Document Approval: **Date Approved**

Originator: Jose Chan, Accelerator System Manager	
Approver: Marc Ross, Cryogenic System Manager	
Approver: Greg Hays, Cryogenic System Deputy Manager	
Approver: Lori Plummer, Systems Engineering Manager	
Approver: Joe Preble, Acting JLAB LCLS-II Senior Team Lead	
Approver: Richard Stanek, FNAL LCLS-II Senior Team Lead	
Approver: Darren Marsh, Quality Assurance	
Approver: David Schultz, Project Technical Director	

Revision History

Revision	Date Released	Description of Change
R2		Added requirement that interconnect region components be delivered in RFI state. Added provision by CS of installation procedures and installation support.
R1	9/9/2014	Revised wording to clarify that Cryogenic Distribution System (CDS) would provide and install end caps and feed caps, and design and supply CDS ceiling supports.
R0	7/30/2014	Original Release.

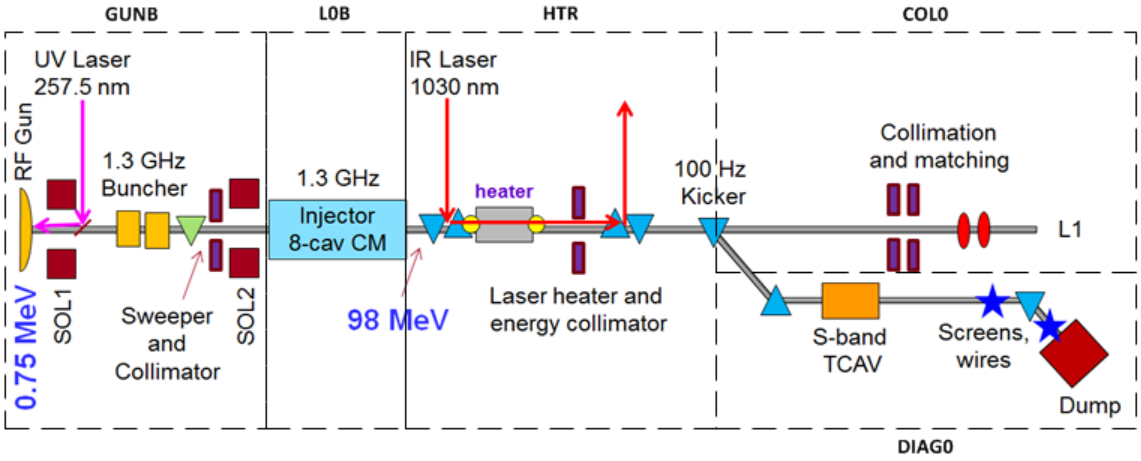
1 Purpose

This Interface Control Documents (ICDs) defines the boundaries between the Accelerator Systems (AS) and Cryogenic Systems (CS), to ensure clear definitions of work scope on both sides of the interface, and to document dependencies of each system on the other.

2 Scope

This document covers the regions of the LCLS-II Injector and Linac, and all technical systems that are required for the superconducting radio frequency cryomodule system to operate. Additional areas of responsibility for AS such as Transfer Lines and Dump, and CS such as the Cryogenic Plant, are not included in the descriptions in this section but may be referenced elsewhere in this document.

2.1 Injector



The Injector includes the Laser, the Injector source, which includes a short beamline section between the source and the first cryomodule (GUNB), the first cryomodule (L0B), a beamline section after L0B that includes the Laser Heater Undulator (HTR), a diagnostic line (DIAG0), and a collimation section (COL0).

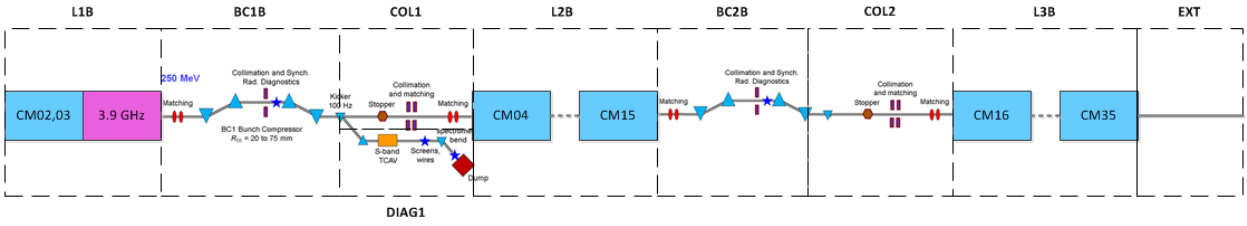
Refer to “SLAC to LBNL Injector Interface Control Document” for GUNB.

The physical interface between L0B and HTR is the Cryogenic Distribution System (CDS) feed cap isolation valve, which will be provided by CS.

CS is responsible for the design, procurement, fabrication, testing and delivery of L0B. CS is also responsible for the design, procurement, fabrication, testing, delivery and installation of the cryogenic distribution system.

