# GAMMA CAMERA and DATA PROCESSOR SYSTEM

# TENDER QUESTIONNAIRE – PART E Dedicated PET and PET/CT Systems

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## Contents

## The System

Please identify the PET scanner system make and model to which the following specification applies. Include details of any separate processing workstation and any other options that are required in order to meet the stated performance.

| | |
|---|---|
| Manufacturer | |
| PET scanner model | |
| CT option model | |
| Data acquisition system model | |
| Acquisition software version | |
| Processing system model | |
| Processing software version | |
| Other options required | |

## PET Scanner and accessories

### 1. Detector performance

Please state the performance parameters of the PET scanner as determined according to the methods specified by the National Electrical Manufacturers' Standards Publication NU2-2001. Separate results should be reported for the scanner operated in 2D mode and in 3D mode.

### 1.1 Performance in 2D mode

| | | |
|---|---|---|
| i) | What is the **spatial resolution** of a point source placed at a position **on the central axis** of the detector? Give figures for FWHM and FWTM of a reconstructed tomographic image.<br>a) FWHM in the tangential direction(mm)<br>b) FWHM in the radial direction (mm)<br>c) FWHM in the axial direction (mm)<br>d) FWTM in the tangential direction(mm)<br>e) FWTM in the radial direction (mm)<br>f) FWTM in the axial direction (mm) | |
| ii) | What is the **spatial resolution** of a point source placed at a position **10cm from the central axis** of the detector? Give figures for FWHM and FWTM of a reconstructed tomographic image.<br>a) FWHM in the tangential direction(mm)<br>b) FWHM in the radial direction (mm)<br>c) FWHM in the axial direction (mm)<br>d) FWTM in the tangential direction(mm)<br>e) FWTM in the radial direction (mm)<br>f) FWTM in the axial direction (mm) | |
| iii) | What is the **scatter fraction** (%)? | |
| iv) | What is the **count rate capability**?<br>a) Peak singles count rate (kcps)<br>b) Activity at which peak singles rate occurs (MBq)<br>c) Peak coincidence count rate (kcps)<br>d) Activity at which peak coincidence rate occurs (MBq)<br>e) Activity at which 50% dead time loss in coincidence counts occurs (MBq) | |
| v) | What is the **Noise Equivalent Count rate** (kcps)? | |

| | | |
|---|---|---|
| | f) Peak NEC (kcps)<br>g) Activity at which peak NEC is achieved (MBq) | |
| vi) | What is the **system sensitivity** (cps/Bq/ml) ? | |

### 1.2 Performance in 3D Mode

| | | |
|---|---|---|
| i) | What is the **spatial resolution** of a point source placed at a position **on the central axis** of the detector? Give figures for FWHM and FWTM of a reconstructed tomographic image.<br>a) FWHM in the tangential direction(mm)<br>b) FWHM in the radial direction (mm)<br>c) FWHM in the axial direction (mm)<br>d) FWTM in the tangential direction(mm)<br>e) FWTM in the radial direction (mm)<br>f) FWTM in the axial direction (mm) | |
| ii) | What is the **spatial resolution** of a point source placed at a position **10cm from the central axis** of the detector? Give figures for FWHM and FWTM of a reconstructed tomographic image.<br>a) FWHM in the tangential direction(mm)<br>b) FWHM in the radial direction (mm)<br>c) FWHM in the axial direction (mm)<br>d) FWTM in the tangential direction(mm)<br>e) FWTM in the radial direction (mm)<br>f) FWTM in the axial direction (mm) | |
| iii) | What is the **scatter fraction** (%)? | |
| iv) | What is the **count rate capability**?<br>a) Peak singles count rate (kcps)<br>b) Activity at which peak singles rate occurs (MBq)<br>c) Peak coincidence count rate (kcps)<br>d) Activity at which peak coincidence rate occurs (MBq)<br>e) Activity at which 50% dead time loss in coincidence counts occurs (MBq) | |
| v) | What is the **Noise Equivalent Count rate** (kcps)?<br>a) Peak NEC (kcps)<br>b) Activity at which peak NEC is achieved (MBq) | |

| | | |
|---|---|---|
| vi) | What is the **system sensitivity** (cps/Bq/ml) ? | |

