

Spallation Neutron Source

Acceptance Criteria



Page 1 of 3 WBS Number 1.4.1.3

Rev. A

Title RF Control Systems

Description LANL Designed and Industry Built RF control systems for Front End, NC and SRF linac.

Originator Hengjie Ma Lab ORNL

*(Originator may list his/her part of the total strategy and request others to add to the list, but the final version must be approved)*

#	Expectation	Location	Responsibility	Verified by	Date																		
1	Contract manufacturer inspection (or LANL inspection of LANL manufactured boards) of boards per LANL-developed/ ORNL-approved criteria. ORNL may participate in inspection/testing.	Vendor/ LANL	LANL																				
2	Deliver to ORNL equipment, documentation, etc. for 7 402.5 MHz NC RFQ/linac, 4 805 MHz NC linac, 81 SC linac, 2 HEBT, and 1 (NC) RF building RF Control systems. Deliver to ORNL all spares contingent upon funding for installation spares.	ORNL	LANL																				
4	Acceptance testing of installed reference line to DCD specification parameters.	ORNL	LANL, ORNL																				
5	<p>Final acceptance tests at ORNL, performed on all units, with LANL in the roles as denoted in the following table. (The cavity type listed actually implies the RFCS associated with said cavity).</p> <table border="1" data-bbox="97 1071 747 1386"> <thead> <tr> <th>LANL lead</th> <th>LANL Mentor</th> <th>ORNL lead (LANL consult)</th> </tr> </thead> <tbody> <tr> <td>RFQ</td> <td>-</td> <td>-</td> </tr> <tr> <td>1<sup>st</sup> 2 DTL</td> <td>Next 2 DTL</td> <td>Last 2 DTL</td> </tr> <tr> <td>1<sup>st</sup> 2 CCL</td> <td>Next 2 CCL</td> <td>-</td> </tr> <tr> <td>1<sup>st</sup> 12 medium beta</td> <td>-</td> <td>The rest of the medium beta systems</td> </tr> <tr> <td>1<sup>st</sup> 2 high beta</td> <td>Next 10 high beta</td> <td>The rest of the high beta systems</td> </tr> </tbody> </table> <p>Tests concurrent with RF structure conditioning, but no beam. These tests are to be performed using EPICS. Acceptance test criteria, per DCD, to include:</p> <ol style="list-style-type: none"> <li>1) Full cavity field control at nominal field level and rep rate for a goal period of 8 hours without any RF Control System faults.</li> <li>2) Full checkout and successful operation of all fault, interlock, and fast protection circuits.</li> <li>3) Demonstration of successful integration (where applicable) with HVCM, HPRF, machine protection system, personnel protection system, Brookhaven timing system, and target protection system.</li> <li>4) Complete local and remote checkout of all EPICS control system functionality.</li> </ol>	LANL lead	LANL Mentor	ORNL lead (LANL consult)	RFQ	-	-	1 <sup>st</sup> 2 DTL	Next 2 DTL	Last 2 DTL	1 <sup>st</sup> 2 CCL	Next 2 CCL	-	1 <sup>st</sup> 12 medium beta	-	The rest of the medium beta systems	1 <sup>st</sup> 2 high beta	Next 10 high beta	The rest of the high beta systems	ORNL	ORNL, LANL taking the roles as described in the "Expectation" column		
LANL lead	LANL Mentor	ORNL lead (LANL consult)																					
RFQ	-	-																					
1 <sup>st</sup> 2 DTL	Next 2 DTL	Last 2 DTL																					
1 <sup>st</sup> 2 CCL	Next 2 CCL	-																					
1 <sup>st</sup> 12 medium beta	-	The rest of the medium beta systems																					
1 <sup>st</sup> 2 high beta	Next 10 high beta	The rest of the high beta systems																					
6	Training of ORNL personnel on installation and operation of LLRF system. Training to occur during installation and checkout at ORNL and at LANL.	ORNL	LANL																				



## Turnover Narrative

## System Description

The RF Control System consists of the high power RF protect module, the field/resonance control module, and a clock distribution module. It also consists of the temperature-stabilized reference coaxial line in the tunnel. The modules will be installed in VXIbus crates. LANL will supply the racks in the Klystron Gallery, and Controls, WBS 1.9, will supply the crates. In addition to the above items, all cabling between internal RF Control System technical components will be supplied by LANL and installed by ORNL.

