# Design Build: Nine Vacuum Sections, Slits, and Monochromator Mechanism for The Variable Line Spacing Plane Grating Monochromator (VLS-PGM) Beamline

## 6.8.80.2 Rev.0

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# 1.0 INTRODUCTION

## 1.1 PURPOSE

This document specifies the requirements for 9 beamline vacuum sections that house a monochromator, slits, switchyard mirror, and refocusing mirrors to be designed in detail, constructed, and installed on the floor at the Canadian Light Source (CLS). These components will be part of the variable line spacing plane grating monochromator (VLS-PGM) beamline.

## 1.2 SCOPE

The VLS-PGM beamline as specified by the user community requires high resolution and flux combined with a reasonably small beam size at the sample. This specification details the requirements for the detailed design, fabrication, supply, and installation of 8 beamline vacuum sections, a plane grating monochromator, entrance and exit slits, switchyard mirror, and refocusing mirrors. This specification includes but is not limited to:

-detailed design of all specified sections
-1 entrance and 2 exit slits
-1 plane grating monochromator chamber including all movement mechanisms
-all required mounts and cooling systems for the mirrors and gratings
-required optical tables and beamline support structures
-required beam pipes and vacuum chambers
-vacuum quality testing
-delivery and installation at CLS
-installation of completed optics into chambers
-quality assurance and safety
-this specification does NOT include any mirrors and/or gratings

## 1.3 BACKGROUND

The Canadian Light Source is a national facility under construction at the University of Saskatchewan campus in Saskatoon, Saskatchewan. This facility is a third generation synchrotron light source that will produce a high intensity source of infrared, visible, ultraviolet, and x-ray radiation. Based upon the needs of the Canadian synchrotron community, a low energy (5-250 eV) plane grating monochromator beamline is being constructed with a goal of being ready for operation when the facility is declared operational in early 2004.

# 2.0 DEFINING SECTIONS REFERRED TO IN THE SPECIFICATION

## 2.1 REFERENCE DOCUMENTS AND TABLES

Refer to the following supplied documents and drawings to aid in the definition of each section requiring design and construction. Please note that these supplied documents and tables also list components not covered in this specification. The specification covers specifically, the entrance slit, monochromator chamber (not including all M3 mirrors and gratings), plane switchyard mirror chamber, exit slits, and refocusing mirror chambers. All components upstream of the entrance slit and all mirrors and gratings are not included in this specification.

a) Ruben Reininger, "Technical Preliminary Design Report For the Variable Line Spacing-Plane Grating Monochromator (VLS-PGM) Beamline for the Canadian Light Source, July 16, 2001. [1].
b) Table 1:Optical components and design parameters of the beamline. Units are in mm and degree. Positions are relative to the center of the insertion device. Rotations are relative to previous element (SHADOW nomenclature) [2].
c) Concept drawing of standard substrate shape including base steps/ledges for mating substrates to mirror mounts [3].

## 2.2 SECTION #1 – ENTRANCE SLIT

This section refers to the vacuum chambers found between the upstream end of the entrance slit mechanism and a pneumatic gate valve on the downstream end that separates this section from Section #2. A pneumatic gate valve at the upstream end of this section is not included in this specification

## 2.3 SECTION #2 – ENTRANCE SLIT/MONOCHROMATOR BEAM TRANSPORT

This section refers to a vacuum section used as beam transport between Section #1 and Section #3. This section is bounded on either end by a pneumatic gate valve.

## 2.4 SECTION #3 –MONOCHROMATOR

This section refers to the vacuum chamber that will contain all the M3 mirrors and gratings, as well as the movement mechanism for the plane grating monochromator. This section is bounded on either end by a pneumatic gate valve.

## 2.5 SECTION #4 – M4 SWITCHYARD MIRROR

This section refers to the vacuum chamber that contains the retractable plane switchyard mirror that allows the beam to be sent down one of two parallel endstation lines. This section is bounded by a single pneumatic gate valve upstream, and two pneumatic gate valves downstream.

## 2.6 SECTION #5 – EXIT SLIT A (EXS)

This section refers to the vacuum chamber housing one of two exit slits. This section is bounded upon either end by a pneumatic gate valve.

## 2.7 SECTION #6 – EXIT SLIT B (EXS2)

See Section #5 above for general description. This section is the exit slit utilized with the switchyard mirror is in the beam.

