

Guidelines for formulation of Specification for Dual Head SPECT (CT) Gamma Camera

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General:

Latest technology Dual Headed variable angle SPECT (CT) Gamma Camera system capable of performing all planar, SPECT, WB SPECT and Whole Body imaging applications with CT based transmission attenuation correction and functional anatomical image fusion.

- Dual Head variable angle SPECT (CT)
- SPECT & Whole body imaging capabilities.
- CT based attenuation correction.
- CT image acquisition and fusion with nuclear medicine image.
- Image fusion software & hardware.
- Features of CT should include other conventional features of required hardware and software.
- Capable of acquiring multi slices SPECT/CT scan.
- DICOM ready system alongwith stand alone image compliant PC (latest version with optimal processor speed) (minimum 80 GB hard disc), supported with complete networking. For this purpose the supplier would be required to supply a minimum six image compliant PC's equipped with necessary software e.g. reporting and analysis terminals to enable access and analysis of the patient images from different locations of the department. Dicom compliance statement/certification should be provided.
- Manufacturer to provide a comprehensive list of users of dual head SPECT gamma camera in India and their performance profile
- **Number of installations & company profile:** Company should preferably be manufacturer of the equipment and in case non-manufacturing vendors (third party supplier) are allowed to participate the same should be mentioned clearly in bid document. In case of third party supplier the liabilities of principal

manufacturing company and third party supplier needs to be clearly demarcated and ensured

Gantry:

- Gantry design should be wide open to avoid claustrophobic imaging with clockwise and anticlockwise movement.
- Height, width and depth should be adequate to conveniently locate the gantry in existing space available in the department. In order to access this, manufacturer are required to mention the dimensions.
- Axis of rotation: 100-104 cm.
- Distance between SPECT & CT field of view: 80 cm or more.
- Patient opening for high energy collimator (HE): Max 66 cm and Minimum: 12cm.
- Patient opening for low energy high resolution (LEHR) collimators: Max: 70 cm; Minimum: 19 cm.
- Auto contouring: The detectors should be equipped with automatic body counteracting (ABC) both for 90° & 180° SPECT with an average auto contour distance of 1.1 cm.
- LCD persistence display unit
- Max CW/CCW: 365°/180°
- Rotation precision: 0.1°
- Rotation speed: 0.03-3.0 rpm
- Centre of rotation (COR): ≤ 0.25 pixel in 64x64 matrix
- Gantry should have emergency stop buttons.
- Persistence scope mounted on the gantry for continuous display of patient position and gantry parameters

Detectors:

Dimensions:

- Large field of view (UFOV) to enable adequate patient breadth coverage
- Should have facility for automatic correction for energy, linearity and uniformity
- Integrated CT hardware option for transmission attenuation correction and lesion localization for all applications

Crystal:

- Size: 40-60 X 40-50 cm or more
- Diagonal: 45-70 cm or more
- Thickness: According to the requirement.

Photomultiplier Tubes:

- Number of PMTs: 55 or more per detector with 1 ADC per PMT (True digital detector)
- Hexagonal array with box type dynodes and high overall efficiency.

Shielding characteristics of Detector:

- Back: 9.5 mm
- Sides: 12.7 mm
- Patient Direction: Max – 36.4 mm; Min – 27.9 mm.
- Edge to edge: Detector housing and FOV – 7.6 mm.

Intrinsic Spatial Resolution:

- FWHM in CFOV: ≤ 4 mm
- FWHM in UFOV: ≤ 4 mm
- FWTM in CFOV: ≤ 8 mm

- FWTM in UFOV: ≤ 8 mm

Intrinsic Energy Resolution:

- FWHM in UFOV: ≤ 10 %

Intrinsic Flood Field Uniformity:

- Differential (CFOV): ≤ 2.5 %
- Differential (UFOV): ≤ 2.7 %
- Integral (CFOV): ≤ 3.0 %
- Integral (UFOV): ≤ 4.0 %

System Spatial Resolution (LEHR at 10 cm):

