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## Guidance for Use of this Template

*This section provides guidance for customizing this template for a specific project. This guidance section is deleted after the plan is customized.*

Rolls-Royce Civil Nuclear SAS (RRCN) will use this template as the basis for preparing the corresponding plant-specific plan that will define specific life cycle processes for **SPINLINE 3** systems for use in nuclear power plants located in the United States (US). RRCN engineers will customize this plan for each plant-specific safety I&C system. The customization replaces symbols defined in this section, as necessary, to reflect the actual scope of the plant-specific project. The basic process defined in this template may not be changed.

Guidance is provided in this template as *italic text* and is either removed or replaced by appropriate normal text in the actual plan. Symbols are used to indicate places where changes are required to customize this template into a project-specific plan. These symbols must be replaced by names relevant to the actual project. The symbols defined in this template are as follows:

<i>Project_Name</i>	<i>Example:</i>	MYPROJECT
<i>System_Name</i> (project composed of one or more systems)	<i>Example:</i>	RPS
<i>Processing_Unit_Name</i>	<i>Example:</i>	FUx
<i>Manager_Name</i>	<i>Example:</i>	P. DUPONT
<i>Document_Number</i> (in RRCN format)	<i>Example:</i>	3 300 000

## 1 INTRODUCTION

This System Installation and Site Test Plan is one of a set of software and system life cycle plans that govern the life cycle for plant-specific **SPINLINE 3** systems. This Plan is compliant with the applicable requirements and guidance documents listed in Section 2.

### 1.1 Purpose

This document is the System Installation and Site Test Plan for the plant-specific **SPINLINE 3** digital safety I&C system(s) developed by Rolls-Royce Civil Nuclear SAS (RRCN) for *Project\_Name*. The processes described in this Plan provide for the installation and site acceptance testing of **SPINLINE 3** *System\_Name\_1*, *System\_Name\_2*, ... to *System\_Name\_n*.

Cyber security risks and mitigating measures appropriate to installation and site testing are identified in the plant-specific *Project\_Name* Cyber Security Plan (Reference 1). This System Installation and Site Test Plan implements cyber security measures into installation and site testing activities.

### 1.2 Relationship of this Plan to the Plans Defined in BTP 7-14

The United States Nuclear Regulatory Commission (USNRC) NUREG-0800, "Standard Review Plan" Branch Technical Position (BTP) 7-14 (Reference 2) defines twelve software life cycle plans, with an additional cyber security plan defined in Regulatory Guide 1.152 (Reference 3). RRCN combines some of the NRC-defined software life cycle plans, and covers all aspects of the plans defined by BTP 7-14 and Regulatory Guide (RG) 1.152. This System Installation and Site Test Plan is equivalent to the BTP 7-14 Software Installation Plan (SInstP) and the portion of the Software Test Plan (STP) dealing with final system-level site acceptance testing. This System Installation and Site Test Plan also addresses hardware installation.

### 1.3 Project Summary

#### 1.3.1 Project objectives

The System Installation and Site Test Plan is specific to the following **SPINLINE 3** systems of *Project\_Name*:

#### Safety Systems – Class 1E

- *System\_Name\_1*  
*Processing\_Unit\_Name*, ... (SPINLINE 3 software)
- *System\_Name\_n*  
*Processing\_Unit\_Name*, ... (SPINLINE 3 software)

#### Nonsafety Systems

- *Monitoring and Maintenance Unit*  
*MMU* (PC software)
- *Other system (to be determined)*  
*Processing\_Unit\_Name*, ... (software to be determined)

### 1.3.2 System description

Insert a brief description of each of the systems to be installed at Nuclear\_Power\_Plant\_Name.

### 1.3.3 Deliverables

The primary deliverables are the installed and operational digital safety I&C systems identified in Section 1.3.1. The following installation documentation is produced in accordance with this Plan.

Description	Number	Intended date
Hardware receipt inspection procedure for <i>System_Name_n</i> and associated records		
Software receipt inspection procedure for <i>System_Name_n</i> and associated records		
Hardware installation package for <i>System_Name_n</i>		
Software installation package for <i>System_Name_n</i>		
Hardware installation procedures for <i>System_Name_n</i>		
Software installation procedures for <i>System_Name_n</i>		
Acceptance test procedure for <i>System_Name_n</i>		
Acceptance test report for <i>System_Name_n</i>		

Each **SPINLINE 3** system is a custom-built system for a plant-specific application. *The System Installation and Site Test Plan is likewise customized for the specific system(s) scheduled for installation.*

### 1.3.4 Constraints and assumptions

The constraints for the installation and site testing of *System\_Name\_1* to *System\_Name\_n* are listed below:

1. All RRCN staff participating in these activities have been trained and certified by RRCN under existing RRCN plans, procedures, and processes.
2. The system(s) scheduled for installation have completed integration and factory acceptance testing in accordance with the System Integration and Factory Test Plan (Reference 4).
3. The utility has approved shipment of these systems from the factory to the NPP.
4. The NPP is prepared to receive the shipment and provide appropriate temporary storage, as required by the NPP Nuclear Quality Assurance (QA) Plan, prior to the start of installation.
5. The NPP has completed all necessary site preparations prior to the start of installation.
6. The NPP will approve the installation package(s) for the *System\_Name\_1* to *System\_Name\_n* hardware
7. Operations and Maintenance Manuals (OMMs) and associated documentation for *System\_Name\_1* to *System\_Name\_n* have been completed and approved by the NPP in accordance with the System Operations & Maintenance Plan (SO&MP, Reference 5).
8. NPP instructors have been trained by RRCN in accordance with the System Training Plan (Reference 6).



9. The NPP instructors have trained the NPP operations, maintenance, and engineering staff and managers participating in installation and/or site acceptance testing in accordance with the System Training Plan (Reference 6).
10. Before the start of installation, the NPP will declare all affected functions to be inoperable in accordance with the NPP Technical Specifications
11. *Add other constraints as appropriate,*

This Plan makes the following assumptions about the installation and site testing of *System\_Name\_1* to *System\_Name\_n*:

1. *Add assumptions as appropriate*

## 1.4 Definitions and Abbreviations

### 1.4.1 Definitions

The following definitions are important for understanding the scope and applicability of this software plan.

Equipment technology This plan considers two equipment technologies:

- **SPINLINE 3** is a proprietary Rolls-Royce Civil Nuclear SAS technology designed to implement safety functions
- A personal computer (PC) is a commercially available technology based on Intel or equivalent microprocessors, run under a commercial operating system, and used to implement nonsafety control, monitoring, or communication functions

Software category This plan considers two categories of software: safety (Class 1E) and nonsafety (non Class 1E)

### 1.4.2 Abbreviations

The following abbreviations are used in this plan.

BTP	Branch Technical Position
EEPROM	Electrically Erasable Programmable Read-Only Memory
FAT	Factory Acceptance Test
IEEE	Institute of Electrical and Electronics Engineers
I&C	Instrumentation and Control
NPP	Nuclear Power Plant
OMM	Operations & Maintenance Manual
PC	Personal Computer
PCR	Problem/Change Report
QA	Quality Assurance



RPS	Reactor Protection System
RG	Regulatory Guide
RRCN	Rolls-Royce Civil Nuclear SAS (Société Anonyme Simplifié)
SAT	Site Acceptance Test
SInstP	System Installation and Site Test Plan
STP	Software Test Plan
USNRC	United States Nuclear Regulatory Commission

## 1.5 Creation and Update of this Plan

The System Installation and Site Test Plan is created jointly by Rolls-Royce Civil Nuclear SAS and the NPP. The NPP Chief Engineer approves this Plan.

## 2 REFERENCE DOCUMENTS

### Reference Standards:

The following standards and guides apply to the installation activities described in this Plan.

Branch Technical Position 7-14 (Reference 2)	"Guidance on Software Reviews for Digital Computer-based Instrumentation and Control Systems", Section B.3.1.5, "Software Installation Plan (SInstP)"
IEEE Standard 1074-1995 (Reference 7)	"IEEE Standard for Developing Software Life Cycle Processes", Clause A.1.2.4, "Plan Installation"
NUREG/CR-6101 (Reference 8)	"Software Reliability and Safety in Nuclear Power Plant Protection Systems", Sections 3.1.8 and 4.1.8, "Software Installation Plan"

The following standards and guides apply to the site testing activities described in this Plan.

Branch Technical Position 7-14 (Reference 2)	"Guidance on Software Reviews for Digital Computer-based Instrumentation and Control Systems", Section B.3.1.12, "Software Test Plan (STP)"
Regulatory Guide 1.152, Revision 2 (Reference 3)	"Criteria for Use of Computers in Safety Systems of Nuclear Power Plants"
Regulatory Guide 1.170 (Reference 9)	"Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants", which endorses IEEE 829-1983
IEEE Standard 829-1983 (Reference 10)	"IEEE Standard for Software Test Documentation"
IEEE Std 7-4.3.2-2003 (Reference 11)	"IEEE Standard Criteria for Digital Computers in Safety Systems on Nuclear Power Generating Stations", Clause 5.4.1, "Computer System Testing"





## Project Documents:

The following documents define the project execution processes.

<u>Mnemonic</u>	<u>Reference</u>	<u>Designation</u>
[CSP]	<i>Document_Number</i>	Cyber Security Plan (project-specific)
[PQP]	<i>Document_Number</i>	Project Quality Plan (project-specific)
[PMP]	<i>Document_Number</i>	Project Management Plan (project-specific)
	<i>Document_Number</i>	System Integration and Factory Test Plan (project-specific)
	<i>Document_Number</i>	System Training Plan (project-specific)
	<i>Document_Number</i>	System Installation and Site Test Plan (project-specific)
	<i>Document_Number</i>	System Operations and Maintenance Plan (project-specific)

## RRCN Quality Management System reference documents:

The following documents provide detailed engineering instructions to implement this system plan.

<u>Mnemonic</u>	<u>Reference</u>	<u>Designation</u>
[MQ]	8 303 186 P (Reference 9)	RRCN Quality Manual <i>Manuel Qualité de RRCN</i>
[PRA]	8 303 314 J	Project Development Process <i>Processus Réalisation d’Affaire</i>
	8 307 032 C	Principles for Control of Design (safety systems) <i>Principes de Maîtrise de la Conception (système classé sûreté)</i>
	8 303 334 F	System Design (Safety Systems) <i>Ingénierie Système (Système classé sûreté)</i>

### 3 INSTALLATION AND SITE TESTING ROLES AND RESPONSIBILITIES

#### 3.1 System Supplier Installation and Site Testing Roles and Responsibilities

The utility is responsible for managing the outage in which the **SPINLINE 3** systems identified in this plan will be installed. As such, the utility has overall responsibility for planning with support from RRCN.

In connection with this installation, the NPP also is responsible for the following:

- Have site conditions ready to support installation.
- Provide an adequate number of staff trained and ready to support installation and take “ownership” of the new systems(s).
- Approve installation packages and procedures.
- Manage the interface between the system supplier and any third-party hired by the NPP to install equipment or otherwise support the installation.
- Manage any third party staff hired by the NPP.
- Manage and perform any required removal of equipment and the installation of all new equipment, wiring, and other support required for the systems supplied by RRCN.
- Maintain Technical Specification compliance during installation.
- Approve start of installation
- Approve the final acceptance test procedures.
- Approve closure of anomalies noted during installation and/or final acceptance testing.
- Restore the system to operational status.
- Verify that the system is ready to be declared operational.
- Declare the system(s) operational.

#### 3.2 System Supplier Installation and Site Testing Roles and Responsibilities

Rolls-Royce Civil Nuclear SAS will execute its installation roles and responsibilities consistent with the terms of its contract. Typically these roles and responsibilities include:

- Develop an installation plan and will work with the NPP to integrate that plan into the NPP’s overall outage schedule.
- Prepare portions of the installation package and installation and testing procedures as dictated by the scope of work contracted by the NPP.
- Provide engineering support during receiving inspection and resolve discrepancies noted during this inspection.
- Assist the NPP in maintaining an installation risk register and managing risks that may arise.
- Supervise or participate in installation, assisting in resolving variances and anomalies observed during installation.
- Prepare the final acceptance test procedures.
- Supervise site acceptance test (SAT) and assist in resolving variances observed during the installation and testing.
- Participate in commissioning and pre-operational testing.

## 4 RISKS MANAGEMENT

The NPP and RRCN will jointly prepare a risk register for installation of *System\_Name\_1* to *System\_Name\_n*. The risk register will identify sources of risk, mitigating measures, and residual risk. This risk register will be established prior to the start of installation activities and will be updated in accordance with a process that will be jointly agreed by NPP and Rolls-Royce Civil Nuclear SAS.