### 2.8 SECTION #7 – REFOCUSING MIRROR A (M5)

This section refers to the vacuum chamber housing one of refocusing mirrors. This section is bounded on either end by a pneumatic gate valve.

### 2.9 SECTION #8 – REFOCUSING MIRROR B (M6)

See Section #7 above for general description. This section is the refocusing mirror utilized when the switchyard mirror is in the beam.

### 2.10 SECTION #9 – DIAGNOSTIC CHAMBERS

These sections are found between the refocusing mirrors and the endstation focal positions.

## 3.0 GLOBAL REQUIREMENTS

3.1 All sections shall be capable of sustaining ultra-high vacuum (UHV) conditions. All factory vacuum test results for each section, performed with CLS supplied ion pumps and ion pump controllers, shall be submitted to the CLS for approval prior to section shipment. These tests shall demonstrate a base pressure of better than $1 * 10^{-9}$ torr after bake out for chambers containing no optics, and pressures of better than $2 * 10^{-10}$ torr for chambers that shall house slits, mirrors, or gratings. RGA tests should show that the sum of the partial pressures of gases having a mass >46 AMU does not exceed $10^{-11}$ torr in all chambers.

3.2 All sections of the design are to be separated by UHV pneumatic gate valves of VAT manufacture with metal bonnet seal and viton seal and the valve designed to fail in the closed position. These valves should also have 24 V DC solenoids, have visual position indicators and manual overrides.

3.3 All sections defined by pneumatic gate valves shall contain at least one CLS supplied ion pump (no dead spaces with regards to pumping), a port for a CLS supplied ion gauge, and a manual UHV all-metal valve for the attachment of a turbo-molecular roughing pump with a KF adaptor on the valve. The KF adaptor shall be equipped with a blank that can be removed for pumping.

3.4 All flanges shall be of Conflat™. Diameters of flanges along the line shall be designed to be as standardized as possible.

3.5 To aid in diagnostics and alignment, a design is required such that at the front end of mirror mounts for M4, M5 and M6 along the direction of the beam are found an electrically isolated blade that will register a current if the beam is misaligned on the upstream end of that particular mirror. All optics tables should also be designed and constructed to contain external fiducial markers for the alignment and placement of these components upon the floor at CLS. The position of these markers relative to the optical pole of any given chamber (i.e. the center of any given optic when inserted into the beam), shall be specified to an accuracy of 250 microns or better.

3.6 Designs shall be made under the assumption that all ion pumps and controllers are to be of Varian manufacture.

3.7 The proponent shall determine an appropriate ion pump capacity based upon standard Varian ion pumps for each section. These pumps and controllers shall be acquired by CLS for installation. Vacuum pressure distribution calculations and graphs shall be provided to the CLS. Short model Starcell type Varian pumps are preferred.

3.8 In the design, there should be no direct line of sight from any pump to an optical surface.

3.9 The preferred method of movement of all mirrors is via movement of the support table as opposed to internal motorization with the exception of the movement mechanism for the M3 mirrors and the gratings in the mono. chamber which is a special case. Mounting of optics via attachment to the mirror tank is preferred to mounting of mirrors via flanges.

3.10 The proponent shall determine the appropriate capacity of each stepper motor. Choice of motor shall conform to CLS stepper motor and stepper motor control policy [4] as much as possible. CLS shall either acquire the appropriate motors and deliver them for installation or shall authorize the proponent to acquire the motors themselves. Motor controllers and software drivers will also be supplied by the CLS.

3.11 Provisions for ion gauges shall be included in the design. However, CLS shall acquire the appropriate number of ion gauges and deliver them for installation. CLS shall also supply ion gauge controllers and cabling.

3.12 Large chambers and components requiring accurate placement upon the floor shall be designed such that their support structures bolt to the floor via Hilti studs where nuts above and below the flange allow adjustment of the height and tilt of the columns. In addition, a nominal 1.75 inch space between the column and floor is filled with epoxy grout for stability after everything is aligned. (DWG No. 100-104629) [5].

3.13 Lighter areas containing beam pipes and ion pumps that also require support may be mounted with smaller columns that bolt via Hilti studs but do not require the epoxy grout layer.

3.14 Finite element analysis (FEA) is being performed on the M3 mirrors as well as the plane gratings. This analysis has been completed by Instrument Design Technology Ltd., and must be incorporated into the detailed design of the mounts and cooling for these components.

