British Nuclear Medicine Society

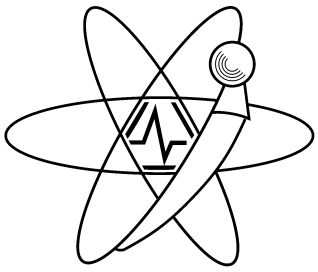
GAMMA CAMERA and DATA PROCESSOR SYSTEM TENDER QUESTIONNAIRE

(Version 3.1)

Part C

Data Processing System

Produced in association with the
Institute of Physics and Engineering in Medicine



INSTITUTE OF PHYSICS AND ENGINEERING IN MEDICINE

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1 The system

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

Manufacturer	
Data processing system model	
Software version	
Options required	

2 Hardware and operating system

2.1 Hardware

2.1.1	What hardware platform does the data processing workstation run on (eg PC, Mac, Sun)?	
2.1.2	What is the CPU speed?	
2.1.3	How much memory is installed?	
2.1.4	What type of monitor is supplied (eg CRT or flat panel LCD)?	
2.1.5	What is the size of the display monitor?	
2.1.6	What is the resolution of the display?	
2.1.7	What is the capacity of the hard disc drive?	
2.1.8	What other storage devices are included? a) Floppy disc drive b) ZIP disc drive c) CD-ROM drive d) Recordable CD drive e) DVD drive f) Recordable DVD drive g) WORM optical disc drive (state capacity) h) Erasable optical disc drive (state capacity) i) Tape cartridge (state capacity) j) Other (specify)	
2.1.9	What input devices are included? a) Keyboard b) Mouse c) Trackball d) Joystick e) Other (specify)	

2.2 Operating system

2.2.1	What operating system does the system use (eg Windows, MacOS, Unix)? State the version number of the operating system which will be installed	

3 Data display and manipulation

3.1 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.

3.1.1	What is the maximum resolution of the screen (pixels)?	
3.1.2	What is the maximum number of distinct steps in a colour scale?	
3.1.3	How many different colour scales are supplied as standard?	
3.1.4	Is a linear monochrome colour scale (grey scale) included?	
3.1.5	Can the user create additional colour scales?	
3.1.6	What is the maximum number of images that can be shown simultaneously on one screen?	
3.1.7	Can each displayed image use a different colour scale, independently of the colour scales used for other images?	
3.1.8	If 'Yes', what is the maximum number of different colour scales that can be used on one screen at the same time?	
3.1.9	Can the display levels be adjusted independently for each image on the screen (so that each image can have different display levels)?	
3.1.10	What is the maximum cine display rate for a dynamic study acquired on a 128x128 matrix (frames per second)?	
3.1.11	Is the cine display rate continuously variable?	
3.1.12	Can ROIs be superimposed on a cine display of a dynamic study?	
3.1.13	What is the maximum number of images that can be displayed in a cine loop?	
3.1.14	What is the maximum cine display rate for a gated cardiac study acquired on a 64x64 matrix?	
3.1.15	Can gated cardiac cines be displayed: a) In a window? b) Full screen?	
3.1.16	Can ROIs be superimposed on a cine display of a gated cardiac study?	
3.1.17	What is the maximum number of independent cine displays that can be shown on the screen at once?	

3.1.18	Can two separate cine displays of gated cardiac data (eg stress and rest) be displayed synchronised - so that corresponding frames display at the same time ?	
3.1.19	Can user specified free text be displayed on the screen: a) At any position b) With control over font c) With control over point size	
3.1.20	Can the user control which patient and study details (eg name, date etc) are displayed on the screen?	
3.1.21	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?	
3.1.22	Can lower and upper display levels be specified as: a) Actual counts? b) Percent of maximum in the current image? c) Percent of maximum in the complete dynamic sequence?	
3.1.23	If display levels can be specified as actual counts, state the permitted values for lower and upper display levels. a) Range available (eg 0 to max in image) b) Smallest increment (eg 1 count)	
3.1.24	If display levels can be specified as percent, state the permitted values for lower and upper display levels. a) Range available (eg 0 to 200%) b) Smallest increment (eg 0.1%)	

3.2 Image manipulation

Image manipulation operations in this section should be available to the user from on-screen menus or simple commands, without having to enter into a programming environment. If some operations are only available in a programming environment, then this must be made clear in the appropriate response.

3.2.1	Can the data processing system (as opposed to the data acquisition system) apply corrections for radioactive decay that has occurred during: a) Dynamic studies? b) Whole body studies? c) SPECT studies?	
3.2.2	Can the system convert images from one matrix size to another for: a) Static studies? b) Dynamic studies? c) Whole body studies? d) SPECT studies?	
3.2.3	Can the system sum several frames from a dynamic study into a single static image:	

	e) From contiguous frames? f) From non-contiguous frames?	
3.2.4	Can the system reframe a dynamic study by summing consecutive groups of frames to create a new dynamic study with a longer frame time?	
3.2.5	Can the system create a new dynamic study by extracting a consecutive sequence of frames from an existing dynamic study? a) By deleting frames from the end of the original study b) By deleting frames from the beginning of the original study	
3.2.6	Can the system rotate an image: a) In 90 degree steps? b) By an arbitrary angle? – specify the minimum step	
3.2.7	Can the system mirror an image : a) By reflection about a horizontal line? b) By reflection about a vertical line?	
3.2.8	Does the system permit full algebraic arithmetic (addition, subtraction, multiplication and division) between: a) Two static images? b) Two single images out of a dynamic sequence?	
3.2.9	Does the system permit full algebraic arithmetic (addition, subtraction, multiplication and division) between an image and a user-defined constant? If 'Yes', specify the allowable range of the constant and the precision with which it can be specified (eg 0 to 9999.99 with precision 0.01)	
3.2.10	Does the system permit the generation of variable-width image profiles: a) In the X direction? b) In the Y direction? c) At a user defined oblique angle?	
3.2.11	Can image profiles be generated from a) Static images? b) Whole body images? c) Single frames from a dynamic study?	
3.2.12	Can the system store the results of such a profile for re-display and analysis in the same way as curves generated by ROIs?	
3.2.13	How many profiles can be simultaneously displayed for a single image?	
3.2.14	Does the system permit image filtering/smoothing of: a) 1D filtering of image profiles? b) Temporal filtering of activity-time curves? c) 2D spatial filtering of static images? d) 2D spatial filtering of whole body images?	

	e) 2D spatial filtering of multiple frames from a dynamic study? f) Temporal filtering of dynamic studies? g) 3D filtering of SPET data sets?	
3.2.15	Does the system perform spatial filtering: a) Using system defined filter functions? b) Using user-definable filter functions? c) As convolutions in real space? d) As Fourier filters?	

3.3 Regions of interest (ROIs)

Region of interest operations in this section should be available to the user from on-screen menus or simple commands, without having to enter into a programming environment. If some operations are only available in a programming environment, then this must be made clear in the appropriate response.

3.3.1	Is it possible to define ROIs on images from a) Static studies? b) Whole body studies? c) Dynamic studies?	
3.3.2	Which input devices can be used for manual drawing of ROIs? a) Keyboard b) Joystick c) Trackball d) Mouse e) Other (specify)	
3.3.3	Which of the following methods are available for drawing ROIs? a) User positioned rectangle with adjustable size b) User positioned circle with adjustable size c) User positioned ellipse with adjustable size d) Irregular shaped polygon formed by joining straight line segments – 'vector method' e) Arbitrary shaped outline formed by joining individual pixels – 'freehand method' f) Using iso-count contour with user adjustable threshold g) Other (specify)	
3.3.4	Can a single ROI be created by simultaneously drawing on more than one image and having the ROI displayed on each image as it is drawn (e.g. using summed images representing different stages of a dynamic study)? If 'Yes', specify the maximum number of simultaneous displayed images that may be used for this purpose	
3.3.5	Specify the maximum number of ROIs that may be drawn on a single image.	

