1. GENERAL CONSIDERATIONS

1.a. **Function.** This mirror will be used in a Plane Grating Monochromator (PGM) for the new undulator beamline currently under construction at the Synchrotron Radiation Center.

1.b. **Scope of Work.** The vendor shall provide all of the materials, fixtures, and labor required to fabricate the mirror specified in this document.

2. OPTICAL SURFACE

2.a. The optical surface is 67 x 20 mm (L x W).

2.b. The optical surface shall be coated with a (hard) carbon film 30 nanometer thick.

2.c. RMS slope error on the optical surface shall be less than or equal to 0.2 arcsec along the length of the mirror and less than or equal to 0.5 arcsec along the width of the mirror.

2.d. RMS surface micro-roughness on the optical surface shall be less than or equal to 0.5 nanometer.

2.e. The requirements on slope error and surface micro-roughness apply to the coated optical element over the entire optical surface.

2.f. The slope error and surface micro-roughness shall be measured prior to delivery. The bidder shall describe in his bid submittal the measuring technique that he intends to use to verify these parameters. The results of these measurements shall be sent to SRC along with the mirror.

3. INTERNAL WATER COOLING

3.a. The blank shall have internal channels for water cooling.

3.b. A secondary pumpable interspace shall be provided between the water cooling channels and the UHV environment (ie., air guard, guard vacuum).
3.c. Active cooling shall be provided to dissipate a total of 16.5 Watts with a power density distribution (in Watt/mm²) given by:

\[ q = 0.024 e^{-0.2525^2} e^{-0.2800^2} \]

3.c.1. where the power distribution q is confined to a portion of the optical surface,

3.c.2. where the point x=0 and y=0 is defined on SRC drawing 4975C006,

3.c.3. where q is evaluated from y= -30 to +30 and from x= -8.3 to +8.3,

3.c.4. where x and y are in mm,

3.c.5. and where y is along the length of the mirror.

3.d. The cooling channel geometry and required coolant flow rate shall be designed to limit heat load induced slope error at the optical surface to less than or equal to 0.2 arcsec along the length of the mirror and less than or equal to 0.5 arcsec along the width of the mirror. This heat load induce slope error is an additional allowance beyond the RMS slope error described in section 2.c.

3.e. The required flow rate shall not exceed 2 gallons per minute.

3.f. The pressure drop from inlet to outlet corresponding to the required flow rate shall not exceed 15 psi.

3.g. The coolant flow velocity shall not exceed 20 feet per second.

4. MIRROR BLANK, VACUUM AND WATER CONNECTIONS

4.a. The blank material shall be silicon carbide, monocristalline silicon or nickel coated Glidcop.

4.b. The nominal blank size will be 78 x 35 x 30 mm (L x W x H).

4.c. The 67 x 20 mm optical surface will be positioned on the 78 x 35 mm face as shown on SRC Drawing 4975C006. Note: The optical surface is not symmetric along the length of the mirror.

4.d. The face containing the optical surface shall have a chamfered end on one side as shown on SRC drawing 4975C006.

4.e. The inlet and outlet water connections will attach to the bottom of the blank as shown on SRC drawing 4975C006.

4.e.1. The water connections will be made via ¼ inch stainless steel tube and stainless steel SWAGELOK to tube weld union fittings. The SWAGELOK fittings shall be attached
permanently to the mirror.

4.e.2. Both water connections shall be contained inside a single pumpable secondary interspace formed by a 1.0 inch o.d. tube and a 2.75 inch conflat flange.

4.f. Unless otherwise shown all dimensions have a tolerance of ± 0.4 mm.

4.g. All non-optical surfaces must be ground to within 0.025 mm (TIR).

5. DESIGN AND ANALYSIS

5.a. A complete set of detail and assembly drawings shall be provided to SRC for review prior to fabrication. The outside dimensions and placement of fittings on the mirror shall be consistent with SRC drawing 4975C003 and section 4.

5.b. Finite element analyses shall be performed prior to fabrication to estimate the optical surface distortion of the mirror due to the absorbed power described in section 3.c. The calculated surface distortion shall be consistent with section 3.d. Results of the analysis shall be provided to SRC for review prior to fabrication.

6. FABRICATION

6.a. This mirror will be used in a UHV environment and must comply with the applicable sections of SRC Technical Note # 99.

7. VACUUM LEAK CHECKING & HYDROSTATIC PRESSURE TESTING

7.a. The vendor shall vacuum leak check the mirror assembly with helium. The leak rate shall not exceed 2x10^{-10} std atm cc/sec He. Separate leak check paths must be used to identify leaks:

7.a.1. from the water cooling channels and associated fittings to the secondary pumpable interspace (i.e., air guard, guard vacuum) and

7.a.2. from the secondary pumpable interspace to the UHV (external) environment.

7.b. The vendor shall hydrostatically pressure test the water circuit to 150 psi. Water must not leak into the secondary pumpable interspace. The vendor shall repeat the vacuum leak check described in section 7.a. after performing the hydrostatic test.

8. SHIPPING

8.a. All handling of the mirror after final cleaning and coating must be compatible with standard clean room practices.
8.b. Talcum powder free clean room gloves must be used when handling the mirror.
8.c. Oil, finger prints, dust and other contaminants must be kept off of the mirror.
8.d. Hermetically sealed packaging shall be used during shipping to protect the mirror from dust and contamination.
8.e. The mirror shall be held securely in its shipping container to prevent chafing that could damage the mirror and/or generate contaminating particles.

9. SUBMITTALS

9.a. Bidders must submit with their quotation the following information:

9.a.1. Examples of previous work on mirrors with internal water cooling which demonstrate the bidder's capability to perform the operations (such as analysis, fabrication, measurement) required to produce the mirror specified in this document.

9.a.2. Name and phone number of two references. Bidder must have supplied mirrors with internal water cooling to said references. References may be contacted by SRC.

9.a.3. Any exceptions or variations to statements, dimensions, tolerances in this document or SRC drawing 4975C006.

10. SPECIAL CONDITIONS

10.a. SRC reserves the right to visit the bidders facility before awarding a contract.

10.b. SRC reserves the right to inspect the mirror during fabrication.