3.15 In the case of all components requiring water-cooling. Direct water to vacuum joints will not be used in the design. An example of appropriate design would be to have water carried by Teflon tubing that is inside of a UHV quality bellows where in the event of a leak, the water would travel through the bellows to be expelled outside of the chamber.

3.16 All mirrors and gratings are NOT included in this specification. All mounts, holders and cooling systems for the mirrors and gratings that will be housed in these sections ARE included in this specification.

3.17 The proponent shall provide technical support for the installation and mounting of the optics fabricated for the sections defined in this specification.

3.18 Distances of certain optics or components from the insertion device as quoted in this specification, are distances quoted along the path of the beam.

3.19 All sections housing slits, mirrors, and/or gratings, shall be designed with viewports for visual examination of the optics.

3.20 In all beam transport sections, the internal diameter of the vacuum pipe shall be approximately 2.5 inches. Flanges and valves shall have an internal diameter of approximately 4 inches.

3.21 All vacuum chambers shall be capable of sustaining 150 $^{o}$C bake-out conditions.

3.22 Machining on the sides of all substrates shall conform to the conceptual diagram for machining required to mate substrate to optical mounts [3]. In each case this machining consists of two steps/ledges, one along each side of the long axis of the substrate at the base. This step shall be 10 mm in height and 10 mm in width.

3.23 All widths/heights of substrates as specified in the document shall refer to the width/height of the optic at the optical surface and NOT the width/height at the base of the substrate where the steps/ledges are found.

3.24 All optic substrates shall be made of this shape with only the length and width of the optical surface varying between substrates. All optical mounts must be designed to accommodate this specific shape of substrate.

# 4.0 SECTION (ENTRANCE SLIT) SPECIFIC REQUIREMENTS

4.1 The beam travels through this section level to the floor at a height of 1.4 meters.

4.2 A pneumatic gate valve for the upstream end of this section is not included in this specification.

4.3 The area between the entrance slit and the downstream pneumatic gate valve should be designed to accommodate an ion pump and ion gauge. An appropriate number of view-ports for visual observation shall be included in the design.

4.4 For purposes of alignment, the position of the entrance slit along the direction of the beam should be adjustable by plus or minus 0.1 meters. The height of the slit shall be adjustable by plus or minus 3 mm. The horizontal position of the slits shall be adjustable by plus or minus 10 mm.

4.5 The slit blades should be adjustable to provide a vertical aperture ranging from 5 to 250 microns.

4.6 The slit blades shall be adjustable manually with the option of modifying them in the future for motorized control.

4.7 The vertical opening resolution should be 1 micron, the repeatability and accuracy better than 2 microns.

4.8 Slit blades shall be parallel to better than 5% of the slits opening.

4.9 Horizontal size of the entrance slit blades should be at least 14 mm.

4.10 The entrance slit blades will require cooling and shall have to withstand a maximum power of ~12 W and a maximum power density of ~160 W/mm$^2$.

4.11 The slit blades should be electrically isolated such that measurement of drain current from the blades shall facilitate beamline alignment.

4.12 The entrance slit is to be placed precisely 20.72 meters from the insertion device (ID) source.

4.13 The design shall include an insertable phosphor screen to be located just upstream of the slit blades and a viewport that allows to see the screen illumination.

## 5.0 SECTION #2 (ENTRANCE SLIT / BEAM TRANSPORT) SPECIFIC REQUIREMENT S

5.1 The beam travels through this section level to the floor at a height of 1.4 meters.

5.2 A pneumatic gate valve for the upstream end of this section is not included in this specification.

5.3 The area between the upstream and downstream pneumatic gate valve should be designed to accommodate an ion pump and ion gauge.

5.4 As many light support columns as deemed necessary shall be used in this section.

## 6.0 SECTION #3 (MONOCHROMATOR) SPECIFIC REQUIREMENTS

6.1 The beam enters this section level to the floor at a height of 1.4 meters. The beam exits this section level to the floor at a height of 1.355 meters.

6.2 The ion pump for this section should be equipped with a titanium sublimation pump (TSP) with no line of sight to optics.

6.3 The monochromator chamber houses three mirrors (M3L, M3M and, M3H) and three variable line-spacing gratings (LEG, MEG, HEG) assembled side by side on a common carriage. The photon beam entering the chamber is deflected by one of the M3 mirrors and subsequently dispersed with the appropriate grating. The design should include a safety system to ensure any mirror cannot be inserted into the beam while another mirror is already in place.