## Turnover Process

The handoff of the LLRF system will occur at the system level for the first two RF Controls Systems for each type of cavity: i.e., 402.5 MHz RFQ (1 system, obviously), 402.5 MHz DTL (2 systems), 805 MHz normal-conducting CCL (2 systems), 805 MHz superconducting medium  $\beta$  cavities (12 systems), and 805 MHz superconducting high  $\beta$  cavities (2 systems). For these initial systems, LANL will lead the equipment installation and integration effort through RF system integration and structure conditioning. To be clear, see the following table.

LANL lead	LANL Mentor	ORNL lead (LANL consult)
RFQ	-	-
1 <sup>st</sup> 2 DTL	Next 2 DTL	Last 2 DTL
1 <sup>st</sup> 2 CCL	Next 2 CCL	-
1 <sup>st</sup> 12 medium beta	-	The rest of the medium beta systems
1 <sup>st</sup> 2 high beta	Next 10 high beta	The rest of the high beta systems

ORNL will install, terminate, and test cables, and LANL will check these out as part of its integration effort. Acceptance of these systems will occur after integration. For the next two systems of each cavity type, LANL will mentor ORNL in the installation and integration phase. For all subsequent systems, ORNL will lead the installation and integration efforts. Subsequent systems will be accepted after delivery to Oak Ridge based on successful module testing at the vendor.

The reference coax will be installed by ORNL crafts (supervised by ORNL technical staff), and tested by LANL and ORNL technical staff. It will be accepted as part of the first article, system tests.

## Special Test/Installation/Support Equipment

Standard test/measurement equipment will not be provided by LANL; however, LANL will supply any special equipment required to simulate signals for the purposes of fully verifying operation and interlocks.

## Software & Databases

Copies of software and associated documentation, updated/revised by LANL as needed during first article final acceptance, including:

1. Fully commented source code files, compiled files and all other related files for both FPGA and DSP chips.
2. Theory of operation technical note for all FPGA and DSP codes.
3. A step-by-step guide of how to edit/modify, compile, download, and run those codes.
4. Design simulation models/Matlab files

ORNL will enter cable data into the SNS cabling database.

## Documentation

For each circuit module, LANL will provide a hardware description containing schematic/pcb/BOM (bill of materials) files, a users manual (operation manual), service manual (test procedure, trouble shooting), and a programming manual (apply to FRCM and HPM).

LANL also will provide:

- As-Built Drawings
- Test Reports/ QA records (Traveler)
- System connection diagrams for each kind (i.e. RFQ, DTL, CCL, and SRF), and turn-on /set-up procedures
- Cabling drawings
- Installation/test guide for the cabling, and frequency reference line

# Spallation Neutron Source

# Acceptance Criteria



Role	Name (originator may suggest approvers)	Plan Approval Signature	Date
SNS Division Lead	Hengjie Ma	<i>Hengjie Ma</i>	10-24-01
Partner Lab Rep.	Amy Regan	<i>Amy H. Regan</i>	10/19/01
Systems Integration	Raymond Fuja	<i>Ray Fuja</i>	10/25/01
Partner Lab Group Leader	Michael Lynch	<i>Michael Lynch</i>	10-19-01
Partner Lab Division Dir.	Donald Rej	<i>D. J. Rej</i>	11/6/01
Linac Tech. Section Head	Marion White	<i>Marion White</i>	15 Nov 01
ASD Division Director	Norbert Holtkamp	<i>N. Holtkamp</i>	11-02-01

Items/System Accepted at SNS

Installation Manager or designee

Printed Name

Signature

Date: