Project Title: ***UFTR DIGITAL CONTROL SYSTEM UPGRADE***

UFTR-QA1-06.2, Factory Acceptance Test (FAT) Plan

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1. Introduction

1.1 Purpose

The purpose of the Factory Acceptance Test (FAT) Plan is to establish the framework for conducting Factory Accepting Testing on the University of Florida Training Reactor (UFTR) TELEPERM XS (TXS) System. This FAT Plan provides top level specification for the development of the individual Test Specifications/Procedures, the Test Log, the Test Incident Report, and the FAT Summary Report. The FAT Plan also provides the guidance for preparing, performing, documenting, resolving, and finalizing tests associated with Factory Acceptance Testing.

Testing activities follow the guidance of IEEE Std 829-1983, /21/, as endorsed by Regulatory Guide 1.170, /23/. This FAT Plan addresses the subjects to meet and/or exceed the recommendations in IEEE Std 829-1983, /21/. Additionally, this FAT Plan addresses the applicable subjects in IEEE Std 7-4.3.2-2003, /19/, as endorsed by the Regulatory Guide 1.152, /22/.

The UFTR "Functional Requirements Specifications (FRS)," /10/, provides the general criteria and requirements for FAT activities as addressed in this FAT Plan.

1.2 Scope

The scope of the FAT includes the hardware and software supplied by AREVA NP Inc. for the UFTR RPS TXS System, from the cabinet input terminals to the output terminals. The scope also includes the TXS Service Unit (SU), the TXS Gateway (GW), and the TXS Qualified Display System (QDS).

The LabVIEW Data Acquisition Equipment, Test Machines and additional test equipment are used to simulate the UFTR conditions and to monitor system outputs.

Tests shall be performed to verify functional requirements in design and UFTR FRS, /10/. The correct implementation of the Application Software will be tested. The successful execution of the Application Software for different cases or a combination of different cases and under different conditions will provide further assurance for the System Software overall functions and operations reliability (see Section 4.1 for a list of the software items to be tested). Functions that are verified by analysis or inspections will not be tested.

Note: The TXS System features and functions were previously deemed acceptable by the NRC within the scope described in the TXS Safety Evaluation Report (SER), /15/.

1.3 Quality Assurance Program (QAP)

The activities of the FAT Plan correspond with the design validation and test control sections of the UFTR "Quality Assurance Program (QAP)," /1/, and the UFTR "Conduct of Quality Assurance," /2/, according to the UFTR "Quality Assurance Project Plan (QAPP)," /3/. The FAT Plan and subsequent FAT documents comply with ANSI/ANS-15.8-1995; R2005 (R=Reaffirmed), "Quality Assurance Program Requirements for Research Reactors," /24/. Software Quality Assurance is governed by the UFTR "Software Quality Assurance Plan (SQAP)," /4/.

Test Procedures are prepared and maintained for inspection and testing in order to verify that the specified requirements for the product concerned are in compliance.

1.4 Configuration Management Plans

1.4.1 Software Configuration Management Plan (SCMP)

The UFTR SCMP, /5/, is established to provide the methods and tools to identify and control the Application Software developed for the UFTR RPS TXS System.

The primary users of the UFTR SCMP, /5/, are those that are planning and executing Software Configuration Management activities or conducting Software Configuration Management audits.

This plan applies to all software and related documentation for the design, modification, or testing of the Application Software developed for the UFTR RPS TXS System. In addition, the UFTR SCMP, /5/, applies to Graphic Service Monitor (GSM) Screen development, and QDS. The SCMP, /5/, is applicable from the Basic Design Phase to the completion of the Final Documentation Phase in the TXS Project Phases.

The identification and reporting of Application Software anomalies apply to all personnel working on the UFTR RPS TXS System.

The UFTR SCMP, /5/, does not apply to the TXS system platform or to the tools for software development or changes. TXS system platform and tools software development and changes are performed by AREVA NP GmbH (Germany) on a project-independent (generic) basis and are handled by their respective Configuration Management Plan.

1.4.2 Hardware Configuration Management Plan (HCMP)

The purpose of the UFTR HCMP, /9/, is to provide an overview of the organization, activities, and requirements for conducting Configuration Management for a TXS Hardware system. The UFTR HCMP, /9/, shall ensure the following:

- TXS Hardware meets customer and regulatory design requirements
- TXS Hardware input and output documents are consistent with contract requirements
- TXS Hardware Configuration is controlled continuously from contract award through final documentation
- TXS Hardware Configuration records are controlled, maintained and distributed through records management to ensure hardware documents and databases are consistent and accurate with the latest approved design

The identification and reporting of Application Hardware anomalies apply to all personnel working on the UFTR RPS TXS System.

The hardware configuration shall be controlled per the UFTR HCMP, /9/.

1.5 Software V&V Plan (SVVP)

The purpose of the UFTR SVVP, /6/, is to specify the V&V activities to be performed during software planning, development, and implementation that will demonstrate high levels of quality and confidence in the software being developed. The V&V activities provide traceable, documented evidence that a high level of quality and a low level of risk have been achieved. The UFTR SVVP, /6/, provides the methods and tools to determine whether the configuration items of the UFTR RPS TXS System conform to the project requirements for the Application Software.

The UFTR SVVP, /6/, defines methods and processes for assuring the following:

- A structured V&V process is applied to the project
- The tools, techniques, and methods for the V&V process are described to ensure the product is complete, correct, accurate, reliable, consistent, and traceable
- The products of the V&V activities are stated and described

The UFTR SVVP, /6/, applies to the Application Software throughout the life cycle phases of the UFTR RPS TXS System. The V&V activities corresponding to FAT shall be in accordance with the UFTR SVVP, /6/.

The responsibilities for the different V&V tasks are assigned in detail in the UFTR SVVP, /6/.

1.6 Software Safety Plan (SSP)

The purpose of the UFTR SSP, /7/, is to achieve high functional reliability and design quality for the Application Software.

To ensure that application software development is consistent with the defined system analyses, planned and documented software safety analysis activities are conducted during the basic design and detailed design phases of the software development life cycle. The analyses must ensure that:

- System requirements as specified in the customer specifications have been met correctly
- No new hazards have been introduced
- Software elements that can affect safety are identified
- There is evidence that other software elements do not affect safety
- Safety problems and resolutions identified in this analysis are documented

The UFTR SSP, /7/, applies to the design or modification of Application Software throughout the life cycle phases of the UFTR RPS TXS System.

Software test documents associated with the FAT Plan shall comply with the UFTR SSP, /7/.

2. Reference Documents

2.1 UFTR Documents

/1/ UFTR-QAP, "Quality Assurance Program (QAP)"
/2/ UFTR-QAP-01-P, "Conduct of Quality Assurance"
/3/ UFTR-QA1-QAPP, "Quality Assurance Project Plan (QAPP)"
/4/ UFTR-QA1-01, "Software Quality Assurance Plan (SQAP)"
/5/ UFTR-QA1-02, "Software Configuration Management Plan (SCMP)"
/6/ UFTR-QA1-03, "Software Verification and Validation Plan (SVVP)"
/7/ UFTR-QA1-05, "Software Safety Plan (SSP)"
/8/ UFTR-QA1-10, "Software Training Plan"
/9/ UFTR-QA1-13, "Hardware Configuration Management Plan (HCMP)"
/10/ UFTR-QA1-100, "Functional Requirements Specifications (FRS)"
/11/ UFTR-QA1-101, "Software Design Description (SDD)"
/12/ UFTR-QA1-105, "TELEPERM XS Cyber-Security"
/13/ UFTR-QA1-109, "Software Library and Control"
/14/ UFTR-QA1-113, "Software Generation and Download"

