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Nuclear**

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LICENSING TOPICAL REPORT

ESBWR I&C

**SOFTWARE CONFIGURATION MANAGEMENT PLAN
(DRAFT)**

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1 Introduction

This Software Configuration Management Plan (SCMP) describes the Software Configuration Management (SCM) activities to be implemented during the development of software-based products {see SMP [1.3.1.2(1)]¹} produced for ESBWR Instrumentation and Control Systems². This plan shall be used in conjunction with Software Management Plan (SMP)³ [1.3.1.2(1)], Verification and Validation Plan (VVP) [1.3.1.2(2)] and Software Safety Plan [1.3.1.2(6)].

1.1 Purpose and Scope

This Plan (SCMP) provides the direction necessary to implement the configuration management activities required for the software engineering process {see SMP [1.3.1.2(1)]}. It establishes a formal set of standards and methodology used to administer and control the configuration of Quality Class S and Quality Class N-R I&C software-based products {see SMP [1.3.1.2(1)]}. Software configuration management of Quality Class N-G software-based products shall follow the applicable requirement stated in Appendix B.

This Plan is to remain in effect throughout the entire life cycle of the I&C software-based product. Exceptions from this plan may be accepted if the product quality level is maintained. Any deviations from this plan must be justified and approved by the Responsible Technical Project Engineer (RTPE) and the Responsible Software Safety Engineer (RSSE). The justification shall be documented in the software project Design Record File (DRF) {see GEEN EOP 42-10.00 [1.3.1.2(3c)]}.

[[

¹ Section numbers referenced in this manner refer to the codes and standards documents listed in the Applicable Documents section (Section 1.3) of this document.

² The functions of I&C are the same as M-MIS as defined in the Overall Requirements section (Section 3) of the M-MIS System and HFE Implementation Plan [1.3.1.1(3)].

³ SMP, SCMP and SVVP herein refers to the SMP [1.3.1.2(1)], SCMP (this plan) and SVVP [1.3.1.2(2)].

]]

1.2 Definitions, Acronyms and Abbreviations

The PDM [2.1.1(2)] specifies the valid Information Management System (IMS) codes, component function codes (CFCs), equipment/service acronyms and abbreviations for the ESBWR Project.

Acronyms and Abbreviations

The following Acronyms and Abbreviations are used in this document:

ASME	American Society of Mechanical Engineers
BRR	Baseline Review Record
BRT	Baseline Review Team
CI	Configuration Item
DRF	Design Record File
ERM/ECN	Engineering Change Notice
EDMS	Electronic Document Management System
EPRI	Electrical Power Research Institute
EOP	Engineering Operating Procedure
ERM	Engineering Review Memorandum
GE	General Electric Company
GEEN	General Electric Energy Nuclear (Previously GENE)
HFE	Human Factors Engineering
HSI	Human System Interfaces
HSS	Hardware/Software Specification
I/O	Input/Output
IEEE	Institute of Electrical and Electronic Engineers
IP	Installation Plan
ISO	International Standards Organization
M-MIS	Man-Machine Interface System
NI	Nuclear Island
NUMAC	Nuclear Measurement Analysis and Control
O&MP	Operation & Maintenance Plan (Change Control)

P&ID	Piping & Instrumentation Diagram
PDM	Project Design Manual
PDMS	Product Data Management System
PMM	Project Management Manual
PP	Project Plan
PPM	Project Procurement Manual
PRM	Process Radiation Monitor
QA	Quality Assurance
Reg Guide	Regulatory Guide
RCCE	Responsible Configuration Control Engineer
RE	Responsible Engineer
RETL	Responsible Engineering Technical Lead
RSSE	Responsible Software Safety Engineer
RTPE	Responsible Technical Project Engineer
SBD	System Block Diagram
SCM	Software Configuration Management
SCMP	Software Configuration Management Plan
SDD	System Design Description
SMP	Software Management Plan
SPR	Software Problem Report
SRS	Software Requirements Specification
SSA	Software Safety Analysis
SSP	Software Safety Plan
VVP	Verification and Validation Plan

UTILITY	Utility
US NRC	United States Nuclear Regulatory Commission
V&V	Verification and Validation

The following definitions apply throughout this document:

Anomaly	- Anything observed in the documentation or operation of software that deviates from expectations based on previously verified software products or reference documents.
Baseline	- A set of items that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures.
Baseline Review	- A formal review, conducted at the end of each software life cycle phase, and requested by the Responsible Technical Project Engineer. The baseline review process is under the control of the Baseline Review Team. The Baseline Review Team (appointed by the BRT Lead) performs the review. These reviews are intended to confirm adherence to the SMP [1.3.1.2(1)], SCMP (this plan) and VVP [1.3.1.2(2)]. All Baseline Reviews are performed and documented in accordance with procedures outlined in SCMP.
Baseline Review Team	- The team responsible for judging the adherence to the process for the documentation being baselined. The members of this team are appointed by the BRT Lead and must be independent from the designers responsible for the documentation.
Baseline Review Team Lead	- The person responsible for organizing the baseline review process. This person is appointed by the Manager/Technical Lead, Control/Electrical Systems.
Code Review (Code Analysis)	- Software source code presented to project personnel for comment or approval.

- Configuration Item - An aggregation of hardware, software, design documents or procedures that is designated for configuration management and treated as a single entity in the configuration management process.
- I&C Software Library - A software library containing computer readable and human readable information relevant to a software development effort.
- Design Record File - Design Record File is the formal controlled information record for in-progress and completed engineering work which is retained and from which information can be retrieved.
- Design Reviews - Formal, design adequacy evaluations which are performed by knowledgeable persons other than those directly responsible and accountable for the design in accordance with GEEN EOP 40-7.00 [1.3.1.2(3g)]. Design reviews are used to verify that product designs meet functional, contractual, safety, regulatory, industry codes and standards, and company requirements.
- Design Walkthrough - An informal review process or inspection to find defects (such as omissions, unwanted additions, and contradiction) in design documentation and to consider alternative functionality, performance objectives, or representations.
- Instrument - A hardware device used for analytical or control functions and usually containing an embedded microprocessor(s).
- Internal Verification and Validation - The V&V activities performed by the responsible design organization in accordance with GEEN EOPs 40-7.00 (Design Reviews) [1.3.1.2(3g)] and/or 42-6.00 (Independent Design Verification) [1.3.1.2(3a)] to ensure the quality of the design process and the associated documents produced. These V&V activities are referred herein as the *Internal V&V*.
- Quality Class N-G - General Grade classification {see Quality Assurance Plan [1.3.1.1(5)]}.
- Quality Class N-R - Reliability-Critical classification {see Quality Assurance Plan [1.3.1.1(5)]}.

- Quality Class S - Safety related classification {see Quality Assurance Plan [1.3.1.1(5)]}.
- Responsible Configuration Control Engineer - The person assigned responsibility for the configuration management of the I&C software-based products.
- Responsible Engineer - The person responsible for a given technical item (e.g., the design and development of the documentation).
- Responsible Engineering Technical Lead - A person with the overall responsibility for a set of I&C software-based products. Each I&C software-based product is assigned a RETL, including those developed by vendors.
- Responsible Software Safety Engineer - The person with overall responsibility for ensuring the safety qualities of the software being developed for I&C, including the integration of the software with the final hardware platform {see SSP [1.3.1.2(6)]}.
- Responsible Technical Project Engineer - The person with overall technical responsibility for ensuring that the hardware and software design of a software-based product meets the requirements.
- Responsible Verifier - The Responsible Verifier(s) is an individual who meets the independence as described in GEEN EOP 42-6.00 [4.1.2(3b)] for verifications or EOP 42-6.10 for deferred verifications of design process and the accompanying documents.
- Software Life Cycle - The period of time that begins when a software product is conceived and ends when the software is no longer available for use.
- Software Module - The smallest segment of code known and controlled by the operating system (also called routine, procedure, function or subprogram).
- Software Package - A collection of software modules (e.g., subroutines, main control tasks) brought together to form a single software product.
- Software Source Code - Computer instructions and data definitions expressed in a form suitable for input to an assembler, compiler, or other translator.

- Traceability Matrix - A matrix that records the relationship between two or more products of the development process (e.g., a matrix that records the relationship between the requirements and the design of a given software component).
- Validation - The testing process that ensures that the software-based product meets its intended use and is compliant with the functional, performance and interface requirements.
- Verification - See Internal Verification and Validation.