AS is responsible for the design, procurement, fabrication and testing of HTR, DIAG0 and COL0, plus the provision of infrastructure and the installation of all regions.

2.2 Linac



The SRF Linac includes the cryomodule strings L1B (2 cryomodules and 2 harmonic linearizer cryomodules), L2B (12 cryomodules), and L3B (20 cryomodules). The beamline between L1B and L2B

contains the BC1B Bunch Compressor. The beamline between L2B and L3B contains the BC2B Bunch Compressor. Beamline components (EXT) downstream of L3B transport the accelerated electron beam to the Undulator.

The physical interfaces between the cryomodule strings L1B, L2B and L3B to BC1B, BC2B and EXT are the CDS feed cap isolation valves, which will be provided by CS.

CS is responsible for the design, procurement, fabrication, testing and delivery of L1B, L2B and L3B. CS is also responsible for the design, procurement, fabrication, testing, delivery and installation of the cryogenic distribution system. AS is responsible for the design, procurement, fabrication and testing of BC1B, BC2B and EXT, plus the provision of infrastructure and the installation of all regions.

3 Definitions

Term	Definition
AS	Accelerator Systems
CDS	Cryogenic Distribution System
CS	Cryogenic Systems
EPICS	Experimental Physics and Industrial Control System
FNAL	Fermi National Accelerator Laboratory
FPC	Fundamental Power Coupler
HMI	Human Machine Interface
I/O	Input/Output
JLAB	Thomas Jefferson National Accelerator Facility
LCLS-II	Linac Coherent Light Source II
MCC	Main Control Center
SLAC	SLAC National Accelerator Laboratory
TSP	Titanium Sublimation Pump

4 References

LCLSII-5.4-IC-0230	Cryoplant to SLAC Warm He Storage ICD
LCLSII-4.9-IC-0058	Cryogenic Distribution System ICD
LCLSII-2.2-IC-0173	SLAC to LBNL Injector ICD
LCLSII-2.1-IC-0156	Accelerator to Infrastructure Systems ICD
TBD	Electron Beam Controls Interfaces

5 Responsibilities

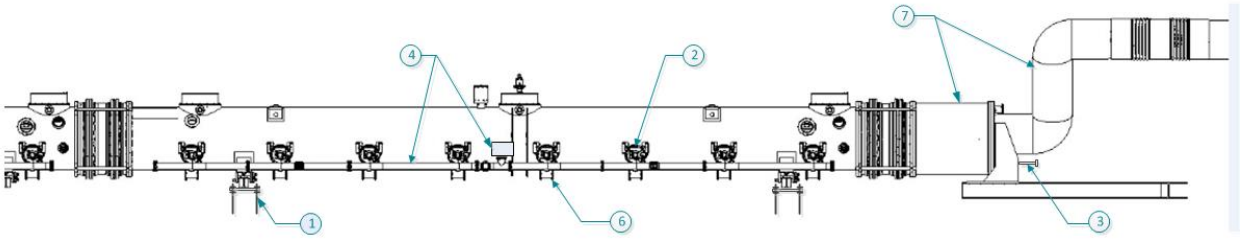


Figure 1: Elevation of 1.3 GHz Cryomodule

Table 1 below lists the major cryomodule elements referenced from Figure 1 (plus additional systems) and the section which describes responsibilities of each System.

Table 1: Cryomodule Elements and Systems

	System or Element	Cryogenic Systems Area of Responsibility	Accelerator Systems Area of Responsibility
1	Cryomodule Supports to SLAC Housing Floor and Shipping Fixtures	• Design, fabrication, procurement and delivery of the cryomodule support that will attach to the floor of the SLAC housing • Provide floor mounting plates and anchor templates • Shipping transport mechanisms for the cryomodules • Ship transport mechanism and transport end caps back to supplying laboratory	• Provide seismic design guidelines • Review and approve mounting design • Provide and install concrete anchors per CS supplied anchor templates • Locate, install and attach cryomodule mounting plates and supports to the SLAC housing floor
2	Fundamental Power Coupler (FPC) and Waveguide	• Design FPC • Install FPCs on cryomodules	• Procure, fabricate and process FPCs • Deliver FPCs (cleaned and ready for assembly into the cavities/cryomodules) to CS. • Design, procure and install cryomodule RF waveguide

	System or Element	Cryogenic Systems Area of Responsibility	Accelerator Systems Area of Responsibility
3	Vacuum – Beamline	• Provide manual isolation valve to warm beamline sections at each CDS end and feed cap	
4	Vacuum – Coupler	• Design, procure and install cryomodule coupler ion and TSP pumps	
5	Vacuum – Cryomodule and Distribution Insulation (not shown in figure)	• Provide cryomodule and CDS vacuum valves and gauges for insulating vacuum volume. Device model types should be mutually agreed upon with AS.	• Provide pumping system to maintain insulating vacuum pressure • Provide and install instrumentation electronics, cables and connectors for cryomodule insulating vacuum valves and gauges.
6	Cryomodule Feedthroughs	• Provide list of I/O signals requiring instrumentation and control. Provide descriptions of associated interlocks, logic sequences, error and alarm signals. Collaborate with AS Controls to design controls logic. • Provide feedthrough flanges to pass signals through insulating vacuum wall for instrumentation and controls of various cryomodule elements. Point of interface to AS Controls is at the connector at the flange.	• Provide and install instrumentation and controls electronics, cables and connectors for cryomodule sensor and control elements