- FWTM in CFOV: 7.8 mm
- FWTM in UFOV: 14 mm

Intrinsic Spatial Linearity:

- Differential (CFOV): ≤ 0.2 mm
- Differential (UFOV): ≤ 0.2 mm
- Absolute (CFOV): ≤ 1 mm
- Absolute (UFOV): ≤ 1 mm
- Multiple window spatial registration: ≤ 1.0 mm
- Intrinsic maximum count rate: 310 kcps
- Intrinsic spatial resolution at 75 kcps

FWTM (CFOV): ≤ 4.6 mm

FWTM (UFOV): ≤ 9 mm

- System Planar sensitivity (LEHR at 10 cm)

Absolute: 150-200 cpm / μ Ci or more

- System planar sensitivity (MEGP at 10 cm)

140- 400 cpm / μ Ci or more

- Reconstructed spatial resolution with scatter (LEHR): ≤ 12.00 mm

Collimator Specification:

- Following collimators along with collimator exchange cart for each set of collimators based on requirements
 1. Low Energy High Resolution (LEHR)
 2. Low Energy Ultra High Resolution (LEUHR)
 3. Medium Energy General Purpose (MEGP)
 4. High Energy General Purpose (HEGP)
 5. Pin hole

CT sub system specifications:

Tube Details: Following parameters should be specified by the buyer based on requirements (non-diagnostic / diagnostic CT)

- Tube current: mA
- Tube Voltage: kV
- Heat storage capacity: MHU
- Anode heat storage capacity: MHU
- Focal spot size: mm
- Rotational time: Second.

- Temporal resolution with heart view CT option: micro Second
- Single continuous spiral scan time: Seconds
- Power generator: kW

Filter Assembly:

- Al-Equivalent: mm
- Beam limiting device: mm

Acquisition System:

- No. of rows of detector: Mentioned according to requirement
- Maximum no. of slice per rotation: Mentioned the slice no per rotation

Gantry Aperture:

- Patient part diameter/ aperture: 70 cm or more
- Scan field: 50 cm

Data Sequencing:

- Manufacturer are desired to furnish complete details of the data sequencing including reconstructed slice widths, full scan times (360°), partial scan time (240°), no. of uninterrupted scans per range, auto range, standard scan cycle time, dynamic scan cycle time etc. In addition manufacturer would also be required to provide details of multislice spiral image reconstruction slice, specifically with reference to reconstructed slice widths, slice increment length and reconstructions time, topogram length and possible views.

Image Quality:

Low contrast resolution:

- Object size: mm
- Contrast: HU

- Surface dose: 20 mGy Air Kerma or less at 100 mAS; 16 mGy Air Kerma or less at 90 mAS using parameters such as 0.6 second, 10 mm and 130 KV (**for Diagnostic CT**)

High Contrast Resolution:

- 0% MTF: 1p/cm
- 2% MTF: 1p/cm

Homogeneity:

- Cross field uniformity in a water phantom:
- Dose (CTDI₁₀₀ volume):

Phantom	110 kv	130 kv
16 cm		
32 cm		

Image Display:

- Range of slice thickness: mm
- Scan field size: cm
- Reconstruction field size: cm
- Reconstruction matrix:
- Houns-field scale:

Patient Bed specifications:

- Length: cm
- Width: cm
- Height: cm
- Range of vertical motion: cm

- Pallet material:
- Pallet thickness: mm
- Pallet width (SPECT):
- Attenuation at 140 keV: less than 10%
- Maximum weight bearing capacity: kg
- Maximum deflection of patient pallet: mm
- Scan length in Whole body mode: cm
- Horizontal range: cm with an accuracy of 0.5 mm
- Adjustable head holder for brain scan, butterfly arms support including cardiac arm support, leg support, cushion pad and wide straps for decreasing breast attenuation for optimized cardiac SPECT studies.
- Pediatric & scinti-mammography pallets.
- Separate pallet for imaging to enable radiotherapy planning.
- ECG Trigger to be provided with two sets of spare leads.

