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Ref. No. FORM FOR INVITING QUOTATIONS

Date: 6.8.2012
DUE DATE: 3.9.2012

CEC	12-13	005	BEEEX	HODX	LMS	1
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To

Dear Sirs,

1. Quotations are invited in duplicate for the various items shown in the attached File.
2. The Quotations are to be in two bid system as : Technical bid and Commercial bid. Two parts of the offer are to be clearly marked on the envelopes. The two parts of the offer in a separate envelop must enclosed in the one bigger envelop duly sealed and superscribed with reference number and due date and, should be addressed to the undersigned so as to reach him on or before the due date stipulated above. A blank price quote (identical to the Commercial bid with numbers removed) should be enclosed with the Technical Part.
3. The Quotations should be valid for sixty days from the due date and the period of delivery required should also be clearly indicated.
4. If the item is under DGS&D Rate contract No. and the price must be mentioned. It may also please be indicated whether the supply can be made direct to us at the Rate contract price (Please note that we are not Direct Demanding Officers). If so please send copy of the RC.
5. Relevant literature pertaining to the items quoted with full specifications (and drawing, if any) should be sent along with the Quotations, wherever applicable. Samples if called for, should be submitted free of charges, and collected back at the supplier's expenses.
6. Local Firms : Quotations should be for free delivery to this Institute. If Quotations for Ex-Godown delivery charges should be indicated separately.
7. Firms Outside Madras : Quotations should be for CIF/F.O.R. Madras. If CIF/F.O.R. consignor station, freight charges by passenger train / lorry transport must be indicated. If Ex-Godown, packing, forwarding and freight charges must be indicated.
8. The rate of sales / General Taxes and the percentage of such other taxes legally leviable and intended to be claimed should be distinctly shown along with the price quoted. Where this is not done, no claim for Sales / General Taxes will be admitted at any stage and on any ground whatsoever. The taxes leviable should take into consideration that we are entitled to have concessional Sales Tax applicable to non Government Educational Institutions run with no profit motive for which a concession. Sales Tax Certificate will be issued at the time of final settlement of the bill.
9. Goods should be supplied carriage paid and insured.
10. Goods shall not be supplied without an official supply order.
11. Payment : Every attempt will be made to make payment within 30 days from the date of receipt of bill/acceptance of goods, whichever is later.

Yours faithfully,

Head of the Dept/Centre

**CENTRAL ELECTRONICS CENTRE
INDIAN INSTITUTE OF TECHNOLOGY MADRAS
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Specifications

Spectral Light Measurement system Compliant with IS 16106:2012 and IESNA-LM-79 Standards

Scope: The integrating sphere based spectral Light measurement system must be capable of measuring a variety of light sources including;

- LED sourced systems such as LED Luminaires, LED arrays & LED packages
- Architectural lighting
- General lighting
- Fluorescent Tubes
- CFLs
- High Intensity Discharge Lamps
- Indicator Lamps
- Miniature Lamps

The system must be capable of measuring Light source parameters including;

- Total Spectral Flux (W/nm)
- Total Radiant Flux (W)
- Total Luminous Flux (lumens)
- Color (CCT)
- Color Rendering Index (CRI)
- Chromaticity co-ordinates including **Chrom x, Chrom y, Chrom u,Chrom v, Chrom u' & Chrom v'**
- Color Ellipses and color tolerance Quadrangles
- Lamp Performance vs. Time
- Peak Wavelength, Center Wavelength, Centroid Wavelength and Dominant Wavelength

- Spectral Purity
- Full width half max

Key system requirements:

- System must comply with IS 16106:2012 and IESNA-LM-79 for testing of LED and LED based products
- System must comply with CIE-84 for flux measurement of all other traditional light sources
- The system calibration must comply with ISO 17025 (either spectral flux calibration lamp must comply with ISO 17025 or system must be calibrated by ISO 17025 certified laboratory)
- The manufacturer of system must have a ISO quality system in place and must provide a proof for that. ISO Certificates for at least last two years from recognized body, certifying that the manufacturer has been diligently following quality protocols, should be produced by the system manufacturer to qualify.