2.2 AREVA Documents

/15/ AREVA NP Inc. Document No., 38-9033245-000, "Safety Evaluation by the Office of Nuclear Reactor Regulation Siemens Power Corporation Topical Report EMF-2110(NP), "TELEPERM XS: A Digital Reactor Protection System, Project No. 702," May 5, 2000
/16/ TELEPERM XS Service Unit Installation Manual
/17/ TELEPERM XS Gateway Installation Manual
/18/ TELEPERM XS Qualified Display System Installation Manual,

2.3 Industry Standards

/19/ IEEE Std 7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations"
/20/ IEEE Std 610.12-1990, "IEEE Standard Glossary of Software Engineering Terminology"
/21/ IEEE Std 829-1983, "IEEE Standard for Software Test Documentation"

2.4 NRC Documents

/22/ Regulatory Guide 1.152, Rev. 2, January 2006, "Criteria for use of Computers in Safety Systems of Nuclear Power Plants"
/23/ Regulatory Guide 1.170, Rev. 0, September 1997, "Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Plants"

2.5 ANSI Documents

/24/ ANSI/ANS-15.8-1995; R2005 (R=Reaffirmed), "Quality Assurance Program Requirements for Research Reactors"

/25/ ANSI Std. N45.2.2-1972, "Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants"

3. Definitions, Abbreviations, and Acronyms

3.1 Definitions

NOTE: Additional definitions can be found in the IEEE Std 610.12-1990, /20/.

Application Software, *[UFTR SCMP, /4/]:*
The Application Software reflects the plant specific functionality of the TXS I&C system. It is documented and generated by the SPACE Engineering System. The platform system software uses this configuration data in order to carry out the application specific functionality of the I&C system.

Cyber-Security, *[TXS Cyber Security, /12/]:*
The extent to which unauthorized or inappropriate access and use of computer-based systems (hardware and software) is prevented.

ERBUS (see Test Machine)

System, *[IEEE 610.12-1990, /20/]:*
A collection of components organized to accomplish a specific function or a set of functions.

System Software, *[IEEE 610.12-1990, /20/]:*
Software designed for a specific computer system or family of computer systems to facilitate the operation and maintenance of the computer system and associated programs such as operating systems, compilers, and utilities.

Test Machine (ERBUS)
Test Equipment used to simulate field inputs and monitors outputs on the TXS System.

Test Script
Program used by the Test Machine to simulate plant condition inputs on the TXS System and to automate steps in the individual Test Specifications/Procedures.

Test Specification/Test procedure
As described in detail in Section 10.1, for all software related tests two documents will be provided in order to comply with IEEE Std 829-1983, /21/. The first document incorporates the Test-Design Specification and Test-Case Specification as defined in IEEE Std 829-1983, /21/. The second, the Procedure, contains the practical instructions and the script. Generally both documents must be applied in the course of software testing. Test specifications contain the check-off boxes for various tasks (i.e., verification checks, manual actions and expected results) Test procedures have sign-offs for completion of the test steps. For a detailed description see Section 10.1.
For Hardware related tests (as for all of the prerequisite tests) only procedures are provided. They contain much of the information that is provided in the test specification of the software tests.

Validation, *[IEEE 610.12-1990, /20/]:*
The process of evaluating a system or component during or at the end of the development process to determine whether it satisfies specified requirements.

3.2 Abbreviations, and Acronyms

ANSI	American National Standards Institute
CPU	Central Processing Unit
FAT	Factory Acceptance Test
FRS	Functional Requirements Specifications
GSM	Graphic Service Monitor
GW	Gateway
HCMP	Hardware Configuration Management Plan
HW	Hardware
I&C	Instrumentation and Control
I/O	Input/Output
ICS	Instrumentation & Control System
IEEE	Institute of Electrical and Electronics Engineers
NI	Nuclear Instrumentation
NRC	Nuclear Regulatory Commission
QA	Quality Assurance
QAP	Quality Assurance Program
QAPP	Quality Assurance Project Plan
QDS	Qualified Display System
PCA	Physical Configuration Audit
RPS	Reactor Protection System
SCMP	Software Configuration Management Plan
SDD	Software Design Description
SER	Safety Evaluation Report
SIVAT	Simulation Based Validation Tool
SMS	Service Monitor Server
SQAP	Software Quality Assurance Plan
SPACE	Specification and Coding Environment
SSP	Software Safety Plan
Std	Standard
SVVP	Software Verification and Validation Plan
SU	Service Unit
SW	Software
TXS	TELEPERM XS
UFTR	University of Florida Training Reactor
V&V	Verification and Validation

4. Test Items

4.1 Software

Project-independent software is used to establish the software environment for the FAT. The project-independent software under test is:

- TXS System Platform Software (Part of SPACE)
- TXS SU Software (Part of SPACE)
- TXS GW Software
- TXS QDS Software
- GSM Application (Part of SPACE)
- TXS Test Machine Software

The project-specific software operates with the project-independent software in order to satisfy the UFTR required specifications. The project-specific software under test are:

- Application Software (including project-specific GW software)
- Application Specific GSM Software
- Application Specific QDS Software

The requirements for the Application Software are detailed in the UFTR FRS, /10/.

The software items under test are to be transferred to the test field on electronic media (e.g., CD) as governed by the UFTR "Software Library and Control," /13/. Installation of the software items on the TXS processors is governed by the UFTR "Software Generation and Download" procedure, /14/. Installation of the software items on the TXS SU, TXS GW and TXS QDS is handled by the TXS SU Installation Manual, /16/, the TXS GW Installation Manual, /17/, and the TXS QDS Manual, /18/, respectively.

4.2 Hardware

The hardware for the UFTR RPS TXS System consists of items that are specially designed for use in TXS applications. Such items include TXS subracks and the modules that populate the subracks. Other hardware in the UFTR RPS TXS System is purchased from approved suppliers. Such items include breakers, isolation devices, etc.

The hardware items to be tested are as follows:

- TXS Hardware Equipment
  - CPU Modules
  - Communication Modules
  - I/O Modules
  - Isolation Modules
  - Signal Conditioning Modules
  - Subracks
  - Subrack Power Supplies
  - Key Switches
  - Miscellaneous TXS Support Modules

- Cabinet Power Supplies
- Nuclear Instrumentation Equipment

- Peripheral Equipment
  - Isolation Devices
  - Breakers
  - Fiber Optic Cables
  - Internal Wiring and Cabling
  - Miscellaneous Support Modules

5. Features to be Tested

The FAT tests are designed to validate the correct functionality of the RPS as an integrated system (i.e., with all software implemented, with all interfaces and all peripheral equipment that is in the scope of the delivery). Additional tests providing sufficient overlap with the functional tests are performed for equipment that cannot be involved in the functional channel tests.

5.1 Test Specification/Procedure Alignment

For software tests, Test Specifications are utilized to provide the approach and Test-Case clarification for each test. A Software Test Procedure will then follow the test steps described in the Test Specification. Therefore Software Test Procedures will mainly consist of Test Scripts and the necessary steps for executing them. The Test Scripts allow for the test steps to be performed automatically.

"Hardware tests" on the other hand only utilize Test Procedures. The hardware Test Procedures may use auxiliary Test Scripts to facilitate the process, but the Test Scripts will not make up a majority of the work as they do in software Test Procedures. Section 10 provides more information on Test Specifications and Test Procedures.

5.2 System Interfaces

The Application Software operates in conjunction with the hardware to provide system interfaces. Test Specifications / Procedures shall validate the following:

- User Interfaces (Refer to Sections 7.4.2.5, 7.4.3.4, 7.4.3.5, 7.4.3.6 and 7.4.3.9)
- Hardware Interfaces (Refer to Sections 7.4.2.5 and 7.4.3.3)
- Software Interfaces (Refer to Sections 7.4.3.4, 7.4.3.5, and 7.4.3.6)
- Communications Interfaces (Refer to Sections 7.4.3.4, 7.4.3.5, 7.4.3.6 and 7.4.3.9)

5.3 RPS Functions

The following RPS Functions shall be tested to verify compliance with the design and the requirements specifications. This testing will be performed using a series of overlapping tests. The approach for this test includes testing each trip function independently. Table 1 lists the required UFTR automatic and manual trips, and their specifications and types.

