Fabrication Specification for
LCLS LTU, Undulator, and Dump Power Supply Racks

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Brief Summary

This fabrication Specification describes racks that house power supplies and associated electronic equipment in the Stanford Linear Accelerator Laboratory’s (SLAC) Linac Coherent Light Source free electron laser. Seller shall design, manufacture, perform quality assurance, test, package, and deliver Racks and auxiliary components in accordance with the requirements of this Specification and in the quantities required by the Purchase Order.

Change History Log

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1.0 SCOPE, GENERAL REQUIREMENTS AND NOTES
1.1 This specification covers the minimum requirements for indoor, single, and double bay power supply Racks. The Linac Coherent Light Source (LCLS) located at the Stanford Linear Accelerator Center (SLAC) will employ the racks. Both LCLS and SLAC are hereinafter simply referred to as Purchaser.
1.2 Seller shall design, manufacture, assemble, label, perform quality assurance, package, and deliver the Racks in accordance with the requirements of this Specification and the Purchase Order.
1.3 Expend all necessary effort to make the Rack electromagnetic interference (EMI) tight, as intended by this Specification, but testing is NOT required to show compliance with any EMI specification.
1.4 All materials used for Rack and accessory construction shall be non-corroding and non-rusting when installed in a benign indoor location.
1.5 Unless specifically specified otherwise in this Specification, prime all surfaces and paint all surfaces ANSI 61 gray.
1.6 Racks shall be plumb, 90deg to the horizontal.
1.7 The Figures attached to, and the drawing referenced in, this Specification are not fabrication drawings, but depict a concept. Seller has leeway to alter the dimensions labeled on the Figures as “Ref.” Seller shall determine specific Rack fabrication details and dimensions to satisfy the performance, form and fit functions of this Specification.
1.8 The Racks depicted in the attached Figures of this Specification are based on a design that was jointly developed by Purchaser and the California Chassis Company as shown on their drawings that are included.

2.0 AMBIENT CONDITIONS
2.1 Prevailing ambient conditions at Purchaser’s site located in Stanford, California are:
2.1.1 Location …………… Indoors
2.1.2 Temperature ………. 40 °F (4 °C) minimum to 110 °F (43 °C)
2.1.3 Elevation …………… 300 ft above sea level
2.1.4 Humidity …………... 10% to 100% relative humidity with a 50 °F dew point

3.0 APPLICABLE DOCUMENTS
3.1 The latest issue of the documents listed in Table 1 applies to this Specification. In the event of a conflict between the requirements of this Specification and any of the listed documents, the requirements of this Specification govern.
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<td>Electronic Industries Alliance -EIA Standard 310</td>
<td>Racks, Panels and Associated Equipment</td>
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<td>Minimum Requirements for Paint Finishes FP-022-110-03-R1, June 20, 1963</td>
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<tr>
<td>SLAC Document (attached)</td>
<td>Quality Control Workmanship Standards QC-034-100-01-R3, August 20, 1963</td>
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4.0 BASIC FRAME

4.1 Figure 1 depicts a similar double bay Rack for conceptual purposes.

4.2 Double bay Racks are 46” wide, 32” deep (excludes rear door thickness), and 93” high including base (see Drawing 103668). There are no front doors. Single bay Racks are 26” wide. See Figure 6, Rack B2.2-03.

4.3 The base shall be 4.25” high and shall have provisions for anchoring the Rack to a cement floor. The base shall have provisions for forklifting and shall have sufficient mechanical strength to allow forklifting when the Rack is the fully loaded.

4.4 Top, front, side, rear and bottom panels shall be cold-rolled steel. Continuously weld and ground smooth all external panel seams.

4.5 Provide 85.75” (49 space units) of usable chassis panel heights for each Rack bay.

4.6 The horizontal panel opening in each bay shall be in accordance with EIA Standard RS-310-C to accommodate nominal 19” wide chassis.