1.3 Applicable Documents

1.3.1 Supporting and Supplemental Documents

1.3.1.1 Supporting Documents

The following supporting documents were used as the controlling documents in the production of this plan. These documents form the design basis traceability for the requirements outlined in this plan.

Document Title	Document Number
1. Project Design Manual (PDM)	
2. NP-2010 COL Demonstration Project, Project Management Manual (PMM)	NEDC-33216
3. Man-Machine Interface System and Human Factors Engineering Implementation Plan	NEDE-33217
4. Man-Machine Interface System Review Implementation Plan	NEDE-33218
5. NP-2010 COL Demonstration Project Quality Assurance Plan	NEDC-33181
6. Project Procurement Manual (PPM)	

1.3.1.2 Supplemental Documents

Supplemental documents are those documents that are used in conjunction with this document.

Document Title	Document Number
1. Software Management Plan	NEDC-33226
2. Verification and Validation Plan	NEDE-33228

Document Title	Document Number
3. GEEN Engineering Operation Procedures	NEDE-21109
a. 42-6.00 Independent Design Verification	
b. 42-8.00 Document Initiated or Change by ERM/ECN	
c. 42-10.00 Design Record File	
d. 55-2.00 Engineering Change Control	
e. 60-3.20 Quality-Related Computer Data	
f. 30-3.40 Product Data Management System (PDMS)	
g. 40-7.00 Design Review	
h. 40-3.00 Engineering Computer Programs	
i. 30-3 Product Definition	
j. 45-2.00 Procurement of Engineering Services	
4. Configuration Management Plan	
5. Software Development Plan	NEDC-33229
6. Software Safety Plan	NEDE-33230

1.3.2 Codes and Standards

The following codes and standards are applicable to the Software Configuration Management activity to the extent specified in this plan. The applicable date/revision of the code or standard is specified in the ESBWR Certification tier 2, Tables 1.9-n.

1.3.2.1 American Society of Mechanical Engineers (ASME) Codes

1. None

1.3.2.2 Electrical Power Research Institute (EPRI)

1. EPRI TR-106439, Guidelines on Evaluation and Acceptance of Commercial Grade Digital Equipment in Nuclear Safety Application

1.3.2.3 Institute of Electrical and Electronic Engineers (IEEE) Standards

1. IEEE 610.12, Standard Glossary of Software Engineering Terminology

2. IEEE 828, IEEE Standard for Software Configuration Management Plans
3. IEEE 1042, IEEE Guide to Software Configuration Management

1.3.2.4 International Standards

1. ISO-9000-3, Quality management and quality assurance standards - Guidelines for the application of ISO 9001 to the development, supply and maintenance of software

1.3.2.5 U.S. Nuclear Regulatory Commission (NRC) Regulatory Guides (Reg Guide)

1. Reg Guide 1.169, Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
2. Reg. Guide 1.152, Criteria for Digital Computers in Safety Systems of Nuclear Power Plant

1.3.2.6 NUREG

1. CR-6421, A Proposed Acceptance Process for Commercial Off-the-Shelf (COTS) Software in Reactor Applications
2. NUREG/CR-6101, Software Reliability and Safety in Nuclear Reactor Protection Systems

2 Configuration Management Structure

2.1 Organization

The hierarchy of individuals responsible for implementing the configuration management of the I&C software-based product is identified in Figure 1. The Responsible Engineering Technical Lead (RETL) shall request that a Responsible Configuration Control Engineer (RCCE) be assigned and ensure that an assignment is made.

The design interfaces and the organization units (i.e., vendors, other ESBWR project teams, etc.) responsible for the development of I&C computer-based products are identified in Figure 2.

2.1.1 Design Interfaces

It is the responsibility of the Responsible Technical Project Engineer (RTPE) to maintain coordination between I&C design documentation and interfacing design items developed outside the scope of this Plan (i.e., design items developed by other ESBWR Project Organizational Units). [[

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2.1.1.1 Internal Design Interfaces

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2.1.1.2 External (Vendor) Design Interface

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2.1.1.3 Organizational Resources

Budget: The financial resources necessary to carry out the work in the SCMP is proprietary and maintained by the senior manager(s) responsible for the personnel assigned to their area of responsibility.

Personnel:

The SCMP [this plan] specifies the organizational responsibilities for each member of the project team serving in a lead capacity.

