TIO-01: Request for Proposal (RFP)

Vacuum Vessel Assembly Fabrication

for ERL Main Linac Cryomodule (RFP 02473-00062)

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(Prepared by Tim O'Connell)

CORNELL UNIVERSITY
LABORATORY FOR ACCELERATOR-BASED SCIENCES AND EDUCATION (CLASSE)
MAIN LINAC CRYOMODULE (MLC) VACUUM VESSEL ASSEMBLY

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1.0 INTRODUCTION

The Vacuum Vessel Assembly is an essential component required for the first prototype of an ERL Main Linac Cryomodule (MLC). The project includes a single cryomodule consisting of one vacuum vessel which isolates the helium vessel, superconducting cavities, thermal shield, superinsulation, etc., from the atmosphere. The vacuum vessel provides mechanical support to most of the cryomodule's components during normal operation and transportation.

2.0 SCOPE

2.1 PURPOSE

This document describes the requirements necessary to specify, manufacture, and procure the MLC Vacuum Vessel Assembly. Even though the design reflects a built-to-print product, additional requirements are imposed on the manufacturer. Additional (aside from fabrication) responsibilities will include:

2.1.1 Any in-process manufacturing details such as cut sheets and travelers
2.1.2 Sequencing and Parts Control
2.1.3 Quality Assurance
2.1.4 Leak checking
2.1.5 Any special crating or preparation for shipment

2.2 In this text, and in applicable specifications, references such as vendor, seller, manufacturer, subcontractor, fabricator and the like, mean the same thing. We understand this to be the commercial contractor responsible for making and delivering the Vacuum Vessel Assembly. Furthermore, CLASSE and LEPP are different names for the same entity. Herein references to older documents that denote LEPP are still valid and are applicable.

2.3 DELIVERABLES TO CLASSE

Manufacturer shall offer for acceptance a fully fabricated Vacuum Vessel Assembly, including leak check blank-offs, according to this document, associated drawings, and quality control specifications in this document.

2.3.1 One completely fabricated and tested Vacuum Vessel Assembly per the latest revision of LEPP drawing number 7103-153 and 7103-154.
2.3.2 All documentation required in Section 4.2.

2.3.3 All documentation required in Section 4.7.
2.3.4 Quality assurance provisions as stated in section 5.0.

2.4 MANUFACTURER FURNISHED MATERIALS, EQUIPMENT, AND SERVICES

2.4.1 Manufacturer to provide all materials necessary to fabricate complete deliverables. There will be no material provided by CLASSE.

2.4.2 Manufacturer shall provide manufacturing engineering services required to generate internal shop drawings and all documentation needed to manage and support their suppliers. This will include all technical and commercial supervision required in order for CLASSE to receive an assembly that meets all requirements and specifications.

2.4.3 Manufacturer shall provide all labor to assemble, test, and supervise the manufacture of all components regardless of where these are made: within the manufacturer's plant or in a second facility or sub-contractor.

2.4.4 Manufacturer will provide all facilities, tools, fixtures, and consumables necessary to fabricate and test the Vacuum Vessel Assembly.

3.0 REFERENCES

The following baseline drawings, design specifications, and procedures are required technical documents and shall be used by vendor to manufacture and test Vacuum Vessel Assembly.

3.1 The latest revision of CLASSE Drawing 7103-153 "ERL Linac Cryomodule Vacuum Vessel" and 7103-154 "ERL Linac Cryomodule Vacuum Vessel for Leak Check"
3.2 ASTM Standards for materials as called out on the applicable drawings.
3.3 Technical datasheets for interior primer and interior paint finishing.
3.4 Cornell University Terms and Conditions document dated 10/1/2012.

4.0 REQUIREMENTS

4.1 GENERAL DESCRIPTION

The majority of the material of the vacuum vessel is carbon steel (A516 GR70) with the flanges that use O-ring seals made of stainless steel 304L and rails made of stainless steel 304L. The vacuum vessel is approximately 30 feet long and 38 inches in diameter. The vessel has ports for support posts, input RF power couplers, tuner access, instrumentation, gate valve actuator, vacuum pump-out, and safety relief. Final precision machining on port flange sealing surfaces, supports, and alignment survey holes is required. The interior of the vacuum vessel shall be bead or sand blasted to remove all rust and foreign material after final leak checking and prior to paint finishing. All parts must be degreased with soap and water, followed by a thorough DI water rinse, before any welding.