4.7 For the double bay Racks, no separation panels are required between the two (2) bays.

4.8 Provide a rectangular cable cutout in the roof panel in each bay as shown on Drawing 103668, in order to allow cables to enter and leave the Rack. Position one (1) cutout over the front cable rod location (Refer to Para 9.0) and position the other cutout over the rear cable rod location. Provide the same cutout in single bay Racks.

4.9 The total weight of Purchaser’s load is ≤ 1,000 lbs in each bay, approximately uniformly distributed vertically in each bay. All Racks have their loads roughly distributed: 40/60% top half / bottom half, respectively.

4.10 Furnish the Rack with four (4) removable lifting eye bolts, one (1) on each top corner of the frame, allowing lifting of the entire loaded Rack.

5.0 MOUNTING RAILS

5.1 Provide four (4) sets of stationary chassis mounting rails, 2 in the front and 2 in the rear of the Rack. Chassis mounting rails shall be 0.25” thick minimum, drilled and tapped for 10-32 screws with standard E. I. A. spacing. Chassis mounting rail installation holes must match from front to rear. Chassis mounting rails shall be part of the frame or, alternately, continuously welded to the Rack frame. Refer to Drawing 103668.

5.2 The outer mating surfaces of the chassis mounting rails (the surfaces that interface with chassis inner flanges) shall be tin plated (0.0002” minimum thickness) and left unpainted. Re-tap the 10-32 screw holes after tin plating.
6.0 DOORS AND LOCKS

6.1 Provide one (1) rear door per bay. The doors shall be the “short” type with space on top and bottom for Seller-supplied five (5) vertical space unit (8.75”) vent/fan panels that will mount on the rear chassis mounting rails.

6.2 Provide a continuous conductive wire mesh gasket between each door and the chassis mounting rails/frame. Tin plate and do not paint (see 5.2) the gasket mating surfaces to allow full electrical contact to be established.

6.3 The doors shall be hinged, removable, and lockable. Door locks shall be located in the middle of the Rack.

6.4 Furnish key locks and one (1) key per door. All locks and keys furnished under the Purchase Order shall be the same type; i.e.; any key shall open all Rack doors.

6.5 The door structure and latch/lock mechanisms shall be sufficiently sturdy to permit the electrically conductive gasket to make full contact with mating surfaces along its entire length.

7.0 UNISTRUT CHANNELS

7.1 Provide eight (8) full height, vertical Unistrut Channels per double bay Rack, four (4) per bay, and two (2) per side as shown on Drawing 103668. Weld the Unistrut Channels to the rack frame. These form an integral part of the Rack frame. Tie the four (4) inner Unistrut Channels together with welded braces at the rack top, middle, and bottom. Refer to Figure 3 for an example brace.

7.2 Provide four (4) full height, vertical Unistrut Channels per single bay Rack, two per side. Weld the Unistrut Channels to the rack frame. These form an integral part of the Rack frame.

8.0 STRUCTURAL LINEUP END BRACES

8.1 Label all racks with the Rack identifiers shown at the top of the Rack profiles in Figures 5, 6, 7, and 8.

8.2 Provide steel Structural Lineup End Braces at the ends of the Rack lineups as shown in Figures 5, 6, and 8, respectively. The Structural End Braces shall be full height and shall conform to the requirements outlined on Drawing 103668, Detail K.

Note: The Structural Lineup End Braces are a suggested aid to satisfy the seismic requirements. SLAC will consider Rack seismic requirement qualification by other methods.

8.3 Paint the Structural Lineup End Braces the same color as the Rack frame.

9.0 CABLE RODS

9.1 Provide and install Cable Tie-Down Rods along the entire inside vertical height in each bay and on both the front and rear center dividers. Refer to Drawing 103668.
10.0 POWER STRIPS AND OUTLETS

10.1 Provide one (1) 6 ft long Power Strips, with 12, 120 VAC, 20 A, 3-prong outlets in each Rack bay, whether single or double bay. Mount each power strip on the rear center divider facing the outside of the Rack. Furnish each power strip with pre-wired flex-conduit pigtails for connection to Purchaser’s AC system. For single bay Racks, the power strip may be any Seller-supplied color. For double bay racks, the left Power Strip (when viewed from the Rack front) shall be blue-colored. The right Power Strip shall be beige-colored. See also the NRTL requirements of Paragraph 17.1.