**2. General**

| | | |
|---|---|---|
| i) | Specify the overall size of the PET scanner system, excluding any CT option:<br>a) Overall height (cm)<br>b) Overall length (cm)<br>c) Overall width (cm)<br>Please also supply a scale diagram showing the layout of the system in a typical room. | |
| ii) | Specify the overall weight of the system, excluding any CT option (kg) | |
| iii) | Specify electrical requirements of the system, excluding any CT option:<br>d) Single or 3 phase supply<br>e) Voltage<br>f) Power | |
| iv) | Specify cooling requirements, excluding any CT option (kW) | |
| v) | Specify reconstructed transaxial field of view (cm) | |
| vi) | Specify physical axial field of view (cm) | |
| vii) | Specify size of the patient aperture<br>g) Diameter (cm)<br>h) Length (cm) | |
| viii) | Specify details of front end shielding | |
| ix) | Identify back end shielding | |
| x) | Are there internal alignment laser lights? | |
| xi) | Specify separate processing and storage units | |

**3. Gantry detector parameters**

| | | |
|---|---|---|
| i) | Specify the type of crystal used eg BGO, LSO, GSO | |
| ii) | Specify the size of crystal elements<br>a) X (mm)<br>b) Y (mm) | |

| | | |
|---|---|---|
| | c) Depth (mm) | |
| iii) | Specify the number of crystals | |
| iv) | Specify the number of photomultiplier tubes (if applicable to the geometry) | |
| v) | Specify the geometric arrangement of the detectors (diagram) | |
| vi) | Specify the number of rings of detectors (if applicable to the geometry) | |
| vii) | Specify the method of achieving positional information | |

**4. Detection parameters**

| | | |
|---|---|---|
| i) | Specify the number of energy windows | |
| ii) | Specify the coincidence time window size (nS)<br>Is this a user definable parameter? | |
| Iii_ | Specify the number of time window channels<br><br>Is this a user definable parameter ? | |

**5. Modes of acquisition**

| | | |
|---|---|---|
| i) | Is the system capable of acquiring data in 2D mode?<br>If 'yes' can the system perform : -<br>a) Static scans<br>b) Whole body scans<br>c) Dynamic scans (single bed position)<br>d) Dynamic scans (multiple bed positions)<br>e) Respiratory gated scans<br>f) Cardiac gated scans | |
| ii) | Is the system capable of acquiring data in 3D mode?<br>If yes can the system perform : -<br>a) Static scans<br>b) Whole body scans | |

| | | |
|---|---|---|
| | c) Dynamic scans (single bed position)<br>d) Dynamic scans (multiple bed positions)<br>e) Respiratory gated scans<br>f) Cardiac gated scans | |
| iii) | If the system is capable of acquiring gated scans then specify the number of simultaneous gating signals available | |

**6. Imaging table**

| | | |
|---|---|---|
| i) | Specify the type of imaging table supplied | |
| ii) | For the imaging table, specify:<br>a) Dimensions of the table (cm x cm)<br>b) Minimum height (cm)<br>c) Maximum height (cm)<br>d) Maximum weight loading (kg) | |
| iii) | Is a patient head support (suitable for brain studies) available?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |
| iii) | Are patient arm rests (to support patient arms at their sides) available?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |
| iv) | Are patient restraint/immobilisation devices available?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |
| v) | Give brief details regarding any such patient restraint or immobilisation devices | |
| vi) | Is there an attachment for drip stands? | |
| vii) | Specify if any other patient-connected equipment can be attached to the imaging table | |
| viii) | Specify any further patient positioning aids that are available | |
| ix) | Specify table movement modes available | |
| x) | Specify table movement controls available | |
| xi) | Does the whole body imaging system require:<br>a) Tracking rails | |

| | | |
|---|---|---|
| | b) Attachment points to the floor | |
| xii) | Are any such rails or attachment points fitted flush with the floor surface? | |
| xiii) | Are there any areas on the imaging table reinforced with high gamma-ray attenuation materials? | |
| xiv) | If the answer to question 2.6.14 is yes, are these areas visibly delineated to the operator?<br>Provide details of any such areas, preferably by diagram or labelled photograph | |
| xv) | Is the imaging table motorised? | |
| xvi) | How long does it take to rise from the lowest to the highest table position? | |
| xvii) | What is the minimum force (Newtons) required to move the table in any horizontal position when the table is holding a 100kg patient | |
| xviii) | Is a flat top table available?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |
| xix) | Is an indexed flat top available for radiotherapy planning applications?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |
| xx) | Does the system provide an interface to record and control a radiotherapy positioning laser system for CT simulation applications?<br>a) At no extra cost<br>b) As an extra cost option (ECO) | |