Table 1. List of RPS Trips, their types and specifications

List of Trips and their Specifications	Type of Trip
Automatic	
Period ≤ 3 sec	Full
Power ≥ 119% of full power	Full
Loss of NI high voltage (<90%) Loss of electrical power to control console	Full Full
Primary cooling system Loss of primary pump power Low water level in core (≤ 42.5") No outlet flow Low inlet water flow (≤ 41 gpm)	Blade-drop
Secondary cooling system (≥ 1 kW) Loss of flow (well water ≤ 60 gpm) Loss of secondary well pump power	Blade-drop
High primary coolant inlet temperature (≥ 99°F)	Blade-drop
High primary coolant outlet temperature (≥ 155°F)	Blade-drop
Shield tank low water level (6" below established normal level)	Blade-drop
Ventilation system Loss of power to stack dilution fan Loss of power to core vent fan	Blade-drop
Manual	
Manual scram bar	Full
Console key-switch OFF	Full

Refer to Section 7.4.3.2 for the test that covers the above functions.

5.4 Additional Features to Test

In addition to the RPS functions listed above, tests shall be performed to verify the functionality of the support equipment, monitoring equipment, and other functionality as required by the design and UFTR FRS, /10/. These additional features to be tested include:

- Cabinet Alarm Monitoring (Refer to Section 7.4.2.4)
- Nuclear Instrumentation (Refer to Section 7.4.3.1)
- RPS Hardware Failures (Refer to Section 7.4.3.3)
- GSM (Refer to Section 7.4.3.4)
- GW to T3000 control system (Refer to Section 7.4.3.5)

- QDS (Refer to Section 7.4.3.6)
- System Test (Refer to Section 7.4.3.7)
- RPS Response Time (Refer to Section 7.4.3.8)
- Cyber Security (Refer to Section 7.4.3.9)

6. Features Not to be Tested

Features of the UFTR RPS TXS system not to be tested are those validated by other means or are of a nature that does not impact overall system functionality. These items are associated with the following categories:

1) Features validated by inspection (e.g., physical configuration audits).
2) Features validated by analysis.
3) Existing plant external I/O interface devices (e.g., status lamp / light, trip pushbuttons, etc.) or equipment (e.g., control room alarms, control rod trip relays, transmitters, etc.)
4) TXS System features and functions that were previously deemed acceptable by the NRC within the scope described in the TXS SER, /15/.

7. Approach

Design validation is based on performing organized inspection and testing on the UFTR RPS TXS system hardware and software. This systematic approach validates design from the single component level to a fully integrated functional level. Test activities shall be non-intrusive and non-destructive to the protection related equipment and system under test.

7.1 General Approach

The general approach to the FAT activity is shown in sequence as follows:

1) Planning FAT activities (this document).
2) Define the Test Specifications in accordance with approved design documents (Sections 7.4.2, 7.4.3, and 10.0).
3) Prepare test environment and equipment for FAT (Section 7.4.2.1).
4) Complete FAT prerequisites (Section 7.4.2).
5) Conduct FAT activities (Section 7.4.3).
6) Compare FAT results to acceptance criteria (Sections 7.4.3 and 8.0).
7) Document the FAT Summary Report (Section 7.4.4).

The general approach to the prerequisites and to the Factory Acceptance is shown in Figure 7.1-1. Each of the items identified in Figure 7.1-1 is described in Section 7.4.

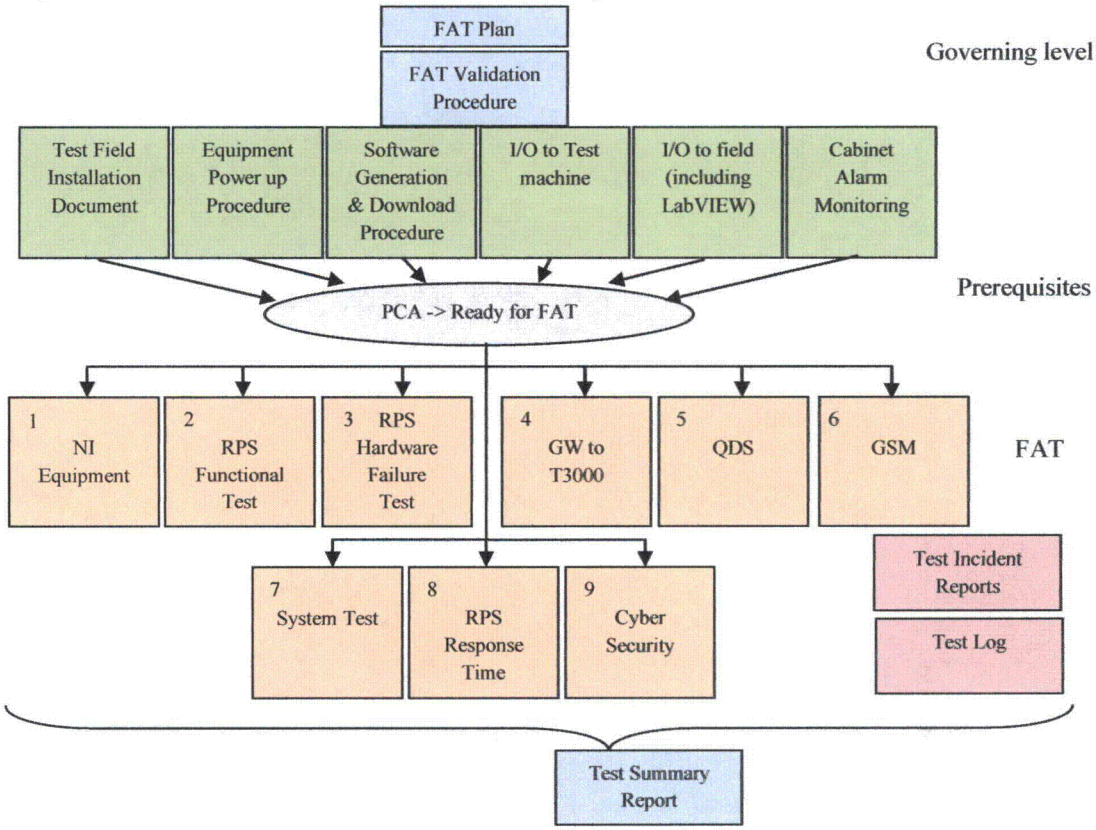

Figure 7.1-1: General Approach to the FAT

The prerequisites to the FAT and the FAT itself utilize an overlapping approach to ensure that all segments of the UFTR RPS System are tested. Figure 7.1-2 provides an illustration of the major system segments of the UFTR RPS System. The items listed in Section 4.0 are included in the major system segments identified in Figure 7.1-2.

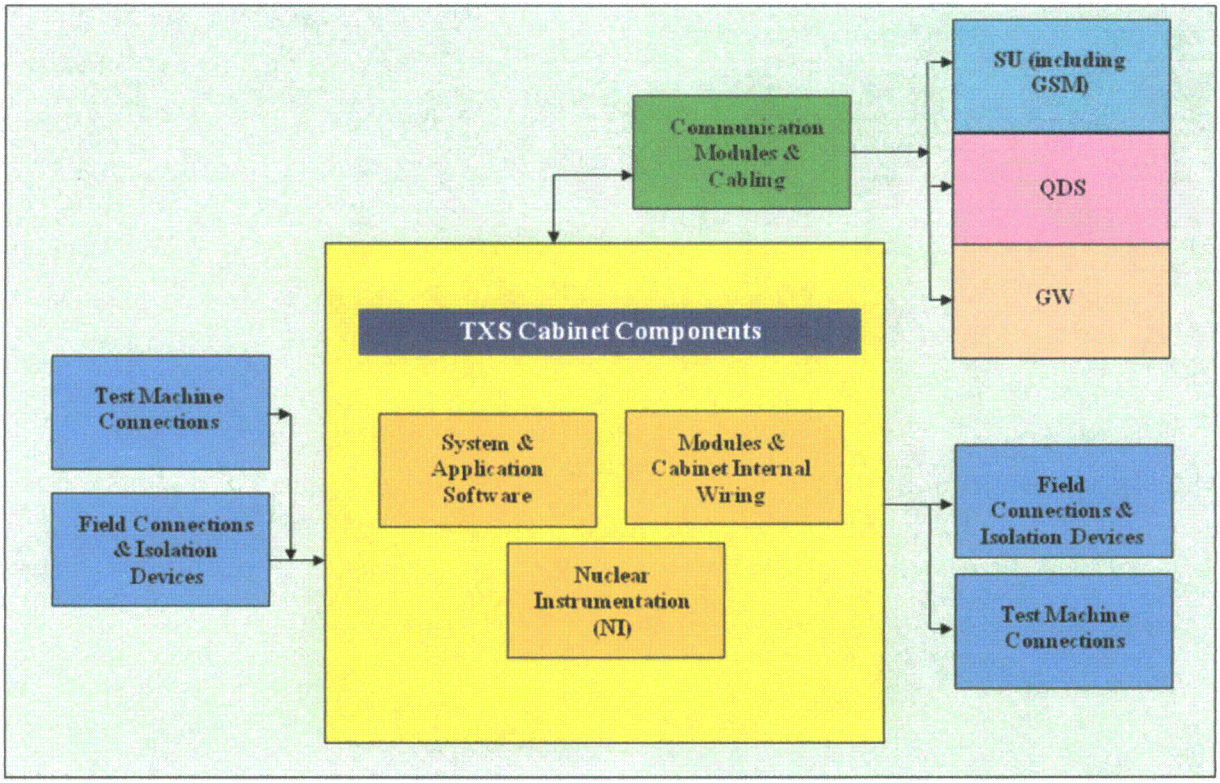

Figure 7.1-2 Major System Segments of the UFTR RPS System

Table 7.1-1 provides a breakdown of which FAT Specifications/Procedures (as numbered in Figure 7.1-1) correspond to each major system segment.

Table 7.1-1: Major System Segment and Test Specification/Procedure

Major System Segments	**Corresponding Tests (From Figure 7.1-1)**
Field Connections & Isolation Devices	1, 8
Test Machine Connections	2, 3, 7
Communication Modules & Cabling	2, 4, 5, 6, 9
TXS GW	2, 4
TXS QDS	2, 5
TXS SU (including GSM)	2, 6, 9
System & Application Software	2, 3, 7, 8, 9
TXS Modules & Cabinet Internal Wiring	1, 2, 3, 8
Nuclear Instrumentation Equipment	1, 8

7.2 Comprehensiveness

The FAT shall be comprehensive and complete in that all components and functions of the UFTR RPS System shall be exercised under a set of realistic operating conditions that takes into account all credible combinations.

For each of the features or groups of features to be tested as listed in Section 5, a general approach is described to validate the functionality of the equipment under test. Where complete functionality is not tested in a single procedure, there will be overlap testing to ensure the complete feature or group of features are tested. Each feature of the system shall, however, be formally tested under at least one test.

7.3 Coverage and Overlap of SW and HW

The following tables provide an overview of which tests check what parts of the system. It also illustrates how sufficient overlap between the tests and for Hardware and Software is ensured.

Table 7.3-1a: List of tested parts/components and the necessary input channels used

	Input Channels					
	External cable terminal/ PB and key switches	Conditioning module, if any	TM plug/ internal terminal	A/D input (HW/SW)	Input exchange/ Validation logic (2oo4, 2.Min/Max)	Input failure / Input range monitoring (SW)
Test field installation document						
Equipment Power Up Procedure				X		
I/O-to-Field	X	X		X		
I/O-to-Test Machine			X	X		
Cabinet Alarm Monitoring						
NI Functional Test	X	X	X			
RPS SW Functional Test			X	X	X	F
GSM SW Functional Test						
GW to T3000 SW Functional Test						
QDS SW Functional Test						
RPS Response Time Testing	X	X	X	X		
Cyber Security						
RPS Hardware Failure Testing				F		

Table 7.3-1b: List of tested parts/components and the tested functions

	Functions					
	Digitalized functions according to SDD (downloaded SW)	GSM maint. Functions on SU SW)	Cabinet monit. / maint. (HW)	CPU and comm. processors (HW)	LAN lines (HW)	Diverse functions (HW)
Test field installation Document				X	X	
Equipment Power Up Procedure						
I/O-to-Field						
I/O-to-Test Machine						
Cabinet Alarm Monitoring			X			
NI Functional Test						X
RPS SW Functional Test	X				F	
GSM SW Functional Test	X	X				
GW to T3000 SW Functional Test	X				F	
QDS SW Functional Test	X				F	
RPS Response Time Testing	X			X	X	
Cyber Security	X	X	X			
RPS Hardware Failure Testing				F	F	

Table 7.3-1c: List of tested parts/components and the corresponding output channels

	Output Channel				Superordinated
	D/A output (SW/HW)	TM plug/ internal terminal	Interposing Relay	Output to process control	Power distribution/ Supply
Test field installation document					X
Equipment Power Up Procedure	X				X
I/O-to-Field	X		X		
I/O-to-Test Machine	X	X			
Cabinet Alarm Monitoring					X
NI Functional Test					
RPS SW Functional Test	X	X		X	
GSM SW Functional Test					
GW to T3000 SW Functional Test				X	
QDS SW Functional Test					
RPS Response Time Testing	X	X	X		
Cyber Security					
RPS Hardware Failure Testing					F

Legend:

Hardware	
Hardware / Software Interface	
Software	
X	this test covers the corresponding HW/SW
F	includes testing of failure behavior

7.4 Major Activities

The Test Administrator shall check out the following activities prior to test activities.

7.4.1 FAT Plan

The FAT Plan establishes the framework for conducting Factory Acceptance Testing on the UFTR RPS TXS System. The FAT Plan is the highest tier test document.

7.4.2 FAT Validation Procedure

The FAT Validation Procedure is used to control activities that must be completed prior to the start of FAT (i.e., FAT Prerequisites) and to record pertinent information during the course of FAT (i.e., FAT Activities). This information includes:

- FAT Prerequisites:
  - Documenting the service and test network setup
  - Test Machine connections and wiring test results
  - LabVIEW Data Acquisition Equipment connections and wiring test results
  - Installation and setup of the TXS SU per the SU Installation Manual, /16/
  - Installation and setup of the TXS GW per the GW Installation Manual, /17/
  - Installation and setup of the TXS QDS per the QDS Installation Manual, /18/
  - Ensuring calibrated temperature and relative humidity recording devices are installed and operational in the test field prior to the start of FAT
  - The System and Application Software are loaded on the appropriate TXS processors
  - Ensuring that all prerequisites to starting FAT are complete. An example of such a requirement is the status of the physical configuration audit to be completed prior to the start of FAT
- The Test Supervisor and/or Test Lead shall declare that the UFTR RPS TXS System prerequisites are complete to the extent that there is no adverse impact on the commencement of FAT activities. This "Ready for FAT" statement shall be recorded in the FAT Validation Procedure and in the Test Log.
- FAT Activities:
  - Recording the initiation of each of the Test Specifications/Procedures
  - Recording the completion of each of the Test Specifications/Procedures
  - Maintaining the Test Log activities
  - Recording the temperature and humidity levels daily during the performance of FAT.
  - Recording any lifted leads or inserted jumpers

- Recording which piece of calibrated test equipment was used on which test

7.4.2.1 Test Field Installation Document

This document includes all connection and setup information required to prepare the UFTR RPS TXS system for the FAT. This information includes such items as the power and grounding connections for the TXS cabinets, the network configuration of the equipment (including the test equipment), and the connections of the Test Machine and the LabVIEW Data Acquisition Equipment.