10.2 Two (2) 120 VAC, 20 A, 4-plex outlets shall be provided and shall be mounted at the bottom of the center dividers, one (1) in the front divider and one (1) in the rear divider. The outlets shall face and shall be useable from the outside of the Rack. Two (2) duplex outlets are an acceptable substitute for a 4-plex. Provide the 4-plex receptacles termination points for connection to Purchaser’s AC system. Install the Power Outlets in all Racks.

11.0 AC POWER ENCLOSURE

11.1 Provide one (1), 14 gauge, sheet steel, unpainted, 12.0” high AC Power Enclosures in each Rack bay as shown on Drawing 103668-500 and Figure 4. Provide the AC Power Enclosures with hardware for mounting to the Unistrut Channels. Install the AC Power Enclosures as shown in Figure 4.

12.0 POWER SUPPLY SHELVES

12.1 Provide Power Supply Shelves pairs for each Rack as shown on Drawings 103668 and 103668-100 with all necessary hardware for shelf installation to the Unistrut Channels by Purchaser. Install the shelves in Seller-determined locations. The Purchase Order specifies the Power Supply Shelf quantity. See also Figure 3.

13.0 TRANSDUCTOR MOUNTING PLATES

13.1 Furnish one (1), 8-Transductor Mounting Plate per Rack bay as shown in Drawings 103668 and 103668-700.

13.2 Mount the Transductor Mounting Plates in Seller-defined locations. See Figure 3 for a typical Transductor Mounting Plate. Purchaser furnishes the transductors.

14.0 FAN PANELS

14.1 Furnish and install two (2) Fan Panels for each Rack bay. Furnish and mount two (2) 120VAC fans on each fan panel. Wire the two (2) fans on each fan panel to one (1) plug, capable of reaching the Power Strip in the same bay as the fans. See the NRTL requirement of Paragraph 17.1.

14.2 Paint the Fan Panel front surface gray. Leave all other surfaces unpainted. Install the fan panels in the Racks at the factory. Drawings 103668 and 103668-300 show the requirements for the Fan Panels and Fans. See Figure 4.

14.3 Paint the Fan Panel and Fan mounting hardware (screws and washers) ANSI gray.

14.4 Limit each fan noise to \( \leq 53 \text{ dBA} \), when measured as defined by ANSI Standard S12.11.
15.0 VENTILATION PANELS
15.1 Furnish Ventilation Panels in the quantities given in the Purchase Order. Install the Ventilation Panels at Seller-defined locations. Drawing 103668-200 depicts the Ventilation Panels.

15.2 Paint the vent panel front Sherwin Williams Strobe White F-63-W-13.

15.3 Paint the Vent Panel mounting hardware (screws and washers) ANSI gray.

16.0 GROUNDING
16.1 Provide an untapped hole in the Rack roof for attachment of Purchaser’s grounding cable lug. The hole size and location shall be as shown on Drawing 103668. The surface around the hole (≥ 1” diameter) shall be free of paint and tin-plated.

17.0 SAFETY STANDARDS AND TESTING
17.1 The Ordered Items shall meet nationally recognized safety standards or have been tested and found safe for use by the University in a manner specified by the Seller. All electrical equipment, components and conductors and other items of the type requirement testing by a Nationally Recognized testing Laboratory (NRTL) recognized by the Occupational Safety and Health Administration (OSHA), shall be NRTL listed, labeled, or certified in accordance with Title 29, Part 1910, General Industry Standards, of the Code of Federal Regulations (29 CFR 1910). Seller shall notify the University Procurement Representative, in writing, of any Ordered Items to be furnished or used that do not meet these requirements, and shall not furnish or use such materials or supplies without written approval from the University Procurement Representative.

18.0 SEISMIC REQUIREMENTS
18.1 Item 6, Page 9 of Purchaser’s “Specification for Seismic Design of Buildings, Structures, Equipment and Systems at the Stanford Linear Accelerator Center” defines the Rack as Programmatic Equipment. Design the Rack to withstand the horizontal and vertical forces illustrated in Page 6, Figure 3 and Page 7, Figure 4. Page 22, Table 12 as 6.5 to 8.5 for modulators and power supplies, defines the performance level. The fully loaded Rack shall sustain only minor damage during a seismic event. As such, Table 12 requires “Detailed analysis reveals adequate restraint and anchorage of internal elements to incur minor damage.” Provide this analysis prior to Purchaser’s release for fabrication.

19.0 QUALITY ASSURANCE
19.1 LCLS shall have the right to reject, as not in conformity with the requirements of the Purchase Order, any equipment or services for which all required reports, procedures or certifications are not delivered. Seller’s failure to deliver such documents or delivery of deficient documents is a failure to make delivery.

19.2 Seller shall provide and maintain a quality program/system that complies with any
recognized U.S. Quality Program/System Standard in effect on the date of Purchase Order placement. Typical examples are ISO 9001, MIL-I-45208 and ANSI N45.2 or other equivalent.

19.3 Seller shall require, in writing, all tier subcontractors to comply with all applicable quality program/system requirements. The quality system and control of Seller’s “Special Processes” and all tier subcontractors to the extent practicable shall be subject to audit by LCLS representatives.

19.4 Seller shall tender for acceptance only equipment or services that have been inspected and tested in accordance with its quality program/system and have been found to conform with Purchase Order requirements.

19.5 Bidder shall submit with his proposal evidence of his quality program/system. Such evidence may consist of a copy of the Bidder’s approved QA/QC Manual, a QA/QC Plan, or a combination thereof, and shall specify the standard(s) upon which the system is based.

19.6 Prior to the performance of any operations involving the following, but in no event later than 30 calendar days after the Purchase Order date, Seller shall deliver for LCLS review and written approval:

19.6.1 A concise explanation of all manufacturing processes and assembly procedures.

19.6.2 An Inspection and Test Plan. The plan shall specify, as a minimum:
   a. What is to be inspected (e.g.; components, subassemblies and assemblies).
   b. The inspection/tests to be performed
   c. The inspection/test methods or procedures used.

19.6.3 A description of how the purchased equipment will be marked and identified

19.7 LCLS will notify Seller of its approval or disapproval within 30 calendar days. If notice is not issued within such time, Seller’s procedure shall be deemed approved.

19.8 When deemed necessary, LCLS will conduct a pre-award survey of a prospective Seller’s technical, quality assurance, production, or financial capability. Evaluation of documented quality assurance program/system applicable to materials produced by Seller may include, but will not be limited to, inspection and test controls, calibration of measuring and test equipment, special process controls, material storage and handling and drawing change controls.

19.9 All design drawings and specifications for the purchased equipment shall contain all details necessary for LCLS complete analysis of Seller’s design and compliance with Purchase Order requirements. Submit the design drawings and specifications to LCLS within 8 weeks after Purchase Order award for LCLS review and acceptance.

19.10 If LCLS disapproves Seller’s design drawings and specifications, upon LCLS written request, Seller shall submit revised design drawings and specifications for LCLS review. Upon receipt of each request, Seller shall make any necessary changes, modifications, or additions to the
design drawings and specifications. All costs related to the preparation and submission of revised design drawings and specifications shall be borne by the Seller. LCLS reserves the right to require an equitable adjustment of the Purchase Order price for any extension of the delivery schedule or from any additional costs to LCLS arising out of Seller’s failure to deliver complete design drawings and specifications conforming to the requirements of the Purchase Order.

19.11 Notwithstanding the inspection requirements of the Seller’s facilities, final acceptance of the purchased equipment will take place following delivery to, and testing by, LCLS.