6.4 Motors should be provided to intercept the photon beam any of the mirrors. The reproducibility after reinserting a mirror shall be better than; x: 50 microns, y: 50 microns, z: 5 microns, pitch: 2 micro radians, roll: 50 micro radians, yaw: 50micro radians. Where y is along the outgoing beam, z along the vertical direction, and x perpendicular to the other two.

6.5 Manual mirror adjustments for the M3 mirrors with a resolution better than Pitch: 5 micro radians, Roll: 20 micro radians, Yaw: 20 micro radians, x: 25 microns, y: 25 microns, z: 2 micron, should be provided. y is along the outgoing beam, z along the vertical direction and x perpendicular to the y and z. These adjustments should be decoupled from one another. These adjustments if possible should be able to be performed in vacuum.

6.6 A motor should allow for selection of one of the three gratings. The reproducibility after reinserting a grating should be better than the same numbers and coordinate system quoted for the M3 mirrors above.

6.7 The gratings are operated in the +1 order (inside order). Energy scanning is achieved by rotating the gratings carriage around an axis that passes through the gratings poles. This rotation should be motorized and externally controlled.

6.8 The total grating rotation should be at least 14 degrees. The required resolution step should be better than 0.15 micro radians. The reproducibility in the grating pitch should be better than 0.75 micro radians. At least three rotation speeds should be provided. The slower the rotation speed, the finer the adjustment required.

6.9 A UHV compatible angle encoder (for example the Heidenhain RON905-UHV [6]) should be mounted on the axis of rotation of the gratings carriage with a visual display for the readout of the encoder.

6.10 The water-cooled holders of all mirrors in this section shall be done in accordance with the finite element analysis (FEA) results.

6.11 Grating holders should have manual adjustments with a resolution and coordinate system described for the M3 mirrors with the obvious exception of x and pitch which are handled by the grating-switching and grating rotation mechanisms. These adjustments should be decoupled from one another. It is preferred if a design is made such that these adjustments may be made when this vacuum section is pumped down.

6.12 Viewports must be designed into the chamber to allow visual examination of the optical surfaces and in vacuum adjustments to optical mounts. Viewports should also be positioned such that they may be used to align the optic height, pitch, roll, and yaw. The successful propend in their detailed design shall describe in detail the function of each viewport as well as supply detailed instruction as to how to use these viewports to successfully align the optics in this chamber.

6.13 The chamber mount shall be designed such that adjustment of the hilti studs can be utilized as a method of adjusting, the height, roll, pitch, and yaw of the chamber relative to the beam.

## 6.14 LOW ENERGY MIRROR (M3L) REQUIREMENTS

6.14.1 This mirror center is to be precisely 24.63 meters from the ID source.

6.14.2 The mirror figure shall be spherical.

6.14.3 The grazing angle of incidence for this mirror shall be 15 degrees.

6.14.4 The mirror substrate shall be Si.

6.14.5 The length of this mirror shall be 50 mm.

6.14.6 The width of this mirror shall be 20 mm.

6.14.7 The substrate thickness shall be 40 mm.

6.14.8 The mirror mount shall include water-cooling for the mirror via side contact with OFHC blades with an indium foil or gallium interface.

## 6.15 MEDIUM ENERGY MIRROR (M3M) REQUIREMENTS

6.15.1 This mirror center is to be precisely 24.61 meters from the ID source.

6.15.2 The mirror figure shall be spherical.

6.15.3 The grazing angle of incidence for this mirror shall be 12 degrees.

6.15.4 The mirror substrate shall be Si.

6.15.5 The length of this mirror shall be 55 mm.

6.15.6 The width of this mirror shall be 20 mm.

6.15.7 The substrate thickness shall be 40 mm.

6.15.8 The mirror mount shall include water-cooling for the mirror via side contact with OFHC blades with an indium foil or gallium interface.

## 6.16 HIGH ENERGY MIRROR (M3H) REQUIREMENTS

6.16.1 This mirror center is to be precisely 24.43 meters from the ID source.

6.16.2 The mirror figure shall be spherical.

6.16.3 The grazing angle of incidence for this mirror shall be 4.5 degrees.

6.16.4 The mirror substrate shall be Si.

6.16.5 The length of this mirror shall be 100 mm.

6.16.6 The width of this mirror shall be 20 mm.

6.16.7 The substrate thickness shall be 40 mm.

6.16.8 The mirror mount shall include water-cooling for the mirror via side contact with OFHC blades with an indium foil or gallium interface.