3.3.6	Is it possible to save ROIs to the patient database in such a way that they can be retrieved and manipulated again at a later date? If 'Yes', specify the maximum number of ROIs that may be saved with each patient study?	
3.3.7	Is it possible to apply an ROI to images of any matrix size, regardless of the matrix size on which it was created? a) With automatic conversion of matrix size b) After manual conversion of matrix size	
3.3.8	Is it possible to apply an ROI to images other than the one for which it was created? a) For other images in the same study b) For other studies belonging to the same patient c) For studies belonging to other patients	
3.3.9	Is it possible to create a new ROI by duplication of an existing ROI?	
3.3.10	Is it possible to modify existing ROIs by the following operations: a) Linear translation in X or Y without change of size or shape? b) Reflection about a horizontal plane without change of size? c) Reflection about a vertical plane without change of size? d) Rotation in 90 degree steps without change of size? e) Rotation by an arbitrary angle without change of size f) Magnification or minification	
3.3.11	When an ROI is manipulated by any of the operations specified in 3.3.10 (a) to (f), does the number of pixels it encloses remain constant?	
3.3.12	Does the system permit logical operations (AND, OR, XOR) between two ROIs to produce a new ROI?	
3.3.13	Does the system permit masking operations between an ROI and an image to produce a new image?	
3.3.14	Does the system permit the conversion of an ROI into an image containing a user specified constant count within the region.	
3.3.15	Can the system display on screen, the statistics (at least total counts, ROI size, and average counts/pixel) from a user selected ROI and image?	
3.3.16	Can the statistics given in 3.3.15 be saved in an externally accessible file for later analysis by a stand-alone spreadsheet program? If 'Yes', specify the file format(s) that is (are) available	
3.3.17	Can each ROI be identified by a user definable name that is stored with the ROI?	
3.3.18	Can each ROI be displayed in a user definable colour?	

3.4 Curves

Curve operations in this section should be available to the user from on-screen menus or simple commands, without having to enter into a programming environment. If some operations are only available in a programming environment, then this must be made clear in the appropriate response.

3.4.1	Can the system generate and display time-activity curves from previously generated ROIs?	
3.4.2	Does the system permit the generation of curves from manually-input user data (Y-values for given time points)?	
3.4.3	Can curves be created from pairs of X and Y-values where the X-values are not equally spaced (as opposed to uniformly spaced X-values as normally occurs in a time-activity curve)?	
3.4.4	Is it possible to save curves to the patient database in such a way that they can be retrieved and manipulated again at a later date? If 'Yes', specify the maximum number of curves that may be saved with each patient study?	
3.4.5	Does the system permit full algebraic arithmetic (addition, subtraction, multiplication and division) of curves: a) Between a curve and a user defined constant? b) Between two curves?	
3.4.6	Is the system capable of performing least squares fits to curve data using any of the following fit functions? a) Linear b) Single exponential c) Bi-exponential d) Polynomial e) Gamma variate f) Gaussian g) Others (specify)	
3.4.7	Does the above fitting capability include the following features? a) Display of the fitted curve b) Ability to store the fitted curve c) Display of the fitted parameters	
3.4.8	Which of the following curve processing operations are available: a) Smoothing? b) Integration? c) Differentiation? d) Convolution? e) Deconvolution? f) Others (specify)?	
3.4.9	Can curves be interrogated so that the values of individual data points can be displayed?	

3.4.10	Can curve data be saved in an externally accessible file for later analysis by a stand-alone program such as a spreadsheet? If 'Yes', specify the file format(s) that is (are) available	
3.4.11	Can each curve be identified by a user definable name that is stored with the curve?	
3.4.12	Can each curve be displayed in a user definable colour?	

