICSD SMP Section 6.1 (Reference (10)).

This section describes the standards, practices, and conventions to be applied to the FPGA-based safety-related I&C Systems. It identifies general statistical techniques and metrics to be applied in the quality assurance process.

A compliance with these standards shall be monitored and assured through a review and audit process described in Section 7.

6.1. Documentation Standards

All documents developed by the NICSD shall comply with the requirements in the NICSD Standard NQ-2024 "Document Control Procedure" (Reference (31)).

6.2. Design Standards

All design work developed by the NICSD shall comply with the requirements described in the NICSD Standard NQ-2036 "Procedure for Design Control" (Reference (40)).

6.3. Coding Standards

The software development process shall provide guidance to ensure standardization, compatibility, and maintainability of resulting software products. The process shall provide a coding standard for each language as well as usage guidelines for each software tool.

- VHDL source coding of the PPDD should conform to the PPDD Standard E-68017 "Procedural Standard for FPGA Device Development" (Reference (56)).
- The NICSD design team evaluates in the Preliminary Technical Evaluation Report (PTER) that the coding guidance in the PPDD is acceptable. The NICSD has its own coding guideline document, the NICSD Standard NQ-2031 "Procedural Standard for FPGA Device Development" (Reference (35)) that is used in the evaluation.

6.4. Testing Standards

The NICSD IV&V Team prepares a Software Validation Test Plan (SVTP) for the validation testing that may include a Platform Factory Test (PFT) of the FPGA-based systems, based on the NICSD VVP (Reference (12)). The NICSD IV&V Team also prepares the test documents for unit validation testing and System Validation Testing, which contain test cases and acceptance criteria, in accordance with the SVTP, the NICSD Standard NQ-2019 "Preparation Procedure for Test Specification" (Reference (30)), the NICSD Standard NQ-3015 "Test Control Procedure" (Reference (45)), the NICSD Standard NQ-3016 "Software Test" (Reference (46)) and the NICSD VVP (Reference (12)).

The procurement document for the PPDD describes the requirements for the testing which are conducted by the PPDD in the following software life cycle phases defined in the NICSD SMP

(Reference (10)). Testing documents prepared by the PPDD are verified by the NICSD IV&V Team in accordance with the NICSD VVP.

- Implementation and Integration Phase
- Module Validation Testing Phase

Testing of FPGAs and modules developed by the PPDD in the above phases shall comply with the requirements described in the PPDD Standard E-68027 "Test Specification Preparation Standard" (Reference (59)) with special provisions to be specified in the Job Order by the NICSD.

Complying to the instruction through CDI by the NICSD SD Team, the NICS-QA shall conduct a CG Survey for the PPDD in order to evaluate a capability of the PPDD to implement FPGA Testing and Module Validation Testing adequately. In the CG Survey, the survey team shall verify procedures for testing, including E-68027, performance and documentation in accordance with these procedures. The successful CG Survey allows the NICSD to accept the test results by the PPDD.

The NICSD IV&V Team verifies and approves the testing documents prepared by the PPDD through the IV&V activities prior to implementation of the test, and evaluate the test result to accept as a result of the validation testing after completion of the test. The NICSD SQAL shall confirm an adequacy of the NICSD IV&V Team activities by checking a documentation of verification result.

6.5. Acceptance Criteria for the Functional Elements (FEs)

As described in Section 4.2.2 of this NICSD SQAP, the FPGA-based modules incorporating the FEs, which are treated as COTS, are procured by the NICSD from the PPDD through the CGD process. The NICS-QA verifies that the control process of the FE is acceptable to the NICSD for use in the FPGA-based modules by conducting the Commercial Grade Survey (CGS) of the PPDD per request from the SDL, prior to the acceptance of the FPGA-based modules from the PPDD.