The design team shall be composed of experienced individuals whose collective expertise covers a broad range of disciplines relevant to the design and implementation process. These disciplines shall include technical project management, systems engineering, nuclear engineering, electrical engineering and control and instrument engineering. Table 2A in the M-MIS Review

Implementation Plan [1.3.1.1(4)] defines the acceptance criteria for the required skill levels for these disciplines.

Staffing plans shall be established for each work package according to EOP 25-5.00 [2.1.2(7a)]. Due to the very sensitive nature of the information, these plans will be retained as GE Company Private information in Project Files for the duration of the project.

Methods for obtaining, training, and retraining are defined in internal GE human resource policies.

Methods/Tools:

[[

]]

The record collection and retention method

Standards: The primary international, national, industry and company standards and guidelines to be followed in the work defined in the SCMP is identified in Supporting and Supplemental Documents section of this SCMP.

2.2 SCM Responsibilities

The primary duties of the organization covered by the SCMP, and of individuals within the organization are defined below. The Manager/Technical Lead, ESBWR Configuration Management is defined within SDP [1.3.1.2(5)] under Project Responsibilities.

Sections 2.2.1 through 2.2.8 describe the responsibilities of the individuals and organization responsible for the configuration management activities (see Section 3.4) throughout the software engineering process.

Notification of document issues, and distribution or release of documents shall be carried out as defined in the Configuration Management Plan [1.3.1.2(4)].

2.2.1 Responsible Engineering Technical Lead

For the purpose of I&C configuration control, the responsibility of the Responsible Engineering Technical Lead is to appoint an RCCE.

2.2.2 Responsible Technical Project Engineer

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2.2.3 Responsible Engineer

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2.2.4 Responsible Configuration Control Engineer

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2.2.5 Baseline Review Team Lead

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2.2.6 Baseline Review Team

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]]

2.2.7 Responsible Software Safety Engineer

[[

]]

2.3 Applicable Policies, Directives, and Procedures

2.3.1 Naming and Numbering the CIs

[[

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2.3.1.1 Issued Documents

[[

⁴ Verification and Validation (see SVVP [1.3.1.2(2)]) shall be performed on the CIs as required by the SMP prior to the baseline review.

]]

2.3.1.2 Design Record File Documents

[[

⁵ SSA of Concept Definition is not required during the planning phase (phase I) because it does not evaluate the documents issued during this phase. It shall be performed during the Design Definition Phase (phase II) prior to the performance of SSA of Design Definition, therefore, SSA Concept Definition Report shall be prepared during the Design Definition phase. All SSA CI's are reviewed by the BRT and controlled as specified herein, but are not a required CI for the individual software baselines as the SSA activity and reports are not inputs to the software design process.

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2.3.1.3 Software Configuration Items Identification

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2.3.1.4 Physical Media Identification

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2.3.1.5 Vendor Documents Identification

Vendor submittals shall be assigned a unique identification and revision number in accordance with the format described in PDM [1.3.1.1(1)].

2.3.1.6 Acquired Software Identification

[[

]]

2.3.2 Product Measurement

Design traceability analysis and evaluation must be performed to verify the design and development of I&C software-based products. A cross reference traceability matrix and/or errors checklist may be used to manage the implementation of the software engineering process, and to record defects and errors {see SMP [1.3.1.2(1)]}.

[[

]]

3 Configuration Management Activities

This section identifies all functions and tasks required to manage the configuration of I&C software-based products as specified in the supporting documentation listed in Section 1.3.1. The information requirements for each function are identified in Sections 3.1 through 3.9.

3.1 Software Configuration Management Plan Implementation

3.1.1 Baselines

[[

]]

3.2 Configuration Control Tools and Methodologies

3.2.1 Engineering Document Management

[[

]]

3.2.2 Software Library for Computer-Based Configuration Items

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3.2.3 Design Record File

[[

]]

3.2.4 Engineering Information System

[[

]]

3.2.5 Engineering Computer Programs

[[

]]

3.3 Configuration Items Identification

[[

]]

3.3.1 Baseline Items for Planning Phase

[[

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All baseline items shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Planning Baseline Review as required by the SMP [1.3.1.2(1)]. The Non-Safety I&C project plans will be maintained in their individual software project DRFs and will not be baselined.

3.3.2 Baseline Items for Design Definition Phase

[[

⁶ The development of User's Manual may evolve through the Software Design and Software Coding Phases (see SMP [1.3.1.2(1)]).