## 6.17 LOW ENERGY GRATING (LEG) REQUIREMENTS

6.17.1 This grating center is to be precisely 24.73 meters from the ID source.

6.17.2 The grating figure shall be planar.

6.17.3 The grating substrate shall be Si.

6.17.4 The length of this grating shall be 96 mm.

6.17.5 The width of this grating shall be 25 mm.

6.17.6 The substrate thickness shall be 40 mm.

## 6.18 MEDIUM ENERGY GRATING (MEG) REQUIREMENTS

6.18.1 This grating center is to be precisely 24.72 meters from the ID source.

6.18.2 The grating figure shall be planar.

6.18.3 The grating substrate shall be Si.

6.18.4 The length of this grating shall be 86 mm.

6.18.5 The width of this grating shall be 25 mm.

6.18.6 The substrate thickness shall be 40 mm.

## 6.19 HIGH ENERGY GRATING (HEG) REQUIREMENTS

6.19.1 This grating center is to be precisely 24.72 meters from the ID source.

6.19.2 The grating figure shall be planar.

6.19.3 The grating substrate shall be Si.

6.19.4 The length of this grating shall be 126 mm.

6.19.5 The height of this grating shall be 25 mm.

6.19.6 The substrate thickness shall be 40 mm.

## 7.0 SECTION #4 (M4 SWITCHYARD MIRROR) SPECIFIC REQUIREMENTS

7.1 The beam travels through this section level to the floor at a height of 1.355 meters.

7.2 Similar to all previous sections, this section should be designed to accommodate an ion pump and an ion gauge. An appropriate number of view-ports for visual observation should also be included in the design.

7.3 The switchyard mirror should have a vertical translation at least 25 mm, to allow for the mirror to be moved in and out of the beam path. Horizontal position of the mirror shall be adjustable by plus or minus five mm. Resolution of the horizontal adjustment shall be 2 microns. Resolution of the pitch adjustment shall be 15 micro radians.

7.4 The reproducibility after reinserting a mirror should be better than Pitch: 50 micro radians, Roll: 100 micro radians, Yaw: 100 micro radians, x: 5 microns, y: 50 microns, z: 100 microns. Where y is along the outgoing beam, z along the vertical direction and x perpendicular to the other two.

7.5 This mirror center is to be precisely 25.72 meters from the ID source.

7.6 The mirror figure shall be planar. The grazing angle of incidence for this mirror shall be 4.5 degrees.

7.7 The mirror substrate shall be zerodur or fused silica.

7.8 The length of this mirror shall be 160 mm.

7.9 The height of this mirror shall be 25 mm.

7.10 The substrate thickness shall be 40 mm.

## 8.0 SECTION #5 (EXIT SLIT A) SPECIFIC REQUIREMENTS

8.1 The beam travels through this section level to the floor at a height of 1.355 meters.

8.2 The section should be designed to accommodate an ion pump and ion gauge.

8.3 For purposes of alignment and focus, the position of the exit slit along the direction of the beam should be adjustable by plus or minus 0.1 meters. The height of the slit shall be adjustable by plus or minus 3 mm. The horizontal position of the slits shall be adjustable by plus or minus 10 mm.

8.4 The slit blades should be adjustable to provide a vertical aperture ranging from 5 to 1000 microns.

8.5 The slit blades shall be adjusted manually.

8.6 The vertical opening resolution should be 1 micron; the repeatability and accuracy better than 2 microns.

8.7 Slit blades shall be parallel to better than 5% of slit's opening.

8.8 Horizontal size of the exit slit blades should be at least 14 mm.

8.9 The slit blades should be electrically isolated such that measurement of drain current from the blades shall facilitate beamline alignment.

8.10 The exit slit is to be placed precisely 28.72 meters from the insertion device (ID) source.

8.11 No cooling is required for this section.

8.12 The design of this section shall include an insertable phosphor screen to be located just upstream of the slit blades and a viewport that allows viewing of the screen illumination.

## 9.0 SECTION #6 (EXIT SLIT B) SPECIFIC REQUIREMENTS

9.1 The beam travels through this section level to the floor at a height of 1.355 meters.

9.2 The section should be designed to accommodate an ion pump and ion gauge.

9.3 For purposes of alignment and focus, the position of the exit slit along the direction of the beam should be adjustable by plus or minus 0.1 meters. The height of the slit shall be adjustable by plus or minus 3 mm. The horizontal position of the slits shall be adjustable by plus or minus 10 mm.