The interior will also be painted with low vapor pressure vacuum compatible epoxy. The carbon steel portions ONLY of the vacuum vessel exterior shall be thoroughly cleaned/burnished and painted with an agreed upon marine paint product. The SS portions of the vacuum vessel exterior shall be solvent cleaned only, no painting is permitted. Both interior and exterior paints must have good adhesion to the metal surfaces, and must be solvent resistant. Vendor must submit a proposal for the interior and exterior cleaning process and for the finish paint for Cornell approval. (See attached PDF technical datasheets for interior primer and interior paint finishing recommendations.)

All painting MUST be done after the assembly has passed final leak checking (see section 4.4). If part of painting needs to be applied prior to welding and leak checking, proper and approved masking MUST be used 1” from weld seams and weld preps. The interior rail system must be masked off prior to any interior painting.

4.2 DIMENSIONAL CONFORMANCE

The CLASSE drawings, 7103-153 and 7103-154, and all drawings referenced shall be used by the manufacturer for configuration control and dimensional conformance. Dimensional variances and overall envelope configuration shall be maintained within specified tolerances.

DRAWING NUMBER TABLE

7103-153 Sh. 1 (rev -)	ERL Linac Cryomodule – Vacuum Vessel Assembly
7103-153 Sh. 2 (rev -)	Vacuum vessel cylinder; end flanges; stiffening rings
7103-153 Sh. 3 (rev -)	Slip flange; port parts
7103-153 Sh. 4 (rev -)	Port parts
7103-153 Sh. 5 (rev -)	Support parts
7103-153 Sh. 6 (rev -)	Rail support parts

7103-153 Sh. 7 (rev -)	Welding of rail supports
7103-153 Sh. 8 (rev -)	Welding of end flanges
7103-153 Sh. 9 (rev -)	Welding of support patches & feet
7103-153 Sh. 10 (rev -)	Drilling of port holes
7103-153 Sh. 11 (rev -)	Welding of side ports
7103-153 Sh. 12 (rev -)	Welding of stiffening rings and brackets
7103-153 Sh. 13 (rev -)	Finish machining
7103-153 Sh. 14 (rev -)	Finish machining of end flanges
7103-153 Sh. 15 (rev -)	Rail installation details
7103-154 Sh. 1 (rev -)	ERL Linac Cryomodule – Vacuum Vessel Leak Check Assembly
7103-154 Sh. 2 (rev -)	Beam entrance blank sub assembly
7103-154 Sh. 3 (rev -)	Beam entrance blank end flange details
7103-154 Sh. 4 (rev -)	Beam entrance blank port flanges
7103-154 Sh. 5 (rev -)	Beam exit blank sub assembly
7103-154 Sh. 6 (rev -)	Beam exit blank end flange details
7103-154 Sh. 7 (rev -)	Beam exit blank end cryo line flange and misc blank flanges

A full 3D design model with all components which are part of this request for proposal can be downloaded from the following:

http://www.lepp.cornell.edu/~draft/MLC_Vac_Vessel/

The ERL Main Linac Cryomodule Vacuum Vessel Assembly is available in Autodesk Inventor 2013 file format and alternatively in STEP format.

Autodesk Inventor users should:

- Unzip and then open the desired component file, the 3D model and 2D production drawing, if available, will be in the Inventor workspace.

- As long as the directory structure is not modified, all library parts and references will resolve.

STEP file translation users should:

- Open the component file "*.stp" in your CAD program. The assembly constraints formed in Inventor will be lost but the parts/assemblies are in place. Be aware that without the constraints THESE PARTS CAN MOVE

AND CHANGE RELATIONSHIPS if they are dragged around within the assembly file. Your CAD program should create the necessary part and sub-assembly files as it is translating the 3D data from the STEP file.

- The 2D production drawing for the component, if available, will be posted in the same directory as a *.pdf file.

A full set of drawings, including the 2D production drawings, will be available at the time the contract is awarded.

The drawings supplied as part of this request for proposal are to be considered near-final release. Minor modifications will be done by Cornell during the RFP open period, and a final set of drawings will be given to the vendor at the time a contract is awarded.

Unless stated otherwise in this technical specification, the US system of units (inches, pounds, etc.) shall be used for all standard hardware. This includes the use of standard US nut/bolt sizes, flange sizes, tubing sizes, etc. Cornell shall be consulted if adherence to the US system is impractical in certain instances and Cornell shall make the final decision in writing if another system can be used.

4.3 PRECISION MACHINING

The three top flanges serve as the supporting surfaces of a three ton cold-mass, thus a reference for the alignment of the beam-line string with a strict allowable tolerance. Precision aligned rails would ensure the cold-mass rolls into the vessel smoothly. Fine surface finishing and flatness on O-ring seals would ensure a high vacuum seal on the flanges. Throughout the process of assembling and installation of the cryomodule, the references on the vacuum vessel end flanges and survey fiducials will be used in multiple stages. It is important to have a single machine tool setup of precision machining on all reference features, as indicated in the drawings, at the final stage after all welding is done. The center-line datums used in the manufacturing drawings are defined by the end flanges bore-to bore center line axis. For machining lubricant, use only alkaline detergent lubricant CIMSTAR 40 or equivalent approved by Cornell CLASSE.

4.4 LEAK CHECKING

All ports/openings that have welded piping/tubing connections to the vacuum vessel shall be leak checked with a calibrated Helium Mass Spectrometer Leak

Detector (HMSLD). Manufacturer shall provide recorded evidence in the form of independent reports or line items in the manufacturing travelers that clearly state the date, time, and conditions of these tests. A final integral leak check must be done by bagging and filling with He gas of the entire vacuum vessel for an agreed upon time period, or at least by bagging all welded seams. Cornell representative will witness the final leak check. The acceptable leak rate of the final integral leak check should be equal or below $1x10^{-8}$ mbar·liter/sec.

4.5 INSPECTION

Visual inspection shall show that the Vacuum Vessel Assembly is structurally sound and free of scale, cracks, splits, gaps, inclusion porosity or any defect which could be considered a source of structural failure.

4.6 WELDING

4.6.1 Manufacturer shall ensure that no entrapped gases, fluxes, pits, cracks, or like imperfections are left in the heat affected zones. All edges shall be rounded and burrs removed from all seams, joints and welded areas.

4.6.2 Post cleaning of welds with a wire brush only is acceptable (prior to final leak checking) and required to leave the surface in a bright finish condition with no trace of solvent residue. The manufacturer shall identify the cleaning process used to remove the residue as part of the bid package.

4.7 MANUFACTURING ENGINEERING

4.7.1 Manufacturer shall fabricate jigs and simple fixtures to ensure flange faces, pipe fittings, brackets and other important components are maintained to specified tolerances.

4.7.2 CLASSE component parts are detailed to the nominal and assembled material conditions. It is the responsibility of manufacturer to allow for fitting and welding tolerances by adjusting said drawings to their manufacturing style.

4.7.3 Manufacturer is required to generate shop travelers and sequencing documentation to assemble the Vacuum Vessel Assembly.

4.8 MATERIAL

The material used in the fabrication of the Vacuum Vessel Assembly shall conform to the specifications in associated drawings. It is the responsibility of the manufacturer to ensure that ALL material used is traced to the stated specification.

4.9 DOCUMENTATION

4.9.1 A project specific Quality Assurance Plan (QAP), as stated in Section 5.1, must be provided within 4 weeks of contract award. In addition, said plan shall be maintained during the term of the contract.

4.9.2 Certified Mill Test Reports (CMTR) of all raw materials used to fabricate deliverables shall be provided to CLASSE upon Vacuum Vessel Assembly delivery. These material certifications shall include all processes and tests with grade and composition being clearly identifiable.

4.9.3 Copies of all travelers shall be provided to CLASSE with delivery.

4.9.4 Copies of all inspection and test reports shall be provided to CLASSE with delivery.

4.9.5 A production timeline that meets our delivery schedule for fabrication, starting from time of award running through FOB shall be provided as part of the bid package. Following CLASSE approval of timeline and contract award, it is the responsibility of the contactor to comply with and meet dates specified in approved timeline.

4.10 CLEANLINESS REQUIREMENTS

Surfaces must be cleaned and protected at all stages of fabrication such that dust, oils and other contaminates are removed prior to final assembly and preparation for delivery to CLASSE.

4.10.1 Manufacturer shall follow cleaning and handling procedures prescribed in Section 4.1 above. Manufacturer may propose alternative cleaning methods as part of the bid process.