3.5 SPET data processing

3.5.1	Can the processing system perform SPET reconstruction using projection data acquired on a remote gamma camera and transferred to the processing workstation by DICOM protocols? If 'Yes' state for which manufacturers and camera models this is known to work reliably	
3.5.2	Can the processing system correct SPET data for the following effects? (Note that suppliers should respond 'No' here if the corrections are assumed to have been applied by the acquisition system – see Part B question 3.7.18) a) Centre of rotation b) Offsets due to non-circular orbits c) Camera non-uniformity d) Radionuclide decay e) Data from multiple detectors f) Data from multiple rotations	
3.5.3	Can the system perform SPET reconstruction using filtered back projection?	
3.5.4	Which of the following SPET reconstruction filters are available: a) Hanning filter with variable cut-off frequency? b) Butterworth filter with variable cut-off and order? c) Wiener filter with variable parameters? d) Metz filter with variable parameters? e) User definable filter function? f) Others (specify)?	
3.5.5	Can SPET filters be applied: a) As a 2D pre-filter to the raw data b) As a 1D filter during back projection c) As a 2D post-filter to the reconstructed data	
3.5.6	What matrix sizes can be reconstructed by filtered back projection a) 64x64 b) 128x128 c) Other (specify)	

3.5.7	What acquisition arcs can be reconstructed by filtered back projection? a) 180 degree arc b) 360 degree arc c) Other (specify)	
3.5.8	What is the maximum number of projection angles that may be reconstructed by filtered back projection?	
3.5.9	Does the system permit image zoom to be applied during the reconstruction process?	
3.5.10	Does reconstruction using filtered back projection include a facility for attenuation correction? a) Uniform attenuation correction using a pre-processing method – state method (eg Sorenson) b) Uniform attenuation correction using a post-processing method – state method (eg Chang) c) Non-uniform attenuation correction using an acquired attenuation map and a post-processing method – state method (eg iterative Chang)	
3.5.11	Does reconstruction using filtered back projection include a facility for scatter correction? If 'Yes' specify the method used	
3.5.12	Can the system perform SPET reconstruction using an iterative reconstruction method? If 'Yes', what algorithm is used?	
3.5.13	What matrix sizes can be reconstructed by iterative reconstruction? a) 64x64 b) 128x128 c) Other (specify)	
3.5.14	What acquisition arcs can be reconstructed by iterative reconstruction? a) 180 degree arc b) 360 degree arc c) Other (specify)	
3.5.15	What is the maximum number of projection angles that may be reconstructed by iterative reconstruction?	
3.5.16	Does iterative reconstruction include the ability to perform: a) Attenuation correction using non-uniform attenuation maps? b) Scatter correction using acquired scatter data? c) Scatter correction by modelling of object scatter? d) Correction for system response function?	
3.5.17	Does the system permit the reconstruction and storage of images representing: a) Axial planes?	

	b) Coronal planes? c) Sagittal planes? d) Oblique planes?	
3.5.18	Can the system produce absolute uptake measurements (MBq/pixel rather than counts per pixel)? If 'Yes', give brief details of the method used.	
3.5.19	Is there a facility for defining 3D ROIs and obtaining volume and counts from these ROIs? If 'Yes', give brief details of the method used	
3.5.20	Can the system produce maximum intensity projection (MIP) displays of SPET data?	
3.5.21	Can the system produce 3D surface rendered displays of SPET data?	
3.5.22	Can such 3D rendered displays by viewed in cine mode?	
3.5.23	Can the system process gated tomography data? If 'Yes' what is the maximum on the number of frames per cardiac cycle that can be processed?	

3.6 Software development tools

3.6.1	Does the system provide a facility for producing macros ('protocols') of frequently used sequences of operations?	
3.6.2	Is the macro facility based on: a) A recorder technique (where user actions are automatically recorded but can't be changed)? b) A scripting language (where commands can be entered manually and edited if necessary)? c) A combined technique where user actions are converted into a script which can subsequently be edited	
3.6.3	If you employ a scripting language, is it: a) An 'industry standard' tool? (specify name and version) b) Specific to your system?	
3.6.4	Is the macro language interpreted or compiled?	
3.6.5	Does the associated text editor support 'cut and paste' operations?	
3.6.6	Can all standard utility software (e.g. for drawing ROIs, generating curves etc) be called from the macro? If 'No', specify any limitations?	
3.6.7	Are custom macros supplied to the user's specification as part of the standard price of the software package? If 'Yes', please specify any limitations on type or number	
3.6.8	Do you supply a fast high-level programming language that the user can use to write their own programs?	
3.6.9	If you supply a high level language, is it:	