]]

All baseline items shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Design Definition Baseline Review as required by the SMP [1.3.1.2(1)]. Baseline of support software, third party software, and previously developed software includes documentation and test results.

3.3.3 Baseline Items for Software Design Phase

[[

]]

All baseline items shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Software Design Baseline Review as required by the SMP [1.3.1.2(1)].

3.3.4 Baseline Items for Software Coding Phase

[[

⁷ Module Test Reports document the results of Code Reviews and Module Testing.

]]

All baseline items shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Software Coding Baseline Review as required on by the SMP [1.3.1.2(1)].

3.3.5 Baseline Items for Integration Test Phase

[[

]]

All baseline shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Integration Test Baseline Review as required on by the SMP [1.3.1.2(1)].

3.3.6 Baseline Items for Validation Test Phase

[[

]]

All baseline items shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] prior to the Validation Test Baseline Review as required on by the SMP [1.3.1.2(1)].

3.3.7 Baseline Items for Change Control Phase

[[

]]

The revised documentation {see VVP [1.3.1.2(2)]} shall be verified in accordance with the methods outlined in the VVP [1.3.1.2(2)] and baseline review(s) shall be re-performed for the affected life cycle phase(s).

3.4 Configuration Control Process

3.4.1 Baseline Review

A baseline review shall be performed at the completion of each of the software life cycle phase.

[[

]]

3.4.2 Baseline Items Approval Process

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3.4.3 Baseline Review Record

The Baseline Review Team Lead shall prepare a Baseline Review Record (Appendix A.1) for each Baseline Review. [[

]]

3.4.4 Baseline Item Storage

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]]

3.5 Configuration Change Control

The Change Control Process commences with the identification of a discrepancy or deficient condition detected in a configuration item. [[

⁸ ERM/ECNs are used to change documents bearing a GE Corporate identity (issued CIs).

]]

3.5.1 Change Control Process

Subsections 3.5.1.1 through 3.5.1.3.1 define the responsibilities of the responsible individuals and the corrective actions necessary to coordinate the change control process of the CIs.

3.5.1.1 Responsible Individuals

3.5.1.1.1 Originator

[[

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3.5.1.1.2 Responsible Engineer

[[

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3.5.1.1.3 Responsible Software Safety Engineer

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3.5.1.1.4 Responsible Technical Project Engineer

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3.5.1.1.5 Responsible Configuration Control Engineer

[[

]]

3.5.1.1.6 Baseline Review Team

[[

]]

3.5.1.2 Change Approval

[[

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3.5.1.3 Change Notification

[[

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3.5.1.3.1 Design Interfaces Control

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3.6 Status Accounting

[[

]]

3.7 Configuration Reviews and Audits

[[

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3.7.1 Configuration Reviews

[[

]]

3.7.2 Functional Configuration Audit

[[

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3.7.3 Physical Configuration Audit

[[

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3.8 Configuration Items Release Procedures

[[

]]

3.9 Product Release

The Engineering Manager has the final authority for the release of the final I&C software-based products. Products shall not be shipped without completion of all software safety activities {see SMP [1.3.1.2(1)] section 5.1.2.4}.

4 Vendor Control

4.1 Software Developed by Vendors for the Project

[[

]]

Vendor submittals files shall be maintained and controlled in accordance with the procedures outlined in Project Management Manual [1.3.1.1(2)].

5 Acquired Software

[[

]]

5.1 Configuration Change Control of Acquired Software

[[

]]

6 Record Collection and Retention

[[

]]

All configuration items shall contain a direct indication of the item's revision status.