4.10.2 The Vacuum Vessel Assembly shall be cleaned to a bright metal condition by using grit-less abrasive pads, or CLASSE approved equivalent. No solvents, waxes, oils, or protective coatings shall be placed (or left) on this surface prior to paint finishing. After final leak checking, the Vacuum Vessel Assembly with be finished with an agreed upon painting of both interior and exterior surface. The interior rail system must be masked off prior to any interior painting. This Vacuum Vessel Assembly will be used in a moderate vacuum service.

4.10.3 For machining lubricant, use only alkaline detergent lubricant CIMSTAR 40- or equivalent approved by Cornell CLASSE.

5.0 QUALITY ASSURANCE

5.1 The Seller shall prepare a project specific Quality Assurance Plan for CLASSE's approval and shall furnish such documentation as CLASSE may require. The Seller shall conduct quality control procedures and tests, which will guarantee that the product to be furnished by the Seller hereunder is in full conformance with these specifications.

5.2 INSPECTION

The completed Main Linac Cryomodule Vacuum Vessel Assembly per CLASSE drawing 7103-153 (to include flanges and fixtures for leak checking found in 7103-154) shall be made available for inspection before, during, or after final leak checking. The assembly shall be offered to CLASSE for inspection at the manufacturer's facility. Advanced notice of two weeks shall be provided to CLASSE for travel arrangements.

5.2.1 After inspection, the Main Linac Cryomodule Vacuum Vessel Assembly shall be prepared for crating and shipment to CLASSE.

5.2.2 CLASSE may choose to perform the Main Linac Cryomodule Vacuum Vessel Assembly inspection on Cornell University campus in Ithaca, NY.

5.3 The manufacturer shall maintain records of all inspections and tests. This information shall be made available for inspection to any CLASSE technical representative.

5.4 ACCEPTANCE

5.4.1 The shipment of the Vacuum Vessel Assembly shall be offered to CLASSE for inspection at the manufacturer's facility as stated in Section 5.2 above. Advanced notice of two weeks shall be provided to CLASSE's technical representative for travel arrangements.

5.4.2 After inspection, the MLC Vacuum Vessel Assembly shall be prepared for crating and shipment to CLASSE.

5.4.3 The assembly will be inspected again and tested at CLASSE prior to final acceptance.

5.4.4 CLASSE reserves the right to have its technical or procurement representatives witness any or all manufacturing steps, tests, and inspections established under the manufacturer's quality assurance program to demonstrate compliance with this specification. Any information of a proprietary nature must be identified in the bid response.

5.4.5 CLASSE representatives shall have unannounced visitation access to the manufacturer's plant and personnel during normal operation hours in order to conduct Quality Assurance Audits.

6.0 **SUBMITTALS**

The following table lists all submittals that the Seller shall supply to the Buyer:

No.	Sections(s)	Description	When required	Approval	CVI*
1	4.4	Leak Checking reports	Prior to delivery	Required	Yes
2	5.1	Project specific QAP	Within 4 weeks of contract award	Required	
3	4.9.2	CMTRs	With delivery	-	Yes
4	4.7.3	Travelers	With delivery	-	Yes
5	4.7 & 5.3	Inspection/test reports	With delivery	Required	Yes
6	4.9.5	Production timeline	Part of bid package	Required	-

*Certified Vendor Information (CVI)

For submittals that require Buyer's approvals, Vendor shall wait for the approval notices to continue fabrication activities.

7.0 PREPARATION FOR SHIPMENT

7.1 The Seller shall ship the specified equipment properly packed, to ensure that damage is not incurred during shipment, in accordance with transportation industry standards.

7.2 Assembly packaging shall be such that no damage is incurred during transit. This shall include weather protection and the closure of all open pipes with test plugs or removable caps. Sizing shall be such that handling is facilitated and weight limitations imposed by the transportation industry can readily be met.

7.3 All deliverables including documentation shall be catalogued and offered for acceptance to CLASSE at the time of Vacuum Vessel Assembly delivery. Documentation must accompany the products such that CLASSE receiving personnel clearly understand the contents and can match delivery to a purchase order.

7.4 Any internal component that may be subject to dynamic (road) damage shall be blocked, internally braced or temporarily supported. These shall be easily removed by simple hand tools.