7.4.2.2 Equipment Power-Up Procedure

Equipment power-up testing shall be performed to validate the configuration and functional design of the UFTR RPS TXS system power distribution. The test shall perform functional testing of cabinet power to verify the appropriate voltage is present and distributed to the correct terminal points throughout the equipment as designed. This test shall also verify the functionality of the redundant power supplies. This test shall be performed on a cabinet by cabinet basis.

7.4.2.3 Software Generation and Download Procedure

The UFTR "Software Generation and Download" procedure, /14/, is required to be performed before proceeding to the remaining prerequisites and FATs. The purpose of this procedure is to provide instructions for the TXS software processes on the UFTR RPS TXS system:

- Generation and storage of the Application Software
- Loading of the Application Software onto the SU
- Loading of the Application Software onto the TXS GW
- Loading of the Application Software onto the TXS QDS
- Loading of the System Software onto the TXS processors
- Loading of the Application Software onto the TXS processors
- Loading of the L2-CP Firmware onto the TXS communication processors
- Loading of the H1-CP Firmware onto the TXS SCP2 communication processor
- Preparation of the Configuration File for the TXS communication processors
- Parameterization of the L2-CP Firmware for the TXS communication processors

The steps in this document ensure that the correct tools are used for the code generation and that the correct System Segment Software components are

installed for the Application Software. The TXS SPACE Environment and associated tools configuration is checked and documented with each Software Release created by the steps in this document.

This procedure, /14/, is not controlled by the FAT plan or by the FAT validation procedure, but as it is an important process within the Software life cycle it is controlled and maintained by the Software Development group. The download of the software in the test field, however, is the responsibility of the test team and is governed by the FAT plan.

7.4.2.4 Cabinet Alarm Monitoring

This testing will verify that the internal monitoring alarms of the cabinet monitoring system (including internal indications and signals) operate as designed. Where practical, cabinet alarm conditions will be generated to create the cabinet alarm conditions, otherwise the alarm will be simulated. These tests shall be performed on a cabinet by cabinet basis. The Hardware Failures test (Section 7.4.3.6) for each cabinet provides the overlap to verify the proper alarm signal is output from the TXS cabinet.

7.4.2.5 The I/O to Field

The purpose of this test is to verify the correct cabinet internal wiring from the terminal points to the TXS input modules and from the TXS output modules to the terminal points. This internal wiring includes any hardware logic that may exist. Examples of this hardware logic include the Manual Bypass Keyswitch actuation of the RPS Trip Relays, the AND/OR logic associated with actuating outputs, etc.

Manual injection of test signals to the system inputs and manual recording of the system outputs at the field terminals is the method used for this test. This test utilizes calibrated test equipment and is responsible for validating the accuracy of the supplied equipment. When available, actual keyswitches, pushbuttons, lights, etc. should be used to simulate inputs and outputs.

7.4.2.6 The I/O to Test Machine

The purpose of this test is to validate the correct hardware and software configuration of the TXS ERBUS test machine interface to TXS system hardware Inputs and Outputs. This means all connections of the test machine to and from the TXS system are checked for the followings:

- Correct assignment to the corresponding (internal cabinet) terminal.
- Correct assignment of signal IDs.
- Correct simulation of the measuring ranges (analog) / signal levels (binary).

Upon completion of this test, the Input/Output interface of the test machine is ready to support the subsequent FAT tests.

7.4.3 FAT Procedures

7.4.3.1 Nuclear Instruments (NI)

This test procedure confirms the NI hardware functions in the RPS. The purpose of this procedure is to verify the wiring and function of the RPS NI channel. In addition, the accuracy of the NI channel is verified. In summary this procedure verifies:

- NI modules operate correctly
- Correct wiring from NI modules to TXS cards
- Accuracy of the Analog Inputs

7.4.3.2 RPS Functional Test

Testing shall confirm that the RPS Functions meet design criteria (as defined in the UFTR-QA1-101, "Software Design Description (SDD)," /11/). This test will verify the interface of the Application Software to the analog input, analog output, digital input, and digital output modules, as well as, the functionality of the input submodules, trip functions, test logic, computer points, inter-channel communication, and additional supporting software modules. Hardware Failures testing will be performed to provide sufficient overlap to ensure effects due to postulated failure modes are handled as required.

The inputs to the system from field devices and transmitters will be simulated by connecting the Test Machine to the UFTR RPS TXS system. Likewise, outputs from the UFTR RPS TXS system to recorders, alarms, and field devices are also connected to the Test Machine and the LabVIEW Data Acquisition Equipment.

7.4.3.3 RPS Hardware Failures

Hardware Failures testing will supplement RPS Functional testing (Section 7.4.3.2) and the Cabinet Alarm Monitoring (Section 7.4.2.4) so that sufficient overlap is provided to ensure the effects due to Hardware Failures are consistent with postulated failure modes and are handled as required.

Testing shall be performed by simulating the failures at the signal input (i.e., I/O Modules, Optical Communication Interfaces, etc.), and verifying that the effects are consistent with system requirements. Testing shall also encompass I/O Failures, Communication Failures, and Loss of Power Failures (i.e., breaker failures) as tested failures. Testing will validate detectable failure modes are in fact detectable. Testing will also verify the appropriate response at the system and sub-system levels.

These tests cover mainly the effects of communication failures on the signaling to the T3000 control system and in the control room.

7.4.3.4 Graphic Service Monitor (GSM)

This testing will verify that the proper connections are made between the Application Software and the GSM Screens that operate on the TXS SU.

The signals from each TXS processor to the GSM Screens will be manipulated and the values of the signals will be visually verified on the GSM Screens themselves. The signals that are written from the GSM Screens will be manipulated on the GSM Screens and verified on the SU through the use of the project-independent portion of the GSM and/or the dynamic Function Diagram Editor.

7.4.3.5 GW to T3000 control system

The purpose of this test is to verify the correct connection to the TXS GW and the correct functionality of the Application Software implemented on the TXS GW. This test shall also verify that the data link between the TXS GW and the on-line system can support an update rate of one (1) second for all parameters.

To perform this test, the GW signals from each TXS processor will be manipulated and the values of the signals will be recorded on the GW utilizing the GW Historical Application.

7.4.3.6 Qualified Display System (QDS)

The purpose of this test is to verify the correct connection to the TXS QDS and the correct functionality of the Application Software implemented on the TXS QDS.

The signals from each TXS processor to the QDS will be manipulated and the values of the signals will be visually verified on the QDS themselves.

7.4.3.7 System Test

The purpose of this test is to demonstrate the ability of the UFTR RPS TXS system to function during specified event scenarios. A testing simulator shall be used for this test. The simulator is comprised of the following equipment:

- the test field setup with the TXS ERBUS as primary simulation and recording device,
- the LabVIEW equipment (visualizing panel indicators that are not available in the test field), and
- the additional mockup panel.

Note that a plant simulation model will not be implemented in this setup.

The following test has been selected to demonstrate performance of the UFTR RPS TXS System over a range of realistic operating conditions:

- Controlled Start-up/Shutdown Simulation:
  The purpose of this test is to demonstrate that the UFTR RPS TXS System will operate correctly during a simulated start-up and shutdown of the plant. The test will demonstrate when the combination of inputs corresponding to the plan starting-up or shutting down is applied to the UFTR RPS TXS System, the appropriate system response occurs.