9.4 The slit blades should be adjustable to provide a vertical aperture ranging from 5 to 1000 microns.

9.5 The slit blades shall be manually adjusted.

9.6 The vertical opening resolution should be 1 micron; the repeatability and accuracy better than 2 microns.

9.7 Slit blades shall be parallel to better than 5% of slit's opening.

9.8 Horizontal size of the exit slit blades should be at least 14 mm.

9.9 The slit blades should be electrically isolated such that measurement of drain current from the blades shall facilitate beamline alignment.

9.10 The exit slit is to be placed precisely 28.72 meters from the insertion device (ID) source.

9.11 No cooling is required for this section.

9.12 The design of this section shall include an insertable phosphor screen to be located just upstream of the slit blades and a viewport that allows the viewing of screen illumination.

# 10.0 SECTION #7 (REFOCUSING MIRROR A) SPECIFIC REQUIREMENTS

10.1 The beam travels through this section level to the floor at a height of 1.355 meters.

10.2 Similar to all previous sections, this section should be designed to accommodate an ion pump and an ion gauge. An appropriate number of view-ports for visual observation should be included in the design as well as a metal valve for pump down.

10.3 Motorization of the mirror table should allow for the adjustment of height, pitch, and horizontal position of the mirror.

10.4 Vertical motorization should have a travel range of +- 10 mm adjustable in increments of 10 microns. Horizontal motorizations, should have a travel range of 10 mm adjustable in increments of 1 micron. Resolution of the horizontal adjustment shall be 2 microns. Resolution of the pitch adjustment shall be 15 micro radians.

10.5 This mirror center is to be precisely 30.72 meters from the ID source.

10.6 The mirror figure shall be toroidal. The grazing angle of incidence for this mirror shall be 4 degrees.

10.7 The mirror substrate shall be zerodur or fused silica.

10.9 The length of this mirror shall be 180 mm.

10.10 The height of this mirror shall be 25 mm.

10.11 The substrate thickness shall be 40 mm.

10.12 No cooling for this section is required.

10.13 The design of this section shall include an insertable phosphor screen to be located just upstream of the mirror and a viewport that allows one to see the screen illumination.

# 11.0 SECTION #8 (REFOCUSING MIRROR B) SPECIFIC REQUIREMENTS

11.1 The beam travels through this section level to the floor at a height of 1.355 meters.

11.2 Similar to all previous sections, this section should be designed to accommodate an ion pump and an ion gauge. An appropriate number of view-ports for visual observation should be included in the design as well as a metal valve for pump down.

11.3 Motorization of the mirror table should allow for the adjustment of height, pitch, and horizontal position of the mirror.

11.4 Vertical motorization should have a travel range of +- 10 mm adjustable in increments of 10 microns. Horizontal motorizations, should have a travel range of 10 mm adjustable in increments of 1 micron. Resolution of the horizontal adjustment shall be 2 microns. Resolution of the pitch adjustment shall be 15 micro radians.

11.5 This mirror center is to be precisely 30.22 meters from the ID source.

11.6 The mirror figure shall be toroidal. The grazing angle of incidence for this mirror shall be 4.5 degrees.

11.7 The mirror substrate shall be zerodur or fused silica.

11.8 The length of this mirror shall be 160 mm.

11.9 The height of this mirror shall be 25 mm.

11.10 The substrate thickness shall be 40 mm.

11.11 No cooling for this section is required.

11.12 The design of this section shall include an insertable phosphor screen to be located just upstream of the mirror and a viewport allowing to see the screen illumination.

## 12.0 SECTION #9 (DIAGNOSTIC CHAMBERS) SPECIFIC REQUIREMENTS

12.1 The beam travels through this section level to the floor at a height of 1.355 meters.

12.2 Similar to all previous sections, this section should be designed to accommodate an ion pump and an ion gauge. An appropriate number of view-ports for visual observation should be included in the design as well as a metal valve for pump down.

12.3 These diagnostic chamber sections if possible should not extend closer to the focal point of the endstation areas than 0.8 m.

12.4 Each diagnostic chamber should contain a calibrated silicon photodiode from IRD, a gold mesh for monitoring beamline flux, and a $MgF_2$ of LiF window to block higher order light when using photon energies lower than 10eV.