## PET emission data acquisition

### 1. Acquisition parameters in 2D mode

| | | |
|---|---|---|
| i) | Typical activity injected for whole body FDG scan (MBq) | |
| ii) | Number of slice overlaps between successive axial fields of view<br>Is this a user definable parameter? | |
| iii) | What methods of table motion are available during whole body scans | |

| | | |
|---|---|---|
| | a) Continuous<br>b) Step and shoot<br>c) Other (specify) | |
| iv) | Typical time of acquisition per axial field of view (minutes) | |
| v) | Can studies be paused and re-started during acquisitions without loss of data? | |
| vi) | Can the user create new acquisition protocols? | |

**2. Acquisition parameters in 3D mode**

| | | |
|---|---|---|
| i) | Typical activity injected for whole body FDG scan (MBq) | |
| ii) | Number of slice overlaps between successive axial fields of view<br>Is this a user definable parameter? | |
| iii) | What methods of table motion are available during whole body scans<br>a) Continuous<br>b) Step and shoot<br>c) Other (specify) | |
| iv) | Typical time of acquisition per axial field of view (minutes) | |
| v) | Can studies be paused and re-started during acquisitions without loss of data? | |
| vi) | Can the user create new acquisition protocols? | |

**3. PET data format and storage**

| | | |
|---|---|---|
| i) | What data does the acquisition system produce?<br>a) Raw data files in list mode format<br>b) 2D transaxial projections | |
| | c) Other (specify) | |

| | | |
|---|---|---|
| ii) | If the system <u>can</u> produce raw data files in list mode format specify the format of a list mode data set produced during PET acquisition (this should be in terms of the parameters available in the list mode data for each coincidence event, for example X1,Y1,Z1,E1,Z2,Y2,Z2,E2,q | |
| iii) | If the system <u>can</u> produce raw data files in list mode format does the system permit retrospective rebinning of the list mode into projections?<br>If so, specify the rebinning algorithm(s) available<br>a) Single slice rebinning (SSRB)<br>b) Multi-slice rebinning (MSRB)<br>c) Fourier rebinning (FORE)<br>d) Other (specify) | |
| iv) | During the off-line rebinning of question **Error! Reference source not found.**, can the user specify the following parameters?<br>a) Which energy window combinations to be included (ie only include photopeak events or also include scatter events)<br>b) Axial angular acceptance range<br>c) Transaxial angular acceptance range | |
| v) | If the system <u>does not</u> produce raw data files in list mode format, specify the format(s) of the raw data files produced following an acquisition | |
| vi) | How much disk space is available on the system for storage of PET studies? | |
| vii) | How much disc space is used by a typical PET study? | |
| viii) | What options are available for archiving PET studies | |

## PET emission image reconstruction

### 1. Image reconstruction in 2D mode

| | | |
|---|---|---|
| i) | Specify 2D reconstruction algorithms available | |
| ii) | Specify default dimensions of reconstructed volume<br>a) In the transaxial plane (mm) | |

| | | |
|---|---|---|
| | b) Axially (mm) | |
| iii) | Can the dimensions of the reconstructed volume be modified<br>a) In the transaxial plane<br>b) Axially | |
| iv) | Specify randoms correction methodology | |
| v) | Specify scatter correction methodology | |

**2. Image reconstruction in 3D mode**

| | | |
|---|---|---|
| i) | Specify 3D reconstruction algorithms available | |
| ii) | Specify default dimensions of reconstructed volume<br>a) In the transaxial plane (mm)<br>b) Axially (mm) | |
| iii) | Can the dimensions of the reconstructed volume be modified<br>a) In the transaxial plane<br>b) Axially | |
| iv) | Specify randoms correction methodology | |
| v) | Specify scatter correction methodology | |

## Transmission Imaging

This section refers to transmission images acquired for the purpose of applying patient specific attenuation correction maps to reconstructed PET images.