Acquisition Unit:

- One acquisition station independent of main processing unit capable of data acquisition in static, dynamic, multi-gated, list, whole body scanning, SPECT and gated SPECT with facility for anatomical markers
- Acquisition consol should allow universal networking via DICOM ready to both local and wide area networks
- Display of the alpha numerical patient acquisition data
- High performance Intel duo core PC with multi tasking operating system having minimum of 2 GB RAM, 3.0 GHz processor speed, 200 GB SCSI hard drive and high resolution flat panel LCD monitor of minimum of 19" size. It should also have CD and DVD combo drive with writer facility.

- Fully integrated CT system capable of acquiring X –ray transmission data along with nuclear emission data. SPECT & CT data acquisition should be on the same console. The CT should have multislice capability with minimum 4 or more slices in a single rotation
- Image acquisition and data display should be from 64x64 matrix up to 256x1024 matrix. Acquisition termination by preset time, preset count or manual stop
- Pre-defined acquisition protocols as well as facility for user to configure his own customized protocols
- Should provide ECG gating device with R wave display
- Virtual film sheet with image manipulation.
- The acquisition workstation should be DICOM ready to permit-
 - (i). Exchange of images and other informations
 - (ii). Communication with other manufacturer's equipments/work stations.
 - (iii).Workflow with hospital information system and other radiological information systems.
 - (iv). Coverage for access controls of patient multiple data CD writers.
 - (v). Maximum intensity projections, multiplanar reconstructions, various display format in routine use.
 - (vi).Image fusion volume rendered CT data fused with SPECT data in a single image frame with 3 x 3 display.

Processing & Software workstations: Following softwares may be asked for based on the requirements and choice of non-diagnostic or diagnostic CT.

- High performance intel duo core PC with multi-tasking workstation with full DICOM ready with image transfer print etc
- Minimum of 2 GB RAM, 3.0 GHz processor speed and 200 GB SCSI hard drive logically divided in to 3-4 partitions
- Minimum 21 inch high resolution LCD monitor

- 3.5” FDD and standard DVD & CD combo drive for data archiving and retrieving with write facility for both.
- The computer is to be connected via a DICOM network for processing and storage of the data to the already existing processing and acquisition computers and documentation devices
- Broad band remote diagnostic facility to be provided
- The software, apart from other state of the art applications, should also provide following applications
 - (i). Real time display of volume data set and enable automatic quantification of stenosis and evaluation of aneurysms.
 - (ii). Clinical processing software and comprehensive protocols for wide spectrum of SPECT, SPECT (CT).
 - (iii) SPECT reconstruction, automatic cardiac processing, motion correction, whole body and whole body SPECT. The software should also encompass organ specific protocols for kidneys, lungs heart, thyroid, parathyroid, brain gall bladder, liver, osteology, oncology etc.
 - (iv). 2D & 3D volumetric visualization and quantification for assessment Of myocardial viability and perfusion and correlation with angiography.
 - (v). Quantitative evaluation and display of 2D/3D gated as well as non-gated myocardial perfusion.
 - (vi). Standard package of CT software including those for angiography (Cardiac and renal) applications and other navigation applications.
 - (vii).Provide QGS/QPS tool box with 2D/3D display and review of wall motion myocardial perfusion analysis.
 - (viii).Should provide evaluation of CT images, coronary calcification (calcium scoring), display of dynamic CT data.
- Apart from inbuilt SPECT/CT software for fusion, separate software for fusion of imported CT and MRI data with SPECT is also to be provided
- Software for various scatter corrections and filters, standard attenuation correction with CT data , patient motion correction etc

- Various clinical application softwares including SISCOM, SEGAMI, NEUROGAM on NEURO MATCH and SPM2 etc.

QC Utilities: Choice to be made based on equipment choice and level of QC and experimentation / research likely to be performed.