12.5 The diagnostic chamber downstream of mirror M5 (which has the longer focal distance to the endstation area) should incorporate into its design a differential pumping section capable of sustaining at minimum four orders of magnitude pressure differential with the vacuum upstream of this differential pumping section being of UHV quality. This area should also contain a pair of manual insertable valves, one on either side of the differential pumping section upon which can be mounted windows in the eventuality of users desiring to conduct dirty and/or gas phase experiments in the endstation area downstream of this diagnostic section.

## 13.0 SAFETY, ENVIRONMENTAL, AND RELIABILITY

13.1 The vacuum chambers shall be capable of operation in an ambient temperature range of 10 to 40 degrees C. The normal ambient temperature on the experimental floor is 21 degrees C. The expected temperature stability of the building will be plus or minus 1 degree C during normal operation.

13.2 The components shall be able to withstand a relative humidity range of 0% to 95%. The expected relative humidity limits under operation are from 25% during the winter months and a maximum of 50% during the summer months. The expected relative humidity range for components under storage will be the same as previously mentioned.

13.3 All equipment and structures shall conform to the BKL report “Vibration Isolation Mechanical Equipment”. [7]

# 14.0 QUALITY ASSURANCE AND TESTING

14.1 The proponent shall maintain and apply a quality assurance program compliant with ISO-9001 for the design, manufacture, procurement, testing and installation of all four sections.

14.2 Sections shall be vacuum tested after arrival and installation at CLS for the purposes of remediation of vacuum leaks created during transport. This is in addition to vacuum factory testing done before shipment as stated earlier. Proponent shall verify out gassing and leak rate after installation.

# 15.0 APPLICABLE CODES, STANDARDS, AND PROCEDURES

This work shall meet the following standards. The issue of any standard shall be the issue in effect as of the date of request for tender. Any conflicts between this specification and the referenced documents shall be brought to the attention of the CLS in writing for resolution before any related action is to be taken by the proponent.

American Welding Society (AWS)
American Society for Testing and Material (ASTM)
American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME-BPVC)
American National Standards Institute (ANSI)
International Standards Organization (ISO)
Canadian Light Source Vacuum Component Cleaning Technical Procedure [8]
Canadian Light Source Vacuum Component Leak Test Technical Procedure [9]
Fasteners shall be American standard thread. Proponent may propose metric fasteners if spares are included.

# 16.0 OTHER REQUIREMENTS

16.1 All components of each section shall be completed, delivered, and installed at CLS by September of 2003.

16.2 Packaging to be used during shipping of components shall ensure protection of the components from water, dust, oil, and vibration during shipping. In the case of the mirrors, the packaging should be hermetically sealed.

16.3 Components shall be held securely in the shipping containers to prevent chafing or scratching that could damage the components and / or generate contaminants.

16.4 Vacuum chambers should be shipped pressurized with dry nitrogen gas at a pressure slightly above the highest ambient atmospheric pressure.

16.5 The shipping containers shall be properly labeled in English to ensure proper care during shipment.

16.6 All documentation to the CLS shall be in English and conform to CLS document specification[10].

16.7 Documentation supplied to the CLS shall be provided in hard copy in triplicate plus one electronic copy if available. All drawings shall be supplied in AutoCAD format. All drawings and other documentation should also be appropriately labeled, numbered, and include a revision history.

# 17.0 REFERENCES


1 Ruben Reininger, "Technical Preliminary Design Report For the Variable Line Spacing-Plane Grating Monochromator (VLS-PGM) Beamline for the Canadian Light Source, July 16, 2001. [1].

2 Table 1:Optical components and design parameters of the beamline. Units are in mm and degree. Positions are relative to the center of the insertion device. Rotations are relative to previous element (SHADOW nomenclature) [2].