Cyber security risks and mitigating measures to be implemented during installation and site testing will be identified in the *Project\_Name* Cyber Security Plan (Reference 1). Implementation details will be described in appropriate sections of this Installation and Site Test Plan.

## 5 IDENTIFICATION OF THE INSTALLATION ENVIRONMENT

### 5.1 Hardware Installation Environment

*Insert a brief description of environment in which the system hardware will be installed, including:*

- *Physical locations (rooms, cabinets, racks)*
- *Environmental conditions during normal and abnormal conditions (temperature, humidity, EMC)*

*Insert a confirming statement that the equipment has been qualified for these environmental conditions.*

### 5.2 Software Installation Environment

In **SPINLINE 3** digital safety I&C systems, the platform and application software are stored as executable code in non-volatile memory on a set of Electrically Erasable Programmable Read-Only Memories (EEPROMs) on the UC25+ processor boards. This system configuration is tested during the Factory Acceptance Test (FAT). At the completion of FAT, the EEPROMS are removed prior to shipping the hardware to the customer. After the hardware has been installed at the NPP, the EEPROMS are reinstalled by RRCN staff on the UC25+ processor boards in preparation for system checkout and the Site Acceptance Test.

*Insert additional plant-specific details on the environment in which the system software will be installed as well as verification that the correct EEPROMs are installed in the correct UC25+ processor boards.*

### 5.3 Instrumentation and Tools

*Any instrumentation and installation tools needed during the installation process will be identified in the applicable procedures.*

*As appropriate, procedures for calibration, handling, and storage apply to such instrumentation and tools.*

## 6 RECEIPT INSPECTION

*The systems will be shipped to the NPP after successfully completing the Factory Acceptance Test of the integrated system. At the conclusion of that test, the systems are disassembled for shipping. Upon arrival at the NPP, the equipment will be receipt and inspected in accordance with approved procedures. Inspection discrepancies will be noted and a plan for resolution will be agreed by the NPP and RRCN. This Plan will be expanded to address the receipt inspection activities for a specific project and will define the interfaces between this Plan and the existing NPP QA program, which also will govern receipt inspection.*



## 7 INSTALLATION PACKAGE

This section defines the contents of the installation package and the basic sequence of events in the installation process. Details of this process will be defined in Section 9, which will include a Gantt Chart of the planned installation activities for System\_Name\_1 to System\_Name\_n.

### 7.1 Hardware Installation Package

The hardware installation package includes the following documents:

- Arrangement drawings
- Electrical drawings.

This Plan will contain a list of all drawings, plus upper level instructions for installation, or reference to a separate system-specific set of system installation instructions.

### 7.2 Software Installation Package

The software installation package includes the following document:

- Installation configuration tables.

This Plan will contain the tables, plus upper level instructions for installation and verification of correct installation and operation.

Cyber security measures implemented during software installation will be identified in the Project\_Name Cyber Security Plan (Reference 1) and implemented in the appropriate installation procedures.

## 8 SITE ACCEPTANCE TESTING AND SYSTEM COMMISSIONING

Site Acceptance Testing, commissioning, and pre-operational testing verifies and validates that:

- The equipment is thoroughly tested and free of faults that may have occurred during shipment or during FAT problem resolution,
- The equipment has been tested and calibrated according to Vendor and Purchaser’s expectations.
- Purchaser’s technical personnel are thoroughly familiar with the new system.

Some of the system-level tests will be similar to the tests run during FAT. The goal of re-running these tests is to demonstrate the same correct performance at the NPP as was demonstrated during FAT. The following FAT tests, with modifications as necessary to reflect installed conditions, will be re-run during SAT:

Re-run FAT Procedure Nr.	Test Procedure Description

These repeated test procedures are described in this System Integration and Factory Test Plan (Reference 4).

The NPP and RRCN SAS will generate additional end-to-end tests that can only be performed after installation has been completed. These final acceptance and commissioning test procedures are listed below and described in Section 11 of this Plan.

New Test Procedure Nr.	Test Procedure Description

*Cyber security measures implemented during site acceptance testing will be identified in the Project\_Name Cyber Security Plan (Reference 1) and implemented in the appropriate test procedures.*

At the successful conclusion of the SAT, system commissioning is complete and the system is ready to be declared operational in accordance with NPP procedures.