Table 1 Storage Medium for Established Baseline Items

[[

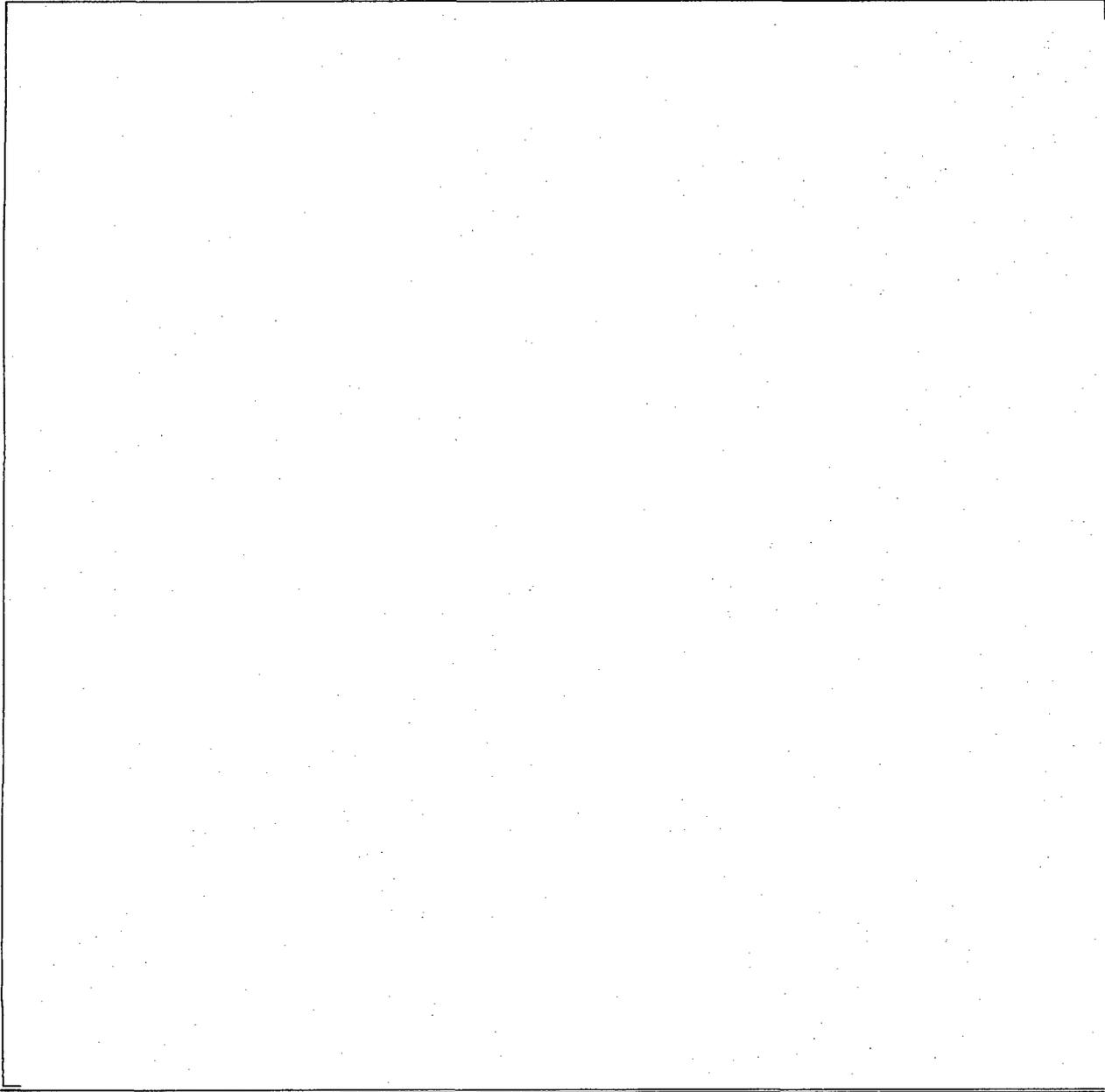
]]

¹ Deleted.

² [[

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[[



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Figure 1 I&C SCM Organizational Chart