3 Concept drawing of standard substrate shape including base steps/ledges for mating substrates to mirror mounts.

4 E. Matias, "Control System Technical Specification", 7.4.39.1 Rev. 2

5 McPherson Inc., "Column Mounting Assy.", 100-104629, Nov. 1, 2001.

6 F. Senf et. al., *J. Synchrotron. Rad.*, **5**, 584 (1998).

7 BKL Consultants Ltd "Vibration Isolation Mechanical Equipment". 0395-99A, June 3, 1999.

8 Canadian Light Source Vacuum Component Cleaning Technical Procedure, 8.7.33.1, September 13, 2000.

9 Canadian Light Source Vacuum Component Leak Test Technical Procedure, 8.7.33.2, September 13, 2000.

10 D.S. Lowe. "CLS Document Specification", 0.4.1.1 Rev. 2 14 Dec 2000

## RFP SELECTION CRITERIA

| | | |
|---|---|---|
| a) | Technical<br>-understanding the scope of the work<br>-fabrication, assembly, installation plan<br>-ability to meet minimum functional and performance requirements<br>-performance ability<br>-quality and duration of proposed warranty periods<br>-proposed delivery if different from stated | 35% |
| b) | Cost<br>-proposal pricing<br>-cost saving proposals<br>-value added benefits and incentives<br>-proposed payment structure | 35% |
| c) | Proponent Qualifications<br>-corporation structure and ownership<br>-demonstrated ability to satisfy the University requirements<br>-relevant experience, competence, and reliability in handling similar projects, based upon references<br>-international scientific reputation of company | 20% |
| d) | Economic Benefits and Incentives Program<br>-national, regional, and local benefits | 5% |
| e) | Any other factors the CLS may consider appropriate | 5% |
| | | 100 % |

Note: All bids are to be submitted in Canadian dollars.

## SCOPE OF WORK

The Proponent shall provide all material, labour, equipment, and services required to complete the Work as set out in the RFP. The Work shall be that which is called for in specifications and drawings. The Work shall include but is not limited to the following:

1. Supply and complete the planning, design, and engineering to carry out the Work.

2. Plan and implement the procurement of materials, equipment, and services to carry out the work.

3. Provide and implement a Quality Assurance and Control Program (QA/QC) for the Work. The QA/QC program to include the testing, certifications, and inspections specified within this RFP.

4. Carry out, document, and distribute the results of testing, certifications, and inspections as specified within this RFP.

5. Provide documentation as specified within this RFP.

6. Provide the components specified in this document including all nine beamline sections.

7. Provide all measurement and testing as defined or required to perform the work. Provide copies of all results to the CLS.

8. Provide packaging and transportation of finished product to designated CLS site.

9. Assemble and vacuum test finished product on the experimental floor at CLS.

# PROPOSAL COST SUMMARY FORM

Proponents shall provide their proposal cost summary using the following format in Canadian dollars:

Design Build: Nine Vacuum Sections, Slits, and Monochromator Mechanism for The Variable Line Spacing Plane Grating Monochromator (VLS-PGM) Beamline

| Item# | Description | Quantity | Unit Rate | Total |
|---|---|---|---|---|
| 1 | Detailed design for all 9 sections | 1 | | |
| 2 | Fabrication Section #1 | 1 | | |
| 3 | Fabrication Section #2 | 1 | | |
| 4 | Fabrication Section #3 | 1 | | |
| 5 | Fabrication Section #4 | 1 | | |
| 6 | Fabrication Section #5 | 1 | | |
| 7 | Fabrication Section #6 | 1 | | |
| 8 | Fabrication Section #7 | 1 | | |
| 9 | Fabrication Section #8 | 1 | | |
| 10 | Fabrication Section #9 | 1 | | |
| 11 | Factory Testing | 1 | | |
| 12 | Testing at CLS | 1 | | |
| 13 | Subtotal | | | |
| 14 | PST | | | |
| 15 | GST | | | |
| 16 | Duties | | | |
| 17 | Shipping | | | |
| 18 | Subtotal | | | |
| 19 | Total | | | |

## Special Requirements to be Included in RFP

1. Proponent shall provide examples of previous work that demonstrates the proponent's capacity to fabricate beamline components with similar performance to the components specified in this document.

2. Provide names and phone numbers of two references to whom the proponent has supplied synchrotron beamline components to that may be contacted by the CLS.

3. Proponent shall provide a list of any exceptions or alterations to statements, parameters, and tolerances in this document and attached drawings.

4. CLS reserves the right to visit the proponent's facility before awarding a contract.

5. CLS reserves the right to inspect components and facilities during fabrication.

6. The proponent shall propose a schedule with the following milestones:

   -start
   -completion of detailed design of optic holders, mounts, and cooling
   -completion of total detailed design
   -completion of vacuum chambers
   -completion of support structures
   -factory vacuum tests
   -shipment to CLS
   -assembly vacuum tests at CLS

The proponent shall also propose a schedule of site visits by representatives of the CLS. It is suggested that these visits occur at approximately the following milestones:

-factory vacuum tests
-just before shipment to the CLS