In this CGS, the NICS-QA shall verify that the PPDD procedure for the FE development is equivalent to and complies with the NICSD Standard NQ-2032 "Procedural Standard for Functional Element Development" (Reference (36)). The CGS team will verify a documentation and configuration control status of the FEs in compliance with verified PPDD procedures. The NICSD IV&V Team shall verify that the FEs are properly implemented in the FPGA through their activities over the PPDD. The NICSD SQAL shall oversee an activities of the NICSD IV&V Team by checking their results.

6.6. Metrics

The NICSD SQAL shall be responsible for defining, implementing, collecting, analyzing, and overseeing metrics data for the FPGA-based modules.

The following metrics shall be maintained:

- The errors discovered during FPGA Testing and the Module Validation Testing by the PPDD shall be identified through the use of Problem Reporting Sheets (PRS) (see Section 7.1.2 of the NICSD VVP (Reference (12))) so that the number of errors discovered can be tracked for an error discovery metric reporting. The overall goal is to identify a decreasing number and severity of errors, as the testing progresses.
- The errors discovered during System Validation Testing and Unit Validation Testing conducted by the NICSD shall be identified through the use of Fuchu Site Nonconformance Notice Report (SNNR) (see Section 9.1) so that the number of errors discovered can be tracked for the error discovery metric reporting. The overall goal is to identify a decreasing number and severity of errors as the testing progresses.

- Each PRS and SNNR shall be recorded with identification number and date in the log.
- In cases where the problem was caused by either the NICSD or the PPDD could not be readily determined, the NICSD has a responsibility to determine the responsible organization.

Metrics that are demonstrated to be of no value shall be abandoned, or if necessary, shall be replaced with metrics that have a value to ascertaining process compliance.

7 Software Reviews

The purpose of this section is to address the review requirements throughout the software life cycle. Reviews are designed to ensure that software documentation and processes comply with the procedures, established standards, and guidelines. Reviews are technical in nature and are designed to verify technical adequacy and completeness of the design and development of software. The NICSD IV&V Team is responsible for software review. Methodologies of performing reviews are described in the NED Standard AS-200A130 "Digital System Verification & Validation Procedure" (Reference (17)) and NQ-2030 (Reference (34)). In this section, activities of the NICSD SQA Team are described.

The NICSD IV&V Team activities are described in the NICSD VVP (Reference (12)).

7.1. NICSD Activity Review

The NICS-QA shall conduct the Internal Audit for each organization of the NICSD once a year or more frequently if required as defined in NQ-3022 (Reference (49)). As described in Section 6.2 of NQ-3022, audits shall be performed as deemed necessary by the NICS-QA manager.

In addition to the NICSD Internal Audit, the NICSD SQAL shall also conduct the NICSD software surveillance at the end of the every software life cycle defined in the NICSD SMP (Reference (10)). In the software surveillance, the NICSD SQA Team shall review the DVRs prepared by the NICSD IV&V Team. The DVRs are intended to be prepared by the NICSD Independent Reviewer as described in the Table-A in the NICSD SMP. This review shall be documented in the Software Surveillance Report, which shall be updated for each life cycle phase. Through this review of the NICSD IV&V activities including reviewing the NICSD Software Safety Analysis Reports (NICSD SSARs) prepared by the NICSD SS Team in accordance with Section 14 of the NICSD SMP, the NICSD SQA Team reviews the software safety analysis activities.

The NICSD SQA Team shall also review the Baseline Review Report (BRR) prepared by the NICSD IV&V Team. Through a review of the BRR, the NICSD SQA Team shall ensure inclusion of all applicable software modification requested by Documents Change Request (DCR) defined by NQ-2024 (Reference (31)), SNNR-I/II, and SCAR, in the baseline reviews.

And if necessary, the NICSD SQAL shall conduct a direct surveillance for the NICSD IV&V Team to confirm that the IV&V and Baseline Review activities are performed appropriately in accordance with applicable procedures and plans including the NICSD VVP (Reference (12)). For example, when the IV&V activity is suspected as not adequate, prior to determining that, the NICSD SQAL will confirm more detail through the direct surveillance. When direct surveillance is conducted, the following shall be addressed to confirm IV&V activities (reference SPP Table-10 through 18 for each phase as guidance).