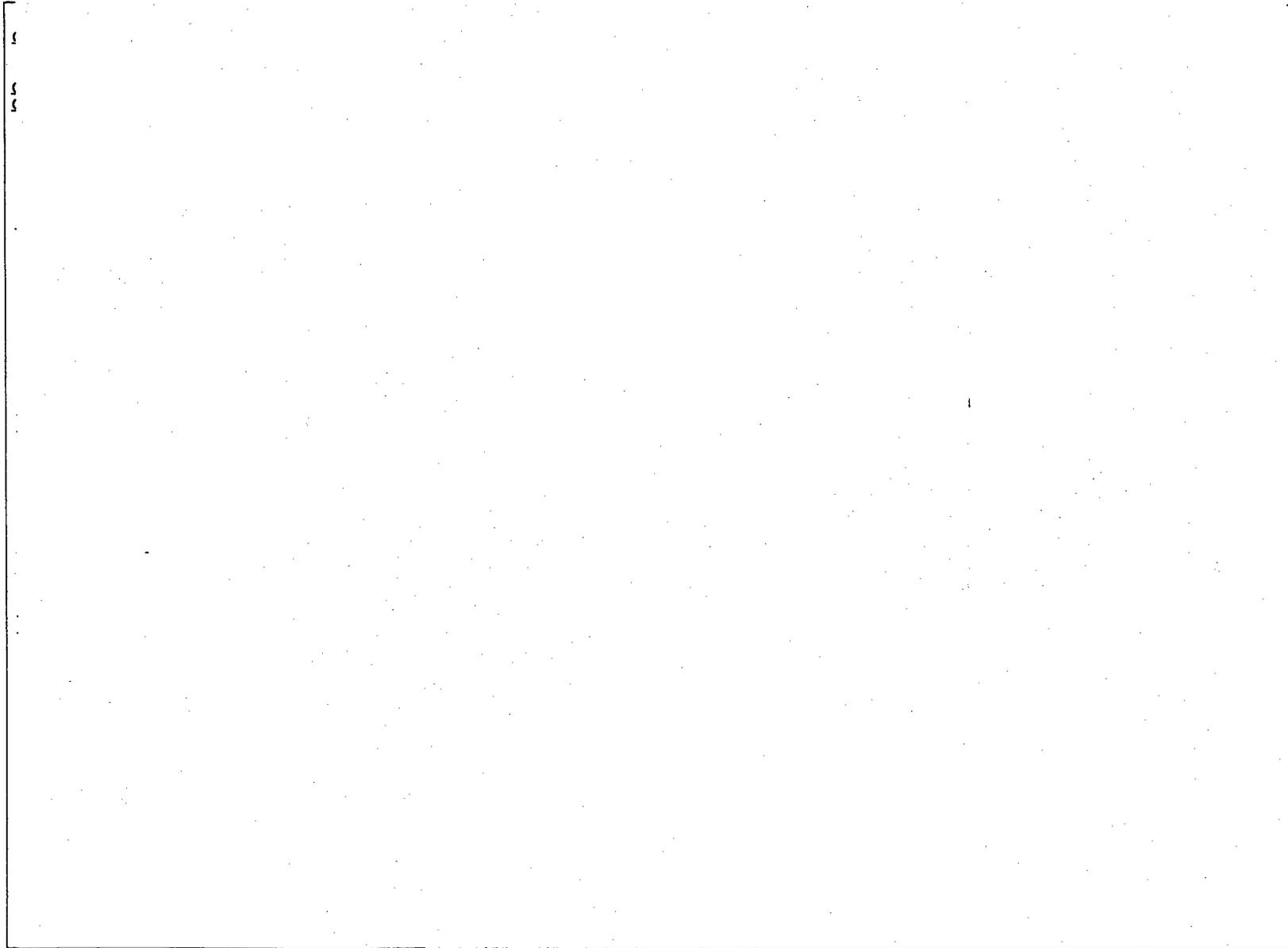


Figure 2 ESBWR I&C Design Relationship and Baseline Review Interface

A.2 I&C Software Problem Report

[[

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* See definition at the end of this appendix.

A.3 Engineering Problem Report

[[

]]

* See definition at the end of this appendix.

[[

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Appendix B: Requirement Standards

Application	Requirement Standards
1. Quality Class S Application or Systems	<ul style="list-style-type: none"> • Reg. Guide 1.152, Criteria for Digital Computers in Safety Systems of Nuclear Power Plant [1.3.2.5(2)] • Reg Guide 1.169, Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants [1.3.2.5(1)]
2. Quality Class N-R Application or Systems	<ul style="list-style-type: none"> • ISO-9000-3, Quality management and quality assurance standards - Guidelines for the application of ISO 9001 to the development, supply and maintenance of software [1.3.2.4(1)]
3. Quality Class N-G Application or Systems	<ul style="list-style-type: none"> • Conform to all commercially accepted products.

Appendix C: I&C Software Library Structure

[[

The diagram consists of three horizontal lines and one vertical line. The vertical line is positioned on the right side of the page, intersecting the three horizontal lines. This creates a table-like structure with three rows and one column on the right side. The left side of the horizontal lines is open.

]]