## 9 SCHEDULE

*The overall schedule for the outage and installation is defined by the utility, with input from the vendor.*

*This section of the Plan will contain a Gantt Chart showing the planned installation activities for System\_Name\_1 to System\_Name\_n and linkages to the main NPP outage schedule.*

*Tasks on the critical path will be identified, along with roles and responsibilities for all involved staff.*

*Ties to the NPP outage schedule will be provided, with NPP outage schedule start, key milestone, and completion dates made consistent with the provided RRCN SAS Gantt Chart.*

## 10 INSTALLATION PROCEDURES

The NPP and RRCN will jointly develop the step-by-step installation procedures that will govern installation of System\_Name\_1 to System\_Name\_n, installation testing, final acceptance testing, commissioning, and pre-operational testing. These procedures describe the expected results and acceptance criteria for each step or set of steps so the installer can confirm that the step has been successfully completed.

The basic software installation and testing procedures used at the NPP are the same as the software installation procedures used in the factory as the system was being integrated prior to FAT. These procedures have been tested prior to their use at the NPP.

*This section of the Plan will identify all of the applicable installation procedures that will be issued as separate documents. These installation procedures will include sign-off blocks for an installer and verifier to confirm completion of the steps in the procedure. The signed-off procedure becomes part of the permanent record of installation.*

All variances logged during installation will be documented with System Problem Reports and/or Problem/Change Reports (PCRs). System Problem Reports and Problem/Change Reports will be handled in accordance with NPP and RRCN nuclear QA Procedures. System Problem Reports and Problem/Change Reports will be communicated to the customer through a copy of the report and by recording each anomaly in the test log. The NPP and RRCN will implement a formal process to evaluate and resolve the observed variances. The System Problem Reports and Problem/Change Reports will be retained by both vendor and utility as quality records.

## 11 FINAL ACCEPTANCE TEST PROCEDURES

*The NPP and RRCN will jointly develop and approve additional end-to-end tests that can only be performed after installation has been completed. Those test procedures will be described in this section. The actual test procedures will be issued as separate documents.*

All variances logged during testing will be documented with System Problem Reports and/or Problem/Change Reports. System Problem Reports and Problem/Change Reports will be handled in accordance with NPP and RRCN nuclear QA Procedures. System Problem Reports and Problem/Change Reports will be communicated to the customer through a copy of the report and by recording each anomaly in the test log. The NPP and RRCN will implement a formal process to evaluate and resolve the observed variances. The System Problem Reports and Problem/Change Reports will be retained by both vendor and utility as quality records.

## 12 RECORDS RETENTION

The NPP is responsible for retaining installation records in accordance with their own procedures.

RRCN will retain installation records in accordance with the RRCN Nuclear Quality Assurance program for the operating life of the system.

## 13 REFERENCES

1. “*Project\_Name* Cyber Security Plan”, based on Rolls-Royce Civil Nuclear SAS Cyber Security Plan template 8 307 255 A, June 30, 2009
2. USNRC Standard Review Plan Branch Technical Position 7-14, Revision 5, “Guidance on Software Reviews for Digital Computer-based Instrumentation and Control Systems”
3. Regulatory Guide 1.152, Revision 2, “Criteria for the Use of Computer Systems in Safety Systems of Nuclear Power Plants”
4. “*Project\_Name* System Integration and Factory Test Plan,” based on Rolls-Royce Civil Nuclear SAS System Integration and Factory Test Plan template 8 307 245 A, June 30, 2009
5. “*Project\_Name* System Operations & Maintenance Plan,” based on Rolls-Royce Civil Nuclear SAS System Operations & Maintenance Plan template 8 307 244 A, June 30, 2009
6. “*Project\_Name* System Training Plan,” based on Rolls-Royce Civil Nuclear SAS System Training Plan template 8 307 242 A, June 30, 2009
7. IEEE Standard 1074-1995, “IEEE Standard for Developing Software Life Cycle Processes,” Institute of Electrical and Electronics Engineers
8. NUREG/CR-6101, “Software Reliability and Safety in Nuclear Power Plant Protection Systems,” Lawrence Livermore National Laboratory, November 1993
9. Regulatory Guide 1.170, Revision 0, “Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
10. IEEE Standard 829-1983, “IEEE Standard of Software Test Documentation” , Institute of Electrical and Electronics Engineers.
11. IEEE Std 7-4.3.2-2003, “IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations”, Institute of Electrical and Electronics Engineers.