7.4.3.8 RPS Response Time

This testing will validate the response time of the UFTR RPS TXS system. The method for performing response time testing shall be to initiate a trip from simulated inputs, monitor system trip outputs, and shall be based upon the slowest output response. This testing shall include all hardware and software items that make up each trip path in the UFTR RPS TXS system.

The test will verify the response time of each trip function of the UFTR RPS TXS system. The test will be performed by simulating each input to the trip function and monitoring that input as well as monitoring the corresponding trip relay outputs. The time between the change in the input and the change of the output is the response time.

7.4.3.9 Cyber Security

The purpose of this test is to validate the Cyber Security of the UFTR RPS TXS system, and shall demonstrate that requirements for ensuring cyber security protection of the UFTR RPS TXS system are met. The Cyber Security document, /12/, provides requirements for cyber security testing. The Cyber Security test shall cover the following areas:

- Hardware security
- Software security
- Network security

7.4.4 FAT Reports

7.4.4.1 Test Log

The Test Log is the chronological record of activities in the test field. This includes a record of start and stop times of individual tests, all encountered errors, day-to-day activities, etc. Any error that results in an Open Item and/or Condition Report shall have the corresponding Open Item and/or Condition

Report identifier listed with the error. Refer to section 10.3.1 for additional information on the Test Log.

7.4.4.2 Test Incident Report

The Test Incident Report documents any event that occurs during the testing process which requires investigation. If the event resulted in an Open Item and/or a Condition Report, then the corresponding number from those items shall be listed in the Test Incident Report. Refer to section 10.3.2 for additional information on the Test Log.

7.4.4.3 FAT Summary Report

The FAT Summary Report is a document summarizing testing activities and results. The FAT Summary Report also contains an evaluation of the corresponding test items. The completed Test Procedures may be attached to the FAT Summary Report or they may be incorporated into a separate, stand alone document (a summary test report that is referenced in the FAT Summary Report). If the completed Test Procedures are collected into a separate, stand alone document then the identity of each component document shall be retained in the new document. The new document shall be referenced in the FAT Summary Report.

7.4.4.4 Test Data Retention

Upon the successful completion of FAT, the resultant data files from all test runs of the Test Specifications / Procedures identified in Section 7.4.3 shall be collected on electronic media such as a CD or DVD. The electronic media shall then be stored into the Software Library as governed by the UFTR "Software Library and Control," /13/. The data will become available to authorized entities for review.

7.5 Constraints

The Test Lead (see Section 13.2.3) is responsible for identifying and resolving significant constraints with regards to testing. These constraints include test item availability and test resource availability.

8. Item Pass/Fail Criteria

All test specifications and test procedures shall define the required acceptance criteria for the UFTR RPS TXS system in order to decide if the test is completed successfully. These criteria shall be developed from design and customer specifications. Test results shall be evaluated during testing to ensure compliance with the stated qualitative and/or quantitative test requirements.

Any deviations between test results and the acceptance criteria (i.e. the expected results) shall be controlled in accordance with Section 9.0.

The role of IV&V with regard to Item Pass/Fail Criteria (i.e., the V&V test acceptance) is described in the UFTR SVVP, /6/.

9. Suspension Criteria and Resumption Requirement

9.1 General

An orderly approach to suspend and resume testing activities is required during testing in accordance with IEEE Std 829-1983, /21/. The following sections provide details for the test suspension and resumption criteria.

9.2 Test Suspension Criteria

If an error that does not change the Scope, Intent, or Acceptance Criteria of a test is encountered during the performance of a Test Specification/Procedure, it is acceptable to have two (2) cognizant test personnel mark a single line through the error, make the necessary correction, initial and date the correction, and continue on with the test. Any such correction shall be recorded in the Test Log along with the names of the personnel making the correction. If any doubt exists whether or not the error falls in this category, the test shall be suspended and the Test Supervisor shall be contacted. An Open Item shall be generated to track all such corrections to ensure that the Test Specification/Procedure is updated with the correction for future use.

If an error in the Test Specification/Procedure that affects the Scope, Intent, or Acceptance Criteria and/or an error in system operation or behavior are encountered, the test personnel shall perform the following actions:

1. Suspend test activities
2. Evaluate condition and place test and equipment in known, controlled condition
3. Notify the Test Supervisor and/or Test Lead
4. Record the relevant information (e.g., test being performed, step number, recognized error, etc.) in the Test Log
5. Perform troubleshooting (if applicable):
   Prior to performing any troubleshooting activities the desired troubleshooting steps shall be prepared, independently reviewed, and approved by the Test Supervisor and/or Test Lead in a manner that can and shall be attached to the affected Test Procedure. The creation and performance of these steps shall be documented in the Test Log. Troubleshooting activities shall:

   - Not alter test objectives or acceptance criteria
   - Not introduce the use of different types of test equipment or test tools
   - Align with an existing test section
   - Restore the hardware and software configuration to original state prior to completion of activities
   - Place the test and equipment in a known, controlled condition upon completion of activities

   The names of all personnel that perform and witness troubleshooting activities shall be recorded in the Test Log.

6. Initiate an Open Item and/or Condition Report (if required). The thresholds for Open Items and Condition Reports are controlled according to the processes which govern each, /1/ and /2/. The Open Item and/or Condition Report number shall be entered into the Test Log. The Open Item and/or Condition Report will be evaluated to determine the cause of the problem (e.g., test procedure error, test script error, software or hardware design or manufacturing error), whether tests must be repeated, and whether regression tests are needed to validate the correctness of the corrective measures.
7. Record incident in the Test Incident Report (including the Open Item and/or Condition Report number). The incident report form is to be signed by both AREVA and UFTR representatives.

9.3 Test Resumption Requirements

After an error is encountered that requires testing to be suspended, the test personnel shall perform the following actions:

1. Evaluate and dispose of applicable resolution (Disposition of Open Item or Condition Report shall document the required actions and conditions to resume testing activities, including items to be retested)
2. Verify Open Items and/or Condition Report resolutions are complete to the extent that Testing/Retesting may continue/resume
3. Enter relevant information in the Test Log
4. Resume testing and retesting as applicable

The Test Lead shall determine if another Test Specification/Procedure may be performed after one test has been suspended provided that no adverse conditions exist that impact testing commencement/continuation. This action shall be recorded in the Test Log.

10. Test Deliverables

Test deliverables are outputs from the test document set and from UFTR procedures that integrate with the Test plan. These include the following:

- FAT Plan
- FAT Validation Procedure (including the Test Log)
- Test Specifications (for the SW related tests only)
- Test Procedures (for both SW and HW related tests)
- Test Incident Reports (including references to Open Items and Condition Reports)
- FAT Summary Report

Test deliverables are also derived from the UFTR QAP, /1/. Though it is hard to draw the line between HW and SW related tests, when integral testing is conducted, this plan describes two (2) groups of tests:

1) The HW related tests focus mainly on the validation of the performance of the hardware rather than the specific SW logics implemented. For these tests a procedure is prepared with the structure presented in section 10.2.1.
2) The SW related tests focus mainly on the validation of the implemented software and its logics. Of course these tests also include features dependent on the performance of the hardware. According to IEEE Std 829-1983, /21/, for the validation of software a test design specification, a test case specification and a test procedure must be prepared. The test design specification and the test case specification are comprised in the "Test specifications" that are provided only for the SW related tests of the UFTR FAT. Section 10.1.1 describes the structure of the test specifications.

For most of these tests, specific test scripts must be provided that are designed according to the UFTR SDD, /11/. The test procedures for the HW related tests follow a similar structure as the SW related tests (see section 10.1.2). The HW test procedures contain the information addressed in the SW test specification and in the SW test procedures, but they leave a few titles to be addressed in the test specification. The test procedures for the SW related tests contain the specific test scripts in order to complete FAT.