| | | |
|---|---|---|
| i) | Does the system have an option for transmission imaging that can be used for attenuation correction of the emission data?<br>a) Included in the basic system<br>b) As an extra cost option that must be specified at the time of initial purchase<br>c) As an extra cost option that can be purchased at a later date | |

| | | |
|---|---|---|
| ii) | If a radionuclide source is used for transmission scanning, specify the following:<br>a) The radionuclide used<br>b) The number of sources<br>c) The total activity in all sources (MBq)<br>d) The physical form (solid or liquid)<br>e) The geometry of the sources(s) | |
| iii) | If a radionuclide source is used for transmission scanning, specify the source replacement schedule including frequency and an indicative cost including disposal | |
| iv) | Does the system provide post-injection transmission capability? | |
| v) | Specify the number of slice overlaps between successive axial fields of view for transmission imaging | |
| vi) | Specify the recommended time of acquisition per axial field of view (minutes) | |
| vii) | Is the system capable of simultaneous emission and transmission acquisition? | |
| viii) | How are non-uniform attenuation correction maps generated from transmission data?<br>a) Using segmentation of different tissue types<br>b) Using measured attenuation coefficient without scaling<br>c) Using measured attenuation coefficient with scaling to appropriate energy<br>d) Other (specify) | |
| ix) | Can transmission maps be reconstructed independently of the emission images? | |

## CT Scanner

This section refers to incorporation of a high resolution CT scanner, capable of producing diagnostic quality CT images aligned with the PET emission image, without moving the patient off the PET imaging table.

## 1. CT Hardware

| | | |
|---|---|---|
| i) | Does the system include a diagnostic quality CT scanner?<br>a) Included in the basic system<br>b) As an extra cost option that must be specified at the time of initial purchase<br>c) As an extra cost option that can be purchased at a later date | |
| ii) | Can stand alone PET data be acquired without CT data? | |
| iii) | Can stand alone CT data be acquired without PET data? | |
| iv) | Specify the overall size of the complete system, with the CT option included:<br>a) Overall height (cm)<br>b) Overall length (cm)<br>c) Overall width (cm)<br>Please also supply a scale diagram showing the layout of the complete system (including CT) in a typical room. | |
| v) | Specify the overall weight of the complete system, including the CT option (kg) | |
| vi) | Specify electrical requirements of the complete system, including the CT option:<br>a) Single or 3 phase supply<br>b) Voltage<br>c) Power | |
| vii) | Specify cooling requirements of the complete system including the CT option (kW) | |
| viii) | Specify the type of CT detectors used | |
| ix) | Describe the detector geometry (e.g. curved/linear) | |
| x) | Specify the number of CT detector rings, ie the number of CT slices acquired simultaneously<br>Is this a user definable parameter? | |
| xi) | State the power rating of the X-ray generator (kW) | |
| xii) | Specify the following details for the X-ray tube<br>a) Maximum power<br>b) Anode heat storage capacity<br>c) Anode heat dissipation characteristics | |

| | | |
|---|---|---|
| xiii) | Is the X-ray tube actively or passively cooled? | |
| xiv) | Specify range of tube output and acquisition details (mA and kV)<br>Is this a user definable parameter? | |
| xv) | Specify acquisition modes (helical or not and speed specifications) | |
| xvi) | Specify the tube rotation time (range and increment) (s) | |
| xvii) | Specify the range of scan times per volume (s) | |
| xviii) | Specify range of scan lengths in PET/CT mode (cm) | |
| xix) | Specify pitch (range and increments) (mm)<br>Is the pitch freely selectable? | |
| xx) | State the gantry aperture (cm) | |
| xxi) | Is there a single integrated system console for both PET and CT acquisitions? | |

**2. CT Software**

| | | |
|---|---|---|
| i) | State the reconstruction time for 512x512 matrix from system memory (s) | |
| ii) | State reconstruction capabilities in terms of images/s | |
| iii) | During volume acquisition, can 512x512 images be displayed in real time? | |
| iv) | State the maximum field of view<br>Is this freely selectable? (State range and increments) | |
| v) | Does the system include software for fusion of PET and CT images? | |
| vi) | Does the system permit the CT data to be used for attenuation correction of the PET emission data?<br>If 'yes' specify the method used | |
| vii) | Does the system include QC software for verifying alignment of the table position between PET and CT acquisitions?<br>If 'yes' specify the method used | |
| viii) | Is there a single integrated system of image processing for both PET and CT images?<br>If not, please give details of hardware provided not covered in Section 7 | |

### 3. CT patient dose

| | | |
|---|---|---|
| i) | What measures are employed to optimise patient dose?<br>a) Pre-patient collimation<br>b) Post-patient collimation<br>c) Automatic selection of mA during scan<br>d) Other (specify) | |

## Data acquisition system

This section covers the basic facilities available on the workstation that controls data acquisition from the PET scanner. If the workstation also includes data processing facilities then the relevant sections of part C of the questionnaire should also be completed.