- Ba-133 point source and Co-57 point source
- Fillable flood phantom for rectangular field of the size adequate for the gamma camera to be supplied.
- Co-57 flood source of at least 15 mCi strength (on the day of the delivery to the institute) for rectangular field of the size adequate for the gamma camera to be supplied
- CT quality assurance phantom for contrast resolution, radiation safety, image uniformity and pixel noise etc.
- QC software (CT) for verifying alignment of the table position between SPECT and CT acquisition
- SPECT phantoms, point sources, CT phantom & KV/mA meter etc to permit comprehensive quality assurance program both for SPECT & CT
- Four Quadrant BAR phantom for rectangular detector size compatible with the detector systems size of the camera to be supplied
- Intrinsic and System resolution phantom
- System count rate performance phantom
- Brain phantom and liver slice phantom having cold and/or hot lesions of various sizes
- QC software package (NEMA NU2-2007 or latest protocol) with documentation

Accessories: As per requirements. It is preferable to specify the make of the accessory.

- High resolution table top dry laser film processor for 8" x 10" and 14"x 17" (CT size) x-ray films.
- Photo quality laser color printer
- Future up gradation of the software or new developments shall be required to be done by the vendor free of charge from time to time.
- Clinical programming language for user programming
- Video imager with networking (optional)
- Tread mill with 12 lead ECG display and processing and a hard copy out put device
- Infusion pump with 5 to 50 ml range syringe capacity
- Radioisotope calibrator for beta and gamma activity measurement (specify make)
- Survey meters for monitoring gamma radiation. (specify make)
- Pocket dosimeters (specify make)
- Syringe carrier and holders
- System to be supplied with online digital UPS of reputed make of appropriate capacity providing 30 minutes backup with maintenance free batteries. (please specify if the back up is required for whole SPECT-CT or computer only)
- One TLC Analyzer with computer and printer.
- Two lead lined Fume hoods with appropriate exhaust system, Airfoil, Air Baffle and Adjustable Slots, Sliding Sash, Bypass Slots, Exhaust Duct and Damper sinks etc for radioactivity handling (GMP Model).
- Auto dispenser for radiopharmaceuticals.
- One Horizontal hood Laminar flow bench with HEPA filter: 4 feet length and 16 gauge stainless steel, 304, 316L also custom quoted (GMP model).
- Two lead lined L-Benches

- Interlocking lead bricks-150 nos.
- Cutie Pie for Gamma detection.(specify make)
- Two lead Aprons.
- Additional flat table top with complete hardware and software for radiotherapy planning

Others: As per requirements

- Comprehensive warranty of ---- years. Warranty of the equipment shall include crystal, CT tube and all accessories (Thyroid uptake, Well counter, Isotope calibrator, Gun monitor, Survey monitor, Pocket dosimeter, Laser printers etc) as well as leads, wires, electronic consumables, third party items to be supplied by vendor.
- CAMC (Comprehensive Annual Maintenance Contract) for a minimum of ---- years to be quoted separately (CAMC would include all kinds of spares that might be required for insuring 95% uptime of the equipment CAMC shall also include the crystal, CT tube and accessories such as Thyroid uptake, Well counter, Isotope calibrator, Gun monitor, Survey monitor, Pocket dosimeter, Laser printers etc and other items as mentioned above.
- Minors modifications in the walls, floors and other areas of the room to permit adequate shielding particularly for CT associated radiation safety requirement. Thickness of the walls/doors to insure safe radiation levels in the working areas around the Gamma Camera room.
- Training slots----weeks duration at an advanced centre national /abroad.
- On site application training in phases to technical and clinical staff initially and also on as and when required basis.
- A fully trained local resident engineer to be posted to ensure optimal uptime and effective and prompt maintenance services subsequent to satisfactory installation.
- The vendor would have to submit their offer as buy back of the existing gamma camera on “as is where in basis” which can be inspected during on any working day. The value to be offered for buy back bids would be required to quote separately by the manufacturer.

- The acceptance of the installation shall be subject to satisfactory handing over of the system to the department and certificate to this effect to be issued by the institute.
- All the operating and service manuals in duplicates to be provided by the vendor at the time of handing over the machine.