10.1 Software Test Documentation

10.1.1 Test Specification

The Test Specification shall incorporate the Test-Design Specification and Test Case Specification as defined in IEEE Std 829-1983, /21/, into a single document. Each Test Specification shall have the following information and structure:

- Test Design Specification
  - Test Specification identifier (i.e., document number)
  - Features to be tested
  - Approach refinements
  - Test identification

- Features pass / fail criteria
- Test Case Specification
  - Test items
  - Input specifications
  - Output specifications
  - Environmental needs
  - Special procedural requirements
  - Intercase dependencies
- Attachments (including description of procedural steps and in some cases the expected test results)

The Test Specifications shall test, verify, and document that the UFTR RPS TXS System meets design specifications. Test Specifications shall validate functionality under a comprehensive set of realistic operating conditions. Specific acceptance criteria shall be defined in the individual Test Specifications. Individual Test Procedures shall be developed using the Software and Hardware design documents. Each Test Specification shall identify the tools required to perform the test.

10.1.2 Test Procedure

Each Test Procedure shall have the following information and structure:

- Test Procedure Identifier (i.e., document number)
- Purpose
  - References
  - Definitions
  - Abbreviations/Acronyms
- Special requirements
  - Test equipment
  - Other equipment
  - Prerequisites
  - Safety requirements
  - Test Supervisor requirements
- Procedure steps
- Restoration
- Test Completion
- Attachments

Each FAT Procedure shall also contain the following sections/information, as applicable, required by the UFTR FRS, /10/. For SW related tests, the following information is specified in the test design sections of the test specification:

- Functions to be tested and not tested
- A listing of inputs and outputs
- Test software descriptions and listings

- Expected results
- Pass/Fail criteria
- Acceptance criteria, expressed in engineering units, including timing and propagation delay
- Data/Data Collection/Data Sheets.

The Test Procedures shall test, verify, and document that the UFTR RPS TXS System meets design specifications.

Specific acceptance criteria shall be defined in the individual Test Procedures.

Test Procedures may utilize Test Scripts to perform the steps specified in the corresponding Test Specification. If Test Scripts are utilized as the Test Procedure, then the Test Scripts shall be entered into the Test Procedure documentation in the exact format in which they exist without modification. The Test Scripts shall also be entered into the Software Library as governed by the UFTR "Software Library and Control," /13/.

A field shall be provided in each procedure to allow the UF representative to enter comments. A signature field to indicate test completion shall be provided for the UF representative.

10.1.3 Software Test

The following tests are considered software tests and therefore fall under the scope of Section 10.1:

- RPS Functional Test
- GSM
- GW to T3000 control system
- QDS
- Controlled Start-up/Shutdown Simulation
- Cyber Security

10.2 Hardware Test Documentation

10.2.1 Test Procedure

The hardware test portion of the FAT is not governed by IEEE Std 829-983, /21/, however, the standard is used as guidance for developing and performing the hardware tests. The Test Procedures shall have the following information:

- Test Procedure Identifier (i.e., document number)
- Purpose
  - References
  - Definitions
  - Abbreviations/Acronyms
- Special requirements

- Test equipment
- Other equipment
- Prerequisites
- Safety requirements
- Test Supervisor requirements

- Procedure steps
- Restoration
- Test Completion
- Attachments

Individual hardware Test Procedures shall be developed using the Hardware design documents. If a Test Procedure uses a Test Script to perform any actions, the Test Script shall be included as part of the Test Procedure.

Each Test Procedure shall identify the tools required to perform the test.

10.2.2 Hardware Test

The following test procedures (as discussed in Section 7.4.3) are considered hardware tests:

- Nuclear Instrumentation (NI)
- RPS Hardware Failures
- RPS Response Time

Note: The Hardware failure tests and the Response Time tests cover Software requirements as well. Therefore the corresponding test procedures may be subject to V&V review activities, though these documents are issued in the form of test procedures as described in section 8.2.1. Whether these procedures are reviewed by V&V or not, is to be determined by the IV&V team.

Furthermore the following prerequisite tests (as discussed in Section 5.4.2) are considered hardware tests and therefore follow the structure specified in Section 8.2:

- Equipment Power-Up Procedure
- Cabinet Alarm Monitoring
- I/O to Field
- I/O to Test machine

10.3 Overall Test Documentation

10.3.1 Test Log

The Test Log provides a chronological record of relevant details about the execution of tests following the guidance of IEEE Std 829-1983, /21/. The Test Log has the following format:

- Test Log identifier
- Description

- Activity and event entries

The Test Log shall be included as an attachment to the FAT Validation Procedure. Therefore the Test Log identifier (or document number) is the same as the FAT Validation Procedure.

10.3.2 Test Incident Report

The Test Incident Report documents any event that occurs during the testing process that requires additional investigation. The Test Incident Report shall have the following information and structure:

- Test Incident Report identifier
- Summary
- Incident description
- Impact

10.3.3 FAT Summary Report

The FAT Summary Report will be generated to document the successful completion of FAT and to document any variances incurred during testing. The Test Summary Report shall have the following information and structure:

- Test Summary Report identifier
- Summary
- Variances
- Comprehensive assessment
- Summary of results
- Evaluation
- Summary of activities

The UFTR Project Manager shall review and approve the FAT Summary Report to acknowledge acceptance and completion of FAT. Completion of the FAT signifies completion of the testing phase and establishes a final configuration. The FAT Summary Report shall include reviews and approvals including:

- Test Lead
- Project Manager
- QA Lead

11. Testing Tasks

The tasks necessary to prepare for FAT prerequisites and performance are listed in Section 7.4.2 and the tasks necessary to perform the FAT are listed in Section 7.4.3.

Successfully completing the training as specified in Section 14.2 provides the necessary skills needed to perform the testing tasks.

The intertasks dependencies between the performance of the prerequisites and the FAT procedures are as follows:

1. The Test Plan must be approved and released before executing any of the FAT prerequisites or tests.
2. The FAT prerequisites listed in Section 7.4.2 must be completed before performing any of the FATs.
3. The FAT prerequisites shall be executed in the following order:
    i. Test Field Installation
    ii. Equipment Power-up
    iii. Software Generation and Download
    iv. Remaining Prerequisites (I/O to Test machine, I/O to field, and Cabinet alarm monitoring)
4. The FAT for NI equipment may be performed following the completion of the FAT prerequisites.
5. The validation of the initial conditions setup as specified in the RPS Functional Tests must be successfully completed prior to proceeding to the following tests (which may be done in any order):
    i. RPS Hardware Failures
    ii. GSM
    iii. GW to non-safety T3000 system
    iv. QDS
    v. System Tests
    vi. RPS Response Time
    vii. Cyber Security

Tasks may proceed without satisfying the stated intertask dependencies provided no adverse conditions exist that impact test commencement/continuation as identified in Section 9.3.

12. Environmental Needs

12.1 Physical Control

The UFTR RPS TXS System shall be placed into a controlled environment in conformance with ANSI Standard N45.2.2-1972, Level B, /25/. These requirements include, but are not limited to the following:

- UFTR RPS TXS System shall be placed into a controlled environment that is well ventilated, protected from water intrusion, and protected from fire, flooding, or animal intrusion.
- UFTR RPS TXS System shall be placed into a secure environment that is protected from vandalism or tampering.
- UFTR RPS TXS System cabinets shall remain locked at all times whenever the test area is unoccupied or authorized UFTR personnel are not present.
- Only authorized personnel shall have access to the TXS cabinet internals.

12.2 Environmental Control

The location of the UFTR RPS TXS System under test shall comply with design requirements regarding environmental requirements per ANSI Standard N45.2.2-1972, Level B, /24/, and design and customer specifications.