7.5 A packing list of loose items shall be included in any kits required.

8.0 ORDERING INFORMATION

8.1 Please submit a proposal in triplicate no later than four (4) business weeks after receipt of RFP in accordance with Cornell Technical Specification TIO-01 dated January 11, 2013 and referenced sketches and drawings therein.

8.2 Your proposal must show prices in U.S. dollars for the following:

- Any required design and/or tooling.
- The construction of a single Vacuum Vessel Assembly including leak check flanges and fixtures for testing/transportation and mechanical/vacuum testing.
- A budgetary quote for 65 production units of the MLC Vacuum Vessel Assembly.

Prices are to be firm for the life of any order placed.

8.3 Prices to be FOB Cornell University freight prepaid and absorbed by vendor. U.S. duty, if applicable, will be paid by Cornell University.

8.4 Payment shall be due upon acceptance of the Vacuum Vessel Assembly after verification of compliance with the Technical Specification TIO-01 by Cornell and receipt of a properly executed invoice, payable Net 30 days.

8.5 A detailed project schedule must be submitted with your proposal which specifies the completion dates of the various steps of the proposed design, engineering, construction/assembly and testing stages. Cornell requests delivery of the Vacuum Vessel Assembly no later than December 2, 2013. An earlier delivery date is desirable and will increase the likelihood of an award of order (all other criteria being equal).

8.6 Cornell may terminate performance of the forthcoming order in whole or in part, if Cornell determines that termination is in Cornell's interests. Cornell shall terminate the order by delivering to the vendor a notice of termination specifying the extent of termination and the effective date. Cornell will be responsible only to pay for those studies, engineering calculations, materials, and fabrication costs, etc. actually completed or in progress with no additional cancellation fees. The total amount to be paid by Cornell will be based on: (a) Unit prices if stated in the order and if the unit is completed, or (b) if work is in progress but the unit is not completed, the actual costs will be multiplied by a factor (to be specified by the offeror in the proposal) to cover overhead and profit. This factor is not to be greater than that normally charged others for similar work under similar circumstances.

8.7 Clearly indicate any exceptions to our technical specifications and ordering information in your proposal.

8.8 Cornell welcomes suggestions for performance improvements or cost reductions; these shall not be considered as proprietary. Any such suggestions should be clearly defined for Cornell's evaluation.

8.9 All proposals must contain adequate technical information as required by the specifications for evaluation by Cornell and offerors must be willing to further discuss the technical details of their proposal before the award of an order. Cornell reserves the right to reject all offers.

8.10 Discuss the overall project management and organization. Include names of key personnel and the percentage of their time this project will represent.

8.11 All major portions of the work to be subcontracted must be clearly stated in the proposal along with the name and address of the subcontractor. No major portions of the work not stated in the original proposal may be subcontracted without the prior written approval of Cornell.

8.12 Cornell reserves the right to visit the vendor's facilities prior to award of order and during actual performance of the work. Cornell also welcomes vendor visits to present status reports.

Cornell reserves the right to base its selection of vendor on its appraisal of the best combination of technical merit, cost, vendor's facilities, capabilities, delivery schedule, and assurances. Cornell reserves the right to reject any proposals.

8.13 Included with this request for proposal are the Cornell University Terms and Conditions updated 10/1/2012 as they appear on the Cornell University purchase order which will govern the purchase.

8.14 The vendor shall define a warranty for the Cornell University Vacuum Vessel Assembly as part of their proposal. This warranty shall include warranty on workmanship and mechanical/vacuum integrity. These warranty provisions will be incorporated in any future contract(s) between the University and the vendor for the purchase of additional vacuum vessels.

8.15 If you are unable to submit a proposal on this project, please respond with no bid, giving reason for no bid.

8.16 Technical questions concerning the requirements should be directed to Tim O'Connell (Manager Technical Services) at (607) 255-1567 or tio1@cornell.edu.

8.17 Proposals are to be prepared in triplicate and submitted to Melinda Sweazey, Purchasing Agent, Cornell University, Procurement Services Department, 395 Pine Tree Road, Suite 330 Ithaca, NY 14850 by 2:00 pm (EST) on February 21, 2013 as well as submitting a quote via Procurex, Cornell's bid system, by date indicated. All prices to be firm for the life of any order placed.

8.18 Please acknowledge your receipt of this request for proposal and indicate a contact person. If you know that you will not be offering a proposal on the project at this time, please so indicate.