	System or Element	Cryogenic Systems Area of Responsibility	Accelerator Systems Area of Responsibility
7	Cryogenic Distribution System, including Feed Caps and End Caps	• Provide list of I/O signals requiring instrumentation and control. Provide descriptions of associated interlocks, logic sequences, error and alarm signals. Collaborate with AS Controls to design controls logic. • Design, procure and install CDS, including primary devices and instrumentation devices. The point of interface with AS Controls is at the device connector. • Provide and install CDS end caps and feed caps to housing floor and adjacent cryomodules • Design CDS ceiling supports.	• Provide seismic design guidelines • Review and approve mounting design • Provide and install concrete floor anchors per CS supplied anchor locations and templates • Provide and install instrumentation and controls electronics, cables and connectors for cryomodule sensor and control elements • Accelerator to weld feed caps and end caps to the cryomodule.
8	CryoPlant (not shown in figure)	• Design, procure, and install the CP. • Provide list of I/O signals requiring interface to MCC. Provide descriptions of associated interlocks, logic sequences, error and alarm signals.	• Provide an EPICS HMI for the CP that is integrated with MCC main control system and HMI.

	System or Element	Cryogenic Systems Area of Responsibility	Accelerator Systems Area of Responsibility
9	Controls (not shown in figure)	• Provide I/O list and controls requirements for cryomodule and CDS	• Design, procurement and installation of data acquisition and control systems for cryomodules and CDS • Provide accelerator safety systems to protect personnel and equipment from beams and radiation
10	Cryomodule Magnets (not shown in figure)	• Provide cryomodule magnet power supply requirements	• Provide cryomodule magnet power supplies and cabling • Design, procurement and installation of quench protection system

5.1 Test/Inspection Plans and Acceptance Criteria

The party providing the equipment shall provide the equipment **Pre-Shipping** Test/Inspection plans and the Acceptance Criteria.

The party providing the equipment shall provide the equipment **Receipt** Test/Inspection plans and the Acceptance Criteria.

5.2 Borrowed Equipment

AS will purchase equipment that will be used by CS at each testing facility, including but not limited to RF sources and magnet power supplies. Upon completion of testing, CS will return the equipment to AS for use in production.

Troubleshooting, repair or replacement of the borrowed equipment will be the responsibility of the lending party if there is a latent problem with the equipment. If the damage is caused by the borrower, accidental or otherwise, responsibility shall fall on the borrower.

5.3 Installation Hardware

Design and/or specification of installation tools shall be provided by CS with input from AS to ensure conformance with SLAC ES&H and WPC. CS will provide drawings of the interconnect region, including a Materials list and tools required for installation. AS will provide tools and verify on SLAC mock-up assembly.

5.3.1 Cryomodule Strings

Beamline Absorber (BLA) will be shipped from CS to AS in RFI condition (no processing required upon receipt). Minimal labor should be required prior to entry in clean room.

All parts, supports and consumable/yield hardware for BLA and cryomodule string interconnect assembly/installation shall be provided by CS as if installation were being performed at their own lab. Hardware includes but is not limited to cryomodule large bellows hardware and interconnect pipes. Quantities should be determined by CS, with concurrence from AS. Usage of parts and materials beyond agreed upon quantities is the responsibility of AS.

5.3.2 Couplers

Couplers will be shipped from AS to CS in RFI condition (no processing required upon receipt). Minimal labor should be required prior to entry in clean room. Attaching hardware and gaskets shall be provided by CS.

5.3.3 Waveguide Boxes

Waveguide boxes will be shipped from AS to CS in RFI condition (no processing required upon receipt). Minimal labor should be required prior to entry in clear room. Attaching hardware shall be provided by AS.

5.4 Installation Procedures

Cryomodule installation procedures shall be provided by CS with input from AS to ensure that cryomodules and interconnect regions are “buildable/installable” by AS and comform to SLAC ES&H and WPC.

5.5 System Checkout

System checkout procedures shall be provided by system or component designer with input from AS and LCLS-II Physics. System checkout will be performed by AS and SLAC Cryogenic System experts, with assistance from CS experts and/or collaborators.

5.6 Training

Fabrication, assembly, installation and operation/maintenance training documentation shall be provided by AS (reviewed by CS) for consistency with SLAC Work-Smart standards. All SLAC Cryogenic System trainees must be signed off by CS.

5.7 Operations Procedures

Documentation for normal operations and irregular procedures shall be provided by mutually agreed upon parties, with input from LCLS-II Physics, CS and AS.

5.8 Maintenance Manual

Documentation for maintenance shall be provided by AS (reviewed by CS) for consistency with SLAC Work-Smart standards.