- Monitor execution of the Software Verification and Validation Plan (SVVP) (i.e., the NICSD VVP) and analyze problems associated with its execution

- Report progress of the various V&V activities
- Ensure the software being produced fulfills requirements
- Evaluate testing results and check for completeness
- Monitor V&V outputs and determine when a task is complete
- Assess proposed changes to the software to identify affected requirements and any new hazards or risks as well as changing and re-performing V&V tasks as necessary to address the changes
- Determine the timing for changes or updates in the SVVP are required

7.2. PPDD Activity Review

The NICS-QA also conducts the Commercial Grade Survey (CGS) for Toshiba Fuchu Complex Power Systems Segment (Fuchu-PS), which includes the PPDD, to keep them as a Commercial Grade Supplier in the Qualified Vendor List (QVL) of NICS in accordance with NQ-3005 (Reference (43)) at least every 3 years. The NICS-QA also conducts an annual evaluation of the Fuchu-PS including the PPDD to maintain the qualification of them in the NICS QVL every year.

In addition, the NICS SDL or the NICS SQAL can request NICS-QA to conduct a CGS as necessary. Upon their request, the NICS-QA shall conduct an additional CG Survey to evaluate performance and capability of the PPDD as requested.

Depending on the purpose of these CG Surveys, the NICS key personnel including the NICS SDL, SSL, SCL, and IV&V Lead will concurrently participate in carry out their responsibility for the PPDD.

8 Test

As mentioned previously, the NICS-QA conducts an internal audit for the NICS-QC to verify compliance with an applicable aspect of the QA program and to determine its effectiveness. The NICS-QC has a responsibility to perform testing in accordance with NQ-3015 (Reference (45)), so that the audit team evaluates the testing activities by the NICS-QC during an internal audit.

The NICS SQAL will conduct the following activities regarding the software testing by reviewing the DVRs and V&V Report (VVR) prepared by the NICS IV&V Team at the end of each life cycle phase which includes testing activities.

The NICS SQAL also conducts a review of such testing activities through the Baseline Review Report prepared by the NICS IV&V Team, if the specific testing activities are not addressed in the DVRs.

8.1. NICS Activity Review for Testing

The NICS SQA Team shall review the DVR for the following item prepared by the NICS IV&V Team as a part of the software surveillance at the end of the software phases indicated in the double parenthesis below.

- Software Validation Test Plan (NICS SVTP)
((Module Validation Testing Phase))

8.2. PPDD Activity Review for Testing

The NICS-QA shall review the testing activity of PPDD through the Commercial Grade Surveys (CGSs) as described in Section 4.2 and 7.2 in this NICSD SQAP.

The NICSD SQA Team also reviews the DVRs prepared by the NICSD IV&V Team for the following items which are the scope of responsibility of the PPDD under the procurement from the NICSD in accordance with the CGD process.

- FPGA Test Procedure (Implementation and Integration Phase)
- FPGA Test Report (Implementation and Integration Phase)
- Module Test Procedure (Module Validation Testing Phase)

When a source surveillance, monitoring, witness, or Hold Point is required by the procurement documents to the PPDD in accordance with the NICSD Standard NQ-2025 "Preparation Procedure for Procurement Document for CG Items & Services" (Reference (32)), an inspector of the NICS-QC performs these activities to verify the PPDD activities. The PPDD is requested to prepare and submit the schedule of these activities to the NICS-QC.

9 Nonconformance Control and Corrective Action

Any anomalies and deviations found in work product after its release for review, test, or other use by someone other than the author, during any phase of the software life cycle shall be formally documented. The purpose of a formal procedure for nonconformance control and corrective action is to ensure that all errors and failures are promptly acted upon and in a uniform manner encompassing all project software. V&V activities are the primary vehicle to uncover problems, while the NICSD SCMP (Reference (11)) shall ensure that actions taken to correct problems by changing design artifacts are consistent and traceable. Any problems found during V&V activities including the RTM efforts shall be reported in the V&V reports. Likewise, any problems found during the Baseline Reviews shall be reported in the Baseline Review Reports.

Through the NICSD SQA Team involvement in the review of DVRs, VVRs, and BRRs, the NICSD SQA Team has the authority to issue the SCAR as necessary in the same measures as an audit issue. Once the SCAR regarding the software Quality Assurance is issued, the NICSD SQAL will have a responsibility to ensure that the corrective action is firmly implemented.

Processing of anomalies and corrective actions shall include evaluation of any metrics indicated in Section 6.6, to determine if the anomaly or corrective action is indicative of a single event, or of a developing adverse trend.

The design change caused by corrective action shall be controlled in accordance with Section 5.2.6 "Change Control" of the NICSD SCMP.

9.1. Nonconformance Control and Corrective Action Process for NICSD Activities

Any problems identified through the NICSD IV&V activities and/or the NICSD SQA activities shall be reported in the following manner:

- As for the issues regarding an item of itself, the issue shall be reported and resolved with the Fuchu Site Nonconformance Notice Report (SNNR-I) in accordance with the NICSD Standard NQ-3019 "Procedure for Control of Nonconformance and Corrective Action" (Reference (47)).

- As for the issues regarding a process, the issue shall be reported and resolved with the Fuchu Site Corrective Action Request (SCAR) in accordance with the NED Standard AS-300A009 (Reference (21)) with application identified by the NICSD standard NQ-1003 "Application of AS Standards" (Reference (23)), or the Fuchu Site Nonconformance Notice Report (SNNR-II) in accordance with the NICSD Standard NQ-3019.

In cases where it is not obvious to determine which organization caused the problem, i.e., which procedure shall be applied, the NICSD SQAL has a responsibility to make a final decision on a responsible organization.

Both in SNNR and SCAR, any safety critical anomalies discovered post-release or after a completion of CGD shall be evaluated to determine if notification under Part 21 is required and perform appropriate notifications in accordance with the PSNE Regulations & Procedures 4810 "REPORTING PROCEDURE FOR DEFECTS AND NONCOMPLIANCE UNDER USNRC 10CFR21" (Reference (13)).

9.2. Nonconformance Control and Corrective Action for PPDD Activities

If the PPDD finds any problem of the configuration items during FPGA Testing and Module Validation Testing, the problems shall be reported using a Vendor Nonconformance Notice Report (VNNR) in accordance with the NICSD Standard NQ-3006 "Procedure for Control of Nonconforming Procurement Items and Services" (Reference (44)). The requirement to use the VNNR process is transmitted to the PPDD by the NICSD procurement documents. The NICS-QC Manager, who is appointed as a person to receive VNNR by NQ-3006, shall notify the NICSD SQAL that a VNNR has been received from the PPDD.

10 Tools, Techniques and Methodologies

Tools, Techniques and Methodologies are described in Section 8.1 of the NICSD SMP (Reference (10)).

11 Vendor Control

The NICSD shall perform the procurement of FPGA-based modules in accordance with the CGD procedure described in Section 6.2 of the NICSD SMP (Reference (10)). Personnel implementing this SQAP shall verify correct implementation of these activities.

11.1. Previously Developed Software (PDS) and Commercial-off-the-Shelf (COTS)

As a part of the vendor control, this section provides the software QA functions for control of Previously Developed Software (PDS) and Commercial-off-the-Shelf (COTS) in the FPGA-based safety-related systems.

As defined in Section 11 of the NICSD SMP (Reference (10)), the NICSD treats the FPGA logic as PDS, and treats the Functional Elements (FEs), which constitute the FPGA logic, as COTS. NICSD procures the FPGA modules from the PPDD through the commercial grade dedication process. The PPDD shall develop the software for the FPGAs using the verified and adequately proven FEs in accordance with the requirements defined in the procurement documents from the NICSD. This procurement documents shall be developed by the NICSD in accordance with NQ-2025 (Reference (32)).

The FEs and FPGA logic are categorized as Software Integrity Level (SIL) 4 software, because the FEs are incorporated into the FPGA logic to be used for an actual safety-related product. SIL is defined by IEEE Std. 1012 (Reference (5)).

The NICSD SQA activities for control of the FEs by the PPDD shall verify the followings:

- The FEs shall be the software library for the products qualified by the PPDD through the quality assurance program in accordance with ISO-9001.
- The PPDD shall train, educate, and qualify a personnel who involved in the development of FEs.
- The PPDD shall develop the software life cycle approach for FEs.
- The PPDD shall develop the software requirements documents for FEs.
- The PPDD shall provide adequate traceability of the FEs as well as the requirements throughout the life cycle, and perform the functional testing of the FEs.
- The PPDD shall demonstrate that the FEs meet the requirements through the functional testing.
- The PPDD shall document the results of the functional testing of the FEs.
- The PPDD shall store FEs using a sufficiently dependable method.
- The PPDD shall track the operating history of FEs which applied in FPGAs.
- The PPDD shall control and dispose problems to ensure they do not affect the safety function of any application, when applicable.
- The PPDD shall have a measure to report the problem to the NICSD in a timely manner.

The PPDD activities are verified or monitored by the NICSD SQA Team via the CG survey, source verification, and/or by the NICSD IV&V Team per the NICSD VVP (Reference (12)).

11.2. Software Tool Vendors

Software tool vendors shall be controlled in accordance with the NICSD Standard NQ-3023 "Procedure for Purchase" (Reference (50)). NQ-3006 (Reference (44)) defines the requirements to the vendors when the vendor finds the discrepancies in the delivered product.

The error notification from the software tool review results for the development of FPGA logic shall be controlled in accordance with NQ-2034 (Reference (38)).

The NICSD SQAL shall ensure that the NICSD SDL applies all pertinent information provided by the vendors in the form of reports on tools, integrated circuits, and application notes.

12 Records Collection, Maintenance and Retention

Records collection, maintenance and retention shall be in accordance with the 10 CFR 50 Appendix B Quality Assurance program, as described in the NICSD Standard NQ-3020 "Control Procedure of QA Records" (Reference (48)).

Requirements for records collection, maintenance, and retention by the NICSD for the FPGA-based safety-related I&C Systems shall comply with the requirements described in NQ-3020 (Reference (48)) with special provisions to be specified in the Job Order Sheet by the NED.

13 Software Training

All NICSD personnel who are involved in the activities for safety-related products including the software development shall be trained on the QA program course, the applicable AS standards, and

the NQ standards identified by NQ-1003 (Reference (23)) and, shall be registered in the personnel list for the safety-related works, prior to start work on the specific project. Also, the personnel who are involved in the software Quality Assurance activities for the project shall be trained on this NICSD SQAP either by classroom training or self-study. The NICSD SQAL has a responsibility for this training. The software QA personnel shall be competent in the appropriate technical and quality activities required in the design, development, review, test, and modification of software products. The software training plan is described in Section 15 of the NICSD SMP (Reference (10))

14 Risk Management

If the NICSD SQAL finds QA related potential risks through the NICSD SQA activities, those potential risks shall be reported to the NICSD SDL, IV&V Lead, and Software Safety Lead so that all reported personnel shall evaluate reported potential risk. If the NICSD SQAL identifies the potential risk is a risk to the project through the evaluation of and the discussion with all members, the risk shall be reported to the NICSD PM, and the NICSD PM shall assign a responsible personnel for the risk mitigation plan. The mitigation plan shall be reviewed and approved by the NICSD PM. Once the mitigation plan is put in place, the status risk shall be monitored in the periodic NICSD Management Meetings.

15 Cyber Security

The NICSD (including SQA) and the PPDD shall implement Secure Development and Operational Environment (SDOE) requirements in accordance with the NICSD Standard NQ-2037 "Cyber Security Procedures of Safety Related Digital System" (Reference (41)).