12.3 Access Control to Test Field

Access to the test field shall be controlled to ensure an orderly and safe conduct of testing. These requirements include, but are not limited to the following:

- Personnel access to the test field shall be minimized to reduce disturbances to the testing activities
- No personnel shall enter the test field without Test Supervisor authorization
- Only authorized personnel shall access the test field without escort

The test field, and therefore the system under test, shall not be connected to any external network or have any outside communication connection. The use of USB storage devices is permissible. The mode of usage (in accordance with IEEE Std 829-1983, /21/) is therefore considered to be stand-alone.

12.4 Required Software

The required communication and system software for the test field is identified in the Project-Independent Software listed in Section 4.1.

Other software packages (e.g., Excel macros) and/or scripts may be used as an aide in the process of reviewing test results, however, these software packages and/or scripts shall not be credited as the method for performing final review of test results.

12.5 Special Test Tool Needs

The special tools needed for performance of the FAT are the Test Machine and the LabVIEW Data Acquisition Equipment.

Calibrated equipment shall be available to record the temperature and relative humidity levels of the test field environment throughout the course of FAT. This equipment shall be able to display the current temperature and relative humidity levels and record the peak values of each. Other special tools needed include calibrated low level current sources (in the μA range) and fast response recording devices for performing the NI and Response Time tests. The requirements for this equipment shall be specified in the corresponding Test Specifications/Procedures.

Other needed test tools are to be specified in the individual Test Specifications or Procedures, but are of a standard nature (e.g., digital Multimeter) and are not considered to be special.

12.6 Other Testing Needs

There shall be a document library readily accessible to the test field. This library shall contain software and hardware detailed design documentation and general product information and/or user manuals. These documents are only intended to be used for reference. A means of connecting to the UFTR Document Server shall be available in close proximity to the test field. This allows test personnel to access controlled documentation that may not be available in the test field library.

Office space shall also be made available to test personnel to perform validation of the recorded, resultant test data from the operation of the Test Procedures. The evaluation of results (especially for software tests) may be performed outside of the test field to allow for other tests to be performed.

Any need (tool, document, etc.) that is not currently available to the test team shall be obtained by the Test Lead (see Section 13.2.6). Each Test Specification/Procedure discussed in this section shall identify the tools required to perform the test. The use of calibrated test equipment shall be recorded as described in Section 7.4.2. Accuracy requirements are to meet general industry standard practices.

13. Responsibilities

13.1 Organization

The overall project team organization and responsibilities are defined in UFTR QAPP, /3/. The individuals and groups identified in the following sections will be involved with FAT. For conducting the FAT tests, all personnel shall adhere to the FAT test specifications and test procedures.

Note: Many of the following roles are not ruled by this FAT plan; they are ruled by other plans, e.g. by the V&V plan, the safety plan etc.

The Test Field Manager is provided by AREVA NP INC. He is responsible for enforcing the NL-G Test field manual.

13.2 Supplier – AREVA NP Inc.

13.2.1 General

Roles and responsibilities of AREVA NP Inc. and AREVA NL-G include:

- Provide the replacement RPS System
- Provide test hardware and software
- Provide special test and calibrated test equipment (see section 12.5)
- Provide testing simulator (Test Machine)
- Provide and maintain test field environment
- Observe and participate in FAT including setup and monitoring of test results

13.2.2 Test Field Manager

- Enforce the NL-G test field manual
- Establish and maintain test field access control list
- Provide infrastructural support for the FAT activities
- Responsible for maintaining the test field access control
- Maintain configuration control FAT activities

13.3 Purchaser – University of Florida (UF)

13.3.1 Project Manager

- Manage project scope
- Ensure qualified personnel are available for testing
- Approve the release of the FAT documents for testing
- Sign as approving Open Item resolution and closeout
- Provide the test items defined in Section 4
- Ensure acceptable environment requirements are met as defined in Section 12

13.3.2 Project Coordinator

- Approve Test Specifications/Procedures

- Approve FAT Summary Report

13.2.3 Test Lead – Hardware and Installation Group Lead

- Maintain and implement the FAT Plan
- Maintain and implement the FAT Prerequisites
- Coordinate the FAT activities
- Resolve test group needs (e.g., tools, documents, etc.)
- Primary responsibility to maintain configuration control
- Generate Open Items and Condition Reports

13.2.4 Test Supervisor(s)

- Responsible for ensuring that pre-job briefs and safety briefs are conducted
- Assist in the preparation of Test Specifications/Procedures and Test Scripts
- Responsible for maintaining the Test Log
- Responsible for maintaining the test equipment
- Responsible for maintaining the test field cleanliness and decorum
- Responsible for supervision of test engineers and technicians
- Coordinate FAT activities
- Review FAT results
- Maintain configuration control
- Ensure test documentation is retained as a permanent record
- Generate Open Items and Condition Reports

13.2.5 Test Engineer(s)

- Prepare Test Specifications/Procedures and Test Scripts
- Perform FAT activities
- Review FAT results
- Prepare FAT Summary Report
- Ensure configuration control
- Generate Open Items and Condition Reports

13.2.6 IV&V Personnel

- Perform V&V activities
- Produce Software Test Review Report
- Maintain configuration control
- Generate Open Items and Condition Reports

13.2.7 Quality Assurance

- Witness/verify FAT, as required
- Review and approve FAT procedures, as applicable
- Responsible for ensuring independence from design and testing activities

- Maintain configuration control
- Ensure test documentation is retained as a permanent record
- Generate Condition Reports
- Acceptance of Condition Report resolutions

14. Staffing and Training Needs

14.1 Staffing

Members of the FAT group are staffed with the following qualified personnel:

- Test Field Manager (AREVA NP Inc)
- Test Lead/Test Supervisor (UF+AREVA NP Inc)
- Test Engineer (UF)
- IV&V Personnel (UF)
- QA Personnel (UF)

The method for providing the independence for the FAT is achieved by having all Test Plans, Test Specifications, Test Procedures, Test Logs, and Test Reports reviewed by personnel that are independent of the design process. Personnel that were involved with the design are allowed to participate in the preparation of any of the previously mentioned documents, but are prohibited from performing any of the independent reviews of them.

Independent V&V (IV&V) personnel report to the IV&V Lead. The IV&V personnel also report indirectly to Quality Assurance Lead, who has oversight authority over the V&V activities.

14.2 Training

The Test personnel will be qualified in accordance with the UFTR Training Plan, /8/, and AREVA's assistance. The Test Lead shall be responsible for verifying Test Personnel under his/her supervision are qualified to perform the testing being conducted.

15. Schedule

15.1 Milestones

The FAT Plan schedule corresponds to major project milestone events that include completion of:

- FAT Plan development
- Test Specification / Procedure development and checkout
- FAT prerequisite activities
- FAT activities
- FAT Summary Report

The preparation of the FAT test specifications and procedures as well as the FAT activities themselves are not controlled by this FAT plan; they are set by the overall project schedule. Therefore, dates and durations must be retrieved from the overall project schedule.

15.2 Basis for Milestones

Milestones are established based on the following logic:

- The FAT Plan is the basis for the development and performance of individual Test Specifications/Procedures
- The TXS System must be assembled prior to performance of the Test Specification or Procedure Checkout and FAT
- Test Specification/Procedure Development and Checkout must be performed prior to the start of FAT
- FAT completion is signified by approval of the FAT Summary Report

15.3 Project Schedule

The overall project schedule is the responsibility of the Project Manager, and the FAT activities shall be included in the overall project schedule. Additional information on requirements for establishing schedules and activities is governed by the UFTR QAPP, /3/.

The overall project schedule provides estimates required to perform each of the identified testing activities. The schedule also specifies the required staff for each of the testing activities. The period of use of the test field and testing tools (e.g., the Test Machine) can be ascertained through the use of the project schedule and identifying the testing activities.

16. Risk and Contingencies

Because of the safety features of the UFTR, risk management is not applicable.