### 1. Hardware

| | | |
|---|---|---|
| i) | What hardware platform does the data acquisition workstation run on (eg PC, Mac, Sun)? | |
| ii) | What is the CPU speed? | |
| iii) | How much memory is installed? | |
| iv) | What type of monitor is supplied (eg CRT or flat panel LCD)? | |
| v) | What is the size of the display monitor? | |
| vi) | What is the resolution of the display? | |
| vii) | What is the capacity of the hard disc drive? | |
| viii) | What other storage devices are included:<br>a) Floppy disc drive<br>b) ZIP disc drive<br>c) CD-ROM drive<br>d) Recordable CD drive<br>e) DVD drive<br>f) Recordable DVD drive<br>g) WORM optical disc drive (state capacity)<br>h) Erasable optical disc drive (state capacity)<br>i) Tape cartridge (state capacity)<br>j) Other (specify) | |
| ix) | What input devices are included?<br>a) Keyboard<br>b) Mouse<br>c) Trackball | |

| | | |
|---|---|---|
| | d) Joystick<br>e) Other (specify) | |

## 2. Software

| | | |
|---|---|---|
| i) | What operating system does the system use (eg Windows, MacOS, Unix)? State the version number of the operating system which will be installed | |
| ii) | Does the acquisition workstation include any software for processing data that is not covered elsewhere in this questionnaire? If yes then please also complete Part C of the questionnaire | |
| iii) | If the workstation includes processing or display software can this be run at the same time as data acquisition is in progress?<br>If 'Yes', please specify any limitations or effect on processing speed that use of simultaneous acquisition and processing imposes | |
| iv) | Does the system include software for fusion of PET and CT images?<br>If yes, please give details | |

## 3. Data display

In order to clarify terminology the following definitions will apply to questions in this section:
*Screen* means the part of the system display that is used for displaying images. This may be less than the full size of the display monitor.
*Colour scale* means the translation table used to convert image counts into intensity (for a monochrome display) or into colours (for a colour display).
*Display levels* means the lower (background) and upper (saturation) count thresholds that correspond to pixels which are displayed at the minimum and maximum steps of the colour scale.
*Cine display* means a sequential display of consecutive frames of a dynamic sequence of images at the same position on the screen so as to give the impression of a moving image.

| | | |
|---|---|---|
| i) | What is the maximum resolution of the screen (pixels)? | |
| ii) | What is the maximum number of distinct steps in a colour scale? | |
| iii) | How many different colour scales are supplied as standard? | |
| iv) | Is a linear monochrome colour scale (grey scale) included? | |
| v) | Can the user create additional colour scales? | |

| | | |
|---|---|---|
| vi) | What is the maximum number of images that can be shown simultaneously on one screen? | |
| vii) | Can each displayed image modality use a different colour scale, independently of the colour scales used for other modalities? | |
| viii) | If 'Yes', what is the maximum number of different colour scales that can be used on one screen at the same time? | |
| ix) | Can the display levels be adjusted independently for each image on the screen (so that each image can have different display levels)? | |
| x) | Can user specified free text be displayed on the screen:<br>a) At any position<br>b) With control over font<br>c) With control over point size | |
| xi) | Can the user control which patient and study details (eg name, date etc) are displayed on the screen? | |
| xii) | Are there independent controls for lower and upper display level, so that the upper level can easily be adjusted without changing the lower level and vice-versa? | |
| xiii) | Can lower and upper display levels be specified as:<br>a) Actual counts?<br>b) Percent of maximum in the current image?<br>c) Percent of maximum in the complete dynamic sequence? | |
| xiv) | If display levels can be specified as actual counts, state the permitted values for lower and upper display levels.<br>a) Range available (eg 0 to max in image)<br>b) Smallest increment (eg 1 count) | |
| xv) | If display levels can be specified as percent, state the permitted values for lower and upper display levels.<br>a) Range available (eg 0 to 200%)<br>b) Smallest increment (eg 0.1%) | |

## 4. Patient database management software

| | | |
|---|---|---|
| i) | Does the system include patient database management software for indexing all patient studies that are stored on the system? | |
| ii) | Can a list of available patient studies include the following fields?<br>a) Patient name<br>b) Patient ID<br>c) Patient date of birth<br>d) Patient sex<br>e) Study name<br>f) Study type (eg bone, renal etc)<br>g) Study date<br>h) Study status (eg processed, archived etc)<br>i) Acquisition mode (static, dynamic, whole body, SPET etc) | |
| iii) | Can the operator choose to display the list of available studies sorted in order by the following fields?<br>a) Patient name<br>b) Patient ID<br>c) Patient date of birth<br>d) Patient sex<br>e) Study name<br>f) Study type (eg bone, renal etc)<br>g) Study date<br>h) Study status (eg processed, archived etc) | |
| iv) | Can the operator search for studies that match the following criteria?<br>a) Exact patient name<br>b) Patient name including wild cards<br>c) Patient ID<br>d) Date of birth or age<br>e) Date of birth range or approximate age<br>f) Patient sex<br>g) Study name<br>h) Study type (eg bone, renal etc)<br>i) Range of study dates | |