The NICSD SQAL shall verify compliance with the requirements of the SDOE and Toshiba cyber security procedures and practices throughout every aspect of the NICSD SQA activities for the project.

16 SQAP Maintenance

As defined in Table-A of the NICSD SMP (Reference (10)), the NICSD SQA Team is responsible for preparing the NICSD SQAP, the NICSD SQAL is responsible for reviewing it, and the NICSD PM is responsible for approval. The QA personnel of the NICS-QA Group shall be responsible to maintain this SQAP. The NICSD SQAP shall be maintained in accordance with Section 16 of the NICSD SMP. The updated SQAP shall be prepared, verified and approved in the same manner as the SQAP was first established as a document in accordance with NQ-2024 (Reference (31)). Also issued NICSD SQAP shall be retained as a QA record in accordance with NQ-3020 (Reference (48)).

17 Life Cycle Task Iteration Process

The life cycle task iteration process is described in Section 13.9 of the NICSD SMP (Reference (10)).

18 Deviations

18.1. Deviation Policy

The deviation policy is described in Section 17.1 of the NICSD SMP (Reference (10)).

18.2. Deviation from NICSD SQAP

None

Appendix A: Compliance Traceability Matrix of Section 5 of Software Program Plan.

(Note: This appendix is just for reference and not a part of this document.)

Table A Compliance Traceability Matrix of Section 5 of Software Program Plan

Section in the SPP	Section in this SQAP
5.1 Introduction	1.Introduction
5.1.1 Purpose	1.1 Purpose
5.1.2 Scope	1.3 Scope
5.1.3 [Deleted]	-
5.1.4 Relationship of the SQAPP to Other SPP Sections	-
5.2 Reference Documents	3 Reference Documents
5.3 Management	4 Management
5.3.1 Organization	4.1 Organization
5.3.2 Tasks	4.2 Responsibilities
5.3.3 Roles and Responsibilities	4.2 Responsibilities
5.4 Documentation	5 Documentation, 7.1 NICSD Activity review
5.5 Standards, Practices, Conventions, and Metrics	6 Standards, Practices, Conventions, and Metrics
5.6 Reviews and Audits	7 Software Reviews
5.6.1 Reviews	7 Software Reviews
5.6.1.1 Baseline Reviews	7.1 NICSD Activity Review
5.6.1.2 Technical Reviews	7.1 NICSD Activity Review
5.6.1.3 Managerial Review	4.2 Responsibilities
5.6.2 Audits and Inspection	7.1 NICSD Activity Review
5.6.2.1 Functional Audit	4.2 Responsibilities, 7.1 NICSD Activity Review
5.6.2.2 Physical Audit	4.2 Responsibilities, 5.2 Audits, Surveillances and Commercial Grade Surveys, 7.1 NICSD Activity Review
5.6.2.3 In-Process Audit and Inspections	4.2 Responsibilities, 5.3 Reports Documentation, 7.1 NICSD Activity review
5.7 Test	8 Test
5.8 Anomaly Reporting and Corrective Actions	9 Nonconformance Control and Corrective Action
5.8.1 Anomaly Reporting	9 Nonconformance Control and Corrective Action
5.8.2 Corrective Action	9 Nonconformance Control and Corrective Action
5.9 Software Modification Process	7.1 NICSD Activity Review
5.10 Tools, Techniques, and Methodologies	10 Tools, Techniques and Methodologies
5.11 Code Control	-
5.12 Media Control	-
5.13 EPC Team Member, EPC Subcontractor, and Vendor Control	1.2 Background, 11 Vendor Control
5.14 Previously Developed or Purchased (COTS) Software	11.1 Previously Developed Software (PDS) and Commercial-off-the-Shelf (COTS)
5.15 Records Collection, Maintenance, and Retention	16 SQAP Maintenance
5.16 Training	13 Software Training
5.17 Risk Management	14 Risk Management