System Components: The spectral light measurement system must be supplied with the following components:

- 1) Light measurement integrating sphere: The proposed integrating sphere should be designed per **IS 16106:2012, IESNA-79 & CIE 84 recommendations**, and must be capable of performing **total flux (4π) and forward flux (2π)** measurements for the devices. The integrating sphere must meet following specifications:
 - i. Sphere nominal diameter shall be 2m.
 - ii. Sphere Coating:
 - a. The sphere shall be coated with high-reflectance diffuse white coating.
 - b. The sphere coating must have **effective spectral range from 300 nm to 2400 nm** or greater.
 - c. Spectral reflectance of the coating must be greater than **97 % in the visible part of the spectrum (400 nm to 800 nm)**.

- d. Coating should be **functional up to 100 °C**
- e. The sphere supplier must present reflectance data for the coating with the proposal. The reported reflectance data must be traceable to the national laboratories such as NIST, PTB or NPL
- f. As a proof of reliability for the coating, the supplier must provide reference for at least three customers who have successfully used their integrating sphere for at least five years without any deterioration in coating performance or need for recoating of the sphere. If no such references can be produced, the supplier must supply equivalent measurement data for coating reflectance as a function of ageing.
- iii. The sphere must have capability of measuring the light sources by mounting it inside the sphere (**4π geometry**) or coupling light from outside port (**2π geometry**).
- iv. For convenience of mounting device under test inside the sphere, the integrating sphere must be mounted on robust rails to allow the non stationed hemisphere to be rolled open for interior access.
- v. Each hemisphere should be mounted to a separate carriage, allowing the sphere to be easily opened and closed to change lamps or perform a measurement, when measuring total flux of sources by mounting them inside.
- vi. The diameter of the port on the sphere for 2π measurement shall be 60 cm. The port should have mechanical arrangement to mount adapters on it. Capability of reducing port diameter is also required.
- vii. The sphere must be designed such that ability to mount two independent detectors on the sphere exists. The detectors must have near cosine response.
- viii. The sphere must also have a port for mounting temperature sensor to monitor temperature inside the sphere.
- ix. Provision for mounting Auxiliary correction lamp on 2.5 cm port should also be provided

- x. A lamp mounting bracket designed to accept a variety of sockets for single contact and double contact lamps is also required
- xi. The sphere must be capable of accepting lamps with maximum length up to 130 cm.
- xii. The sphere must also have capability to measure lamps either in base-up or base-down positions.

2) *Spectral flux calibration lamp standard*: The system must be included with a lamp standard for **total spectral and total luminous flux**. The lamp should be selected for their stability and reproducibility. The standard should be carefully screened, seasoned, and calibrated under the **guidelines recommended by the IESNA (Illuminating Engineering Society) or equivalent authority** and calibrated to the highest degree of accuracy.

- i. Calibration range: Spectral flux standard should be traceable to certified National lab such as NIST, PTB, NPL etc and should be calibrated in the range of 350 nm to 1050 nm or greater. The calibration lamp must be certified by ISO 17025 certified laboratories.
- ii. The calibration lamp should have a luminous flux value of > 1350 Lumens and should be calibrated for total spectral flux
- iii. The calibration lamp shall be supplied with a signed calibration certificate reporting the traceability to NIST and estimated uncertainty values. Detailed calculations of the uncertainty budget should also be reported on the calibration certificate.
- iv. **The uncertainty for total luminous flux of the lamp must not exceed $\pm 1\%$** . The calibration uncertainty for CCT must be less than 7K.
- v. The operating current for lamp should be <3A and the rated lamp life shall be greater than 1000hrs.

- vi. The nominal CCT for the calibration lamp shall be 3000 K and the lamp should be Tungsten halogen based as specified by IS and IESNA standards
- vii. Miniature Screw Lamp Socket Assembly shall also be supplied with the system
- viii. The system supplier must present a typical calibration certificate for the proposed spectral flux standard when submitting the complete proposal. The calibration certificate must contain:
 - i. Proof of traceability to a certified standard laboratory
 - ii. Detailed calibration procedure
 - iii. Relative uncertainty for total luminous flux
 - iv. Wavelength range of the calibration
 - v. CCT of the calibration lamp

3) Calibration lamp power supply: The supplier should also include a preset constant current power supply to operate the calibration lamp. The lamp power supplies' technical specifications should meet the following requirements:

- i. Current Accuracy: +/- 0.1%
- ii. Current Stability: +/- 0.1%
- iii. Regulated output current: Lamp operating current +/- 0.1%
- iv. Current Rise Time: For extending the life and performance of the calibration lamp the current to the lamp should ramp up slowly. The current rise time must be 20 +/- 5 seconds
- v. Temperature Coefficient: +/-0.1%/ °C at 25°C ± -50°C
- vi. Storage Temperature and Humidity: -20°C to 70°C, 10% to 95 %RH
- vii. Operating Temperature and Humidity: 15°C to 40°C, 30% to 90 %RH
- viii. Should have remote control capability

- ix. Power Requirements: 220 V \pm 5 %, 50Hz AC
- x. Timers and display: Power supply must have a timer to track lamp operation time and display the lamp hours
- xi. Should have compliance as per CE
- xii. Valid calibration certificate must be provided

4) TE cooled CCD array spectrometer: System must include CCD array

Spectrometers with multi-channel spectral analyzers designed for real-time spectral characterization. The spectrometer must meet following technical requirements:

- i. Wavelength accuracy of \pm 0.4nm or better. Spectrometer should be calibrated for wavelength accuracy and calibration report should be supplied
- ii. The base design should be Crossed Czerny-Turner spectrograph or equivalent, with a top of the line electrically-cooled, back-thinned illuminated CCD detector.
- iii. Spectrometer must include an **integrated shutter for real-time dark correction**.
- iv. CCD array: Binned detector array with exceptional signal processing speed and improved efficiency in the UV and Shortwave NIR
- v. Detector TE Cooled: 1044 x 64 CCD (back thinned) or better
- vi. Spectral Range: 350nm to 1050 nm
- vii. Resolution: 1.5 FWHM
- viii. Integration Time: 10 ms to 60 s (with software auto exposure), capability to set exposure time in the range eight milliseconds to three minutes.

- ix. Wavelength Accuracy: Less than or equal to ± 0.4 nm (a calibration cert displaying spectrometer wavelength accuracy supplied with the system)
- x. Stray Light Broadband: $<10^{-4}$ at 400 nm w/ Illuminance source
- xi. Stray Light LED/laser: $<10^{-5}$ at 500nm w/633 nm laser
- xii. Focal Length: 100 mm
- xiii. Should include adapter for proper interface with the sphere
- xiv. Speed: 0.1 scans /second
- xv. Dynamic Range (single scan): 30000:1 or better
- xvi. Spectral Sample Interval: 0.25 nm
- xvii. Mechanical Shutter (controlled by software for real time dark correction)
- xviii. AD Converter: 16 bit
- xix. PC Interface: USB
- xx. Pixel size: $24.576 \mu\text{m}^2$
- xxi. Pixel well depth: 1000 Ke-
- xxii. Cooling: $10^\circ\text{C} \pm 0.05^\circ\text{C}$
- xxiii. TE Temp Drift: $\pm 1^\circ\text{C}$
- xxiv. Linearity: $\pm 0.5 \%$
- xxv. Sensitivity: 65 counts for 1000 e-
- xxvi. Quantum efficiency: 90 % peak; 65 % at 250 nm

5) System control software: An intuitive platform for calibrating and analyzing spectral radiometric, photometric and colorimetric properties of light sources must be part of the system. The software must also enable user to calibrate their system in-house using spectral flux standard.

The software must be capable of performing complete characterization of the light sources including:

- i. Total spectral flux (W/nm)
- ii. Total radiant flux (W)
- iii. Total luminous flux (lumens)
- iv. Spectral intensity (W/sr nm)
- v. Averaged luminous intensity (lumens/sr)
- vi. Averaged radiant intensity (W/sr)
- vii. Spectral irradiance (Watts/cm² nm)
- viii. Irradiance (Watts/cm² nm)
- ix. Illuminance
- x. Dominant wavelength
- xi. Spectral purity
- xii. Correlated color temperature
- xiii. Peak wavelength
- xiv. Color rendering index (CRI)
- xv. Chromaticity coordinates
- xvi. Correlated color temperature
- xvii. Spatial distribution
- xviii. Electrical, thermal
- xix. Temporal (W/s, lm/s, CCT/s...)

General requirements:

- The supplier must provide a complete system including instruction manuals, cables and any miscellaneous components along with the components mentioned above
- The system must be upgradable for enabling thermal testing of LEDs
- The quote must include the cost of installation and in house training.