| | | |
|---|---|---|
| v) | Can the searches of **Error! Reference source not found.** be made for<br>a) Studies currently on this computer?<br>b) Current studies plus archived studies?<br>c) All studies on this and other computers on the network? | |
| vi) | Can the user edit the following details in the patient database?<br>a) Patient details (specify whether none, all or some)<br>b) Study details (specify whether none, all or some)<br>c) Acquisition parameters (specify whether none, all or some) | |
| vii) | What methods are available for deleting old studies that have been processed and archived?<br>a) Manual deletion of individual selected studies<br>b) Manual deletion of a range of selected studies<br>c) Automatic deletion of studies after a given time provided that they have been archived | |
| viii) | Can individual studies be marked as protected so that they cannot be deleted? | |
| ix) | Describe any other mechanisms that exist to prevent accidental deletion of studies before they have been processed and archived | |
| x) | Does the system have an HL7 HIS/RIS interface? | |

**5. Data transfer**

| | | |
|---|---|---|
| i) | Is the acquisition workstation capable of connecting to other systems using standard Ethernet protocols? | |
| ii) | What is the speed of the network interface? | |
| iii) | Does the network system support the following protocols?<br>a) TCP/IP<br>b) OSI<br>c) NFS<br>d) DICOM<br>e) Other (specify) | |
| iv) | Can the system be connected to remote networks via a dial-up modem? | |

| | | |
|---|---|---|
| v) | Can the system be connected to remote networks via ISDN link? | |
| vi) | Can acquired images be exported to a remote system in the following formats?<br>a) The systems own internal format<br>b) DICOM<br>c) Interfile<br>d) Other (specify) | |
| vii) | Do these export functions work with all image types?<br>If no, specify any limitations of format and image type | |
| viii) | Do you hold an Interfile 3.3 Conformance Claim (ref: COST B2)? | |
| ix) | Have you included a DICOM 3.0 Conformance Statement for your equipment, structured in accordance with Part 2 of the DICOM standard (NEMA standards publication PS 3.2 - 1993)? | |
| x) | Can image files be transferred automatically to another computer system on completion of acquisition? | |
| xi) | Can an operator sitting at the acquisition workstation send selected image files to another workstation (Push function)? | |
| xii) | Can an operator sitting at another workstation transfer selected image files from the acquisition workstation (Pull function)? | |
| xiii) | Can the system retrieve a Dicom worklist from a RIS system? | |

**6. Archiving and backup**

| | | |
|---|---|---|
| i) | Is software supplied to enable acquired data to be archived for long term storage using any of the following media?<br>a) Floppy disk<br>b) ZIP disc<br>c) CD<br>d) DVD<br>e) WORM optical disc<br>f) Re-writable optical disk<br>g) Tape cartridge | |

| | | |
|---|---|---|
| | h) Other (specify) | |
| ii) | What format is used for the above data archive?<br>a) Interfile<br>b) DICOM<br>c) Other public format (specify)<br>d) Manufacturer's proprietary format | |
| iii) | If the archive uses data compression please state a typical compression ratio, otherwise state 1:1<br>a) For loss-less compression<br>b) For lossy compression | |
| iv) | What data can be archived?<br>a) Patient and study details<br>b) Raw data<br>c) Reconstructed images<br>d) Processed images<br>e) List mode data | |
| v) | How can archiving be initiated?<br>a) Manually using operator selected data<br>b) Manually using all non-archived data<br>c) Automatically at a given time of day | |
| vi) | If an archive process fails for any reason (eg a file is already in use, or the medium is full) what information is provided for the operator about which data has been archived and which has not, and the reason for the failure? | |
| vii) | Is it easy for the operator to identify from a listing of acquired data on the main hard disc, which studies have already been archived? (eg by means of a flag) | |
| viii) | If studies have been archived more than once (eg to two different media) can this be determined from the main patient listing? | |
| ix) | Is there an indexing system on the main hard disk which can be used to locate the appropriate disc or tape on which any given study has been archived? | |
| x) | Does the above index allow archived studies to be located by the following criteria?<br>a) Patient name<br>b) Patient ID<br>c) Study name<br>d) Study type | |