19.12 LCLS reserves the right to perform any or all tests required to verify that the purchased equipment conforms to the requirements of the Purchase Order. Failure of any of the tests performed will deem the Purchased equipment unacceptable. LCLS will return the Purchased equipment to Seller for replacement at no cost to LCLS. Shipping costs of return and replacement shall also be borne by Seller.

19.13 Obtain and make available for inspection by LCLS, certifications of all materials used in the manufacture of the Purchased equipment. Certification shall be in the form of original source test reports of mechanical properties, chemical composition, or other requirements called out in the Purchase Order.

19.14 Certify that equipment and materials furnished under the Purchase Order are free from the use of suspect/counterfeit materials.

19.15 Allow SLAC representatives full access to Seller’s facility as stipulated in the “Quality Assurance Requirements.”

20.0 RELEASE FOR FABRICATION

20.1 Provide the following documents to Purchaser for review and approval prior to release of the Racks for fabrication. Provide sufficient detail to enable Purchaser evaluation. Purchaser might request a conference with Seller at Purchaser’s facility for clarification of design details.

20.1.1 Outline, assembly and fabrication drawings

20.1.2 Fabrication drawings of the AC Power Enclosure, Fan Panel, Vent Panel and Power Supply Shelf

20.1.3 Seismic calculations

20.1.4 Packaging, Shipping, Handling, and Installation Procedure

21.0 FIRST ARTICLE

21.1 Deliver one (1) First Article double bay Rack to Purchaser for examination before proceeding with the balance of the Rack order. Purchase will advise Seller of acceptance or of any deficiencies or needed changes within 15 days of First Article receipt. A single bay First Article Rack is not required.
22.0 DOCUMENTS ACCOMPANYING DELIVERY

22.1 Furnish “as-approved,” editable versions of the drawings and documents listed in Para 16.1 in electronic formats. Preferably, draw electrical drawings using Protek and mechanical drawings using AutoCAD, CAD Key, Microstation, or Solid Edge. Editable Adobe portable document format (PDF), version 5 or Word is acceptable for all other documents.

23.0 PACKAGING, SHIPPING, HANDLING, AND INSTALLATION

23.1 Submit a packing, shipping, handling, and installation procedure in electronic format to Purchaser for review and approval 30 days prior to the scheduled shipment of the Racks.

23.2 Ship the Racks completely assembled and able to withstand shock and vibration incidental to shipment and handling by common carrier.

23.3 All Racks shall be suitably packed, rigidly crated, braced, and protected against weather, damage, or undue strain. Brace subassemblies or panels for shipment. Brace and individually protect other fragile parts.

23.4 All Racks and shipping boxes shall be suitable for unloading and transferal by Purchaser using a forklift.

23.5 Notify Purchaser 10 days prior to shipment and provide a packing list that identifies the contents of each box or crate and its estimated weight.
FIGURE 1-PHOTOGRAPH OF A VERSION 1 PS RACK FRONT

This is a photograph of a double bay Power Supply Rack, similar to that required by this Specification. The depicted Rack is shown with Purchaser-furnished and installed power supplies and other miscellaneous equipment. Purchaser provides this photograph to reinforce the concepts shown in the Specification.
FIGURE 2 – BRACE EXAMPLE

This is a photograph of a Unistrut Channel Brace in a double bay Rack. This is one of three needed per double bay Rack.
FIGURE 3 – RACK REAR LOWER VIEW
This figure shows the Transductor Plates and Power Supply Mounting Shelves. Purchaser supplies the other parts.
FIGURE 4 – RACK REAR UPPER VIEW

This figure shows the top Fan Panel and an AC Power Enclosure. Purchaser supplies the other parts.
FIGURE 5 – BUILDING 2.1 RACK LINEUP

FIGURE 6 – BUILDING 2.2 RACK LINEUP
FIGURE 7 – BUILDING 2.3 RACK LINEUP

FIGURE 8 – BUILDING 3.1 RACK LINEUP