| | | |
|---|---|---|
| | e) Study date | |
| xi) | Is there a restore function to enable fast restoration of selected archived studies to the main system (hard disk) with appropriate updating of patient indexes, etc.? | |
| xii) | Is it possible for the user to make a backup of system software (other than acquired study data) using any of the following media?<br>a) Floppy disk<br>b) ZIP disc<br>c) CD<br>d) DVD<br>e) WORM optical disc<br>f) Re-writable optical disk<br>g) Tape cartridge<br>h) Other (specify) | |
| xiii) | What files can be included in this backup?<br>a) Complete software<br>b) Changed files only<br>c) All files modified by the user<br>d) Calibration files<br>e) Acquisition protocols<br>f) Study data archive index<br>g) Other (specify) | |

## 7. Quality control software and test data

| | | |
|---|---|---|
| i) | Are there specific protocols included in the system software for routine quality control?<br>a) Provided as standard<br>b) Available as an extra cost option (ECO)<br>Please give brief details of available QC protocols | |

| | | |
|---|---|---|
| ii) | Is there a set of NEMA test analysis software and protocols? | |
| iii) | Is software provided to enable testing any of the computer hardware (eg scanner interface, memory, ADC)?<br>If 'Yes', provide brief details of the software supplied | |
| iv) | Are software phantoms or test data provided to test the clinical software supplied?<br>If 'Yes', provide brief details of the software / data supplied | |

**8. Data security**

| | | |
|---|---|---|
| i) | Does the system provide log-on/log-off facilities with appropriate password protection?<br>a) No passwords required<br>b) One login name and password shared by all users<br>c) Separate login name and password for administrators and service personnel, but all other users share the same password<br>d) Individual login name and password for every user | |
| ii) | Are there at least three levels of authorisation to make sure that certain tasks (such as deletion of data, software installation, changing of passwords, etc) can only be performed by authorised users? | |
| iii) | Can the highest level user ('administrator') define access rights for individual users? | |
| iv) | Can security of unattended workstations be provided without actually logging-off (eg by use of a password-protected screensaver)? | |
| v) | Does the system provide facilities for the encryption of data for transmission over public networks? | |

General

## 1. Maintenance and reliability

NHS Supplies have produced short questionnaires ('6.2: Summary and Pricing Schedule: Maintenance' and '6.3: Maintenance Questionnaire') designed to elicit information about maintenance arrangements (contract prices, conditions, non-contract call-outs, etc.) for this type of equipment, which, if used, would mean some overlap with the section below. The authors consider that the section below is sufficient, but use of the NHS Supplies' Maintenance documents may be a mandatory requirement, in which case Suppliers would effectively need to answer some questions twice.

| | | |
|---|---|---|
| i) | Assuming average use, indicate the anticipated useful life expectancy of the system (years.) | |
| ii) | Assuming average use, indicate the anticipated useful life expectancy of the data acquisition system (years). | |
| iii) | Specify the guaranteed up-time of the system within a normal working week, excluding any planned preventative maintenance, provided the system is on a maintenance contract (%). | |
| iv) | Specify the type of compensation offered by the company if this guarantee is not achieved. | |
| v) | How many service inspections will take place during the 12 month warranty period? | |
| vi) | Is a service report submitted to the user following each service visit? | |
| vii) | Specify the frequency and duration of such service inspection visits. | |
| viii) | Is there a guarantee that sufficient spares will be kept to ensure the operation of the system for a full 10 years from the date of purchase? | |
| ix) | Provide details of the geographical bases and relevant training of service engineers who will be responsible for the emergency and routine maintenance of the system. | |
| x) | Provide details of any alternative arrangements, including geography and training, in the event of the above engineer(s) not being available. | |
| xi) | Have you enclosed details of the full range of service contracts available (hardware and software), including prices? | |
| xii) | Specify the guaranteed response time to hardware emergency breakdown calls for all types of service contract and for non-contract holders. Details must include a description of what that 'response' entails. | |
| xiii) | Is some type of on-line diagnostic tool for hardware fault detection available? | |

| | | |
|---|---|---|
| xiv) | If Yes, specify how this system operates (e.g. usable by the operator or just the engineer?), together with any additional costs involved or site requirements. | |
| xv) | Are additional discounts available if service contracts are paid for in advance (i.e. at time of equipment purchase). | |
| xvi) | If so, have you included details of these additional discount offers? | |
| xvii) | What is the hourly charge (excl. VAT) for non-contract call-outs? | |
| xviii) | Is travelling time charged for (for non-contract work)? | |
| xix) | If so, at what rate (excl. VAT) is travelling time charged? | |
| xx) | Is there a minimum call-out charge? | |
| xxi) | If so, what is the minimum charge (excl. VAT)? | |

## 2. Room layout

Suppliers should provide a typical layout for the enclosed room plan, showing the placement (with dimensions) of all specified hardware, including scanner, consoles, data acquisition workstation and any imaging table(s) and rails.

## 3. Pre-installation work/requirements

Suppliers should note that it is their responsibility to check access in order to ensure that all equipment can be delivered to the installation site.

| | | |
|---|---|---|
| i) | Specify the weight and packed size of the system and all major hardware components to be installed. | |
| ii) | Specify any room environment requirements, including:<br>a) The maximum and minimum temperatures for normal working ($^0$C)<br>b) The maximum rate of change of temperature ($^0$C/hr)<br>c) The maximum and minimum relative humidity (%) | |
| iii) | Specify the total heat dissipation of the system (kW/hr)<br>a) Typical<br>b) Maximum | |
| iv) | Specify the electrical power requirements of all hardware to be installed: | |

| | | |
|---|---|---|
| | a) Single or 3 phase supply | |
| | b) Voltage | |
| | c) Power | |
| v) | Specify any necessary pre-installation work, with particular emphasis on the floor material, support and floor surface covering | |
| vi) | If the installation requires floor levelling, specify:<br>a) Exactly what is to be done<br>b) Who is responsible for carrying out and quality assuring the work<br>c) Any additional costs involved in carrying out the work<br>d) Time scales for completion of the work. | |

**4. Purchase, installation and training**

| | | |
|---|---|---|
| i) | Specify the guaranteed delivery time from placement of order (weeks) | |
| ii) | Specify the time required on site to install the system to the point where it can be handed over for acceptance testing (working days). | |
| iii) | Specify the standard provision for on-site operator training post-installation. | |
| iv) | Can a full on-site NEMA test programme be provided? | |
| v) | Specify any additional cost for such a test programme. | |

**5. Electrical and mechanical safety**

| | | |
|---|---|---|
| i) | Does the system fully comply with UK legislation and recommendations on electrical and mechanical safety, including BS5724: Part 1 (IEC601-1), and the Department of Health's document TRS89 - 'Technical requirements for the supply and installation of equipment for diagnostic imaging and radiotherapy'? | |
| ii) | Please quote any safety standards used in the design, manufacture or supply of the system. | |

| | | |
|---|---|---|
| iii) | Is there an emergency stop button provided so that all electrical power to the scanner gantry can be cut immediately? | |
| iv) | If so, state the location(s) of the button(s) | |

## 6. Quality management

| | | |
|---|---|---|
| i) | Is your company accredited under BS EN ISO 9000 (formerly BS 5750)? | |
| ii) | If 'Yes', give the certificate number and date achieved. | |
| iii) | Does your company employ a recognised software development methodology? | |
| iv) | If 'Yes', please state name of the method. | |
| v) | Is your company accredited under the UK TickIT scheme for software quality? | |
| vi) | If 'Yes', give certificate number and date achieved. | |
| vii) | Is your company accredited to any other IT-specific standards? | |
| viii) | If 'Yes', please name them and the date they were achieved | |
| ix) | Does your system have certification of compliance under Annex II of the EC Medical Devices Directive (for a Class IIa medical device)? | |

## 7. Supporting documentation

| | | |
|---|---|---|
| i) | Is the system supplied with an Operator's Manual that includes the following:<br>a) A basic description of system operation?<br>b) A detailed description of utility software?<br>c) A detailed description of the operating system, including file structures / formats?<br>d) A detailed description of clinical software, including intended application(s) and references to scientific papers?<br>e) A detailed description of data backup procedures? | |
| ii) | Is the system supplied with a Service Manual that includes the following:<br>a) Comprehensive block and circuit diagrams? | |

| | | |
|---|---|---|
| | b) Fault-finding procedures?<br>c) Preventative maintenance procedures and schedules?<br>d) List of spares, with part numbers?<br>e) Calibration and adjustment procedures? | |
| iii) | Are all software upgrades fully documented, including the ways in which changes to subroutines, etc, may affect user protocols and programs? | |