	c) An industry standard tool? (specify name and version) d) Specific to your system?	
3.6.10	Is the high level language interpreted or compiled?	
3.6.11	Does the high level language include a debugger facility?	
3.6.12	Is a user manual provided with the high level language which fully describes: a) The syntax of the language b) Use of the editor c) Use of the compiler and debugger	
3.6.13	Is the high level language the same as that used to write the standard system software supplied with the system?	
3.6.14	Can the user make copies of programs from the standard system software and modify them for their own applications.	
3.6.15	Can programs written by the user be integrated into the system so that they can be used in the same way as the standard system software?	
3.6.16	Does the system provide a library of subroutines, callable from within the high level language, that gives user written programs access to the following functions? a) Patient database utilities b) Image manipulation c) Image display d) Region of interest generation and manipulation e) Curve generation and manipulation f) Hard copy generation g) Networking	
3.6.17	Is a user manual provided with the subroutine library that gives all necessary information for access to the above routines?	

4 Clinical software

It is acknowledged that, in principle, many of the analysis techniques described in this section can be performed using general ROI and curve utility software. However you should only answer 'Yes' to the following sections if you can supply software specifically designed for the particular clinical application described. This would, of course, include full documentation and references where appropriate. If any software packages are extra cost options then this must be indicated by the abbreviation ‘ECO’. If any software is licensed from a third party then this should also be indicated.

4.1 Static renal imaging

This section refers to software for processing static renal images acquired with ^{99m}Tc DMSA. The software should allow regions of interest to be drawn around the kidneys and calculate the relative function of each kidney.

4.1.1	Does the system include software for processing static renal images as described above?	
4.1.2	Are the required regions of interest drawn manually or automatically?	
4.1.3	Does the analysis include a background ROI?	
4.1.4	Does the software calculate relative function from the following? a) from the posterior view b) from the geometric mean of anterior and posterior views	

4.2 Dynamic renal imaging (renogram)

This section refers to software for processing dynamic renal studies acquired with ^{99m}Tc DTPA, ^{99m}TcMAG3 or ^{123}I OIH. The software should allow regions of interest to be drawn around the kidneys in order to produce renogram curves. The curves should be corrected for background and displayed.

4.2.1	Does the system include software for processing dynamic renal studies as described above?	
4.2.2	Can background subtraction be performed a) Using one or more manually drawn background region(s)? b) Using automatically generated peri-renal background regions? c) Using separate tissue and vascular background regions together with a Patlak-Rutland plot?	
4.2.3	Can the renogram curves be scaled to percent of administered activity?	
4.2.4	Does the software apply deconvolution to generate kidney retention functions?	
4.2.5	Does the software generate Patlak-Rutland plots?	
4.2.6	Does the software generate parametric images?	
4.2.7	Does the software calculate the following parameters of renal function? a) Relative function of each kidney b) Absolute renal function (GFR or ERPF)	

	c) Percent of administered activity in each kidney d) Parenchymal mean transit times e) Whole kidney mean transit times f) Time to peak of the renogram g) Frusemide response h) Renal output efficiency i) Washout T½ of the renogram	
4.2.8	Does the system include software to calculate the perfusion index for first pass renal transplant studies?	
4.2.9	Does the system include software to perform factor analysis of dynamic structure (FADS) for dynamic renal studies?	

4.3 Myocardial perfusion imaging

This section refers to software for analysing SPET myocardial perfusion images acquired with ^{201}Tl chloride, ^{99m}Tc Tetrofosmin or ^{99m}Tc MIBI. These studies may be acquired at stress or at rest and may be either ungated or with ECG gating.

4.3.1	Does the system include software for processing ungated myocardial perfusion studies?	
4.3.2	Can the software process stress and rest studies separately?	
4.3.3	Can the software process stress and rest studies together and compare the results?	
4.3.4	Can the system produce the ACC-recommended 3-axis display for rest & stress images?	
4.3.5	Can the software produce a polar map (Bullseye plot) of myocardial perfusion?	
4.3.6	Can the system provide automatic quantification of myocardial perfusion from ungated SPET studies?	
4.3.7	If ‘Yes’, specify the parameters which may be derived	
4.3.8	Does the system include software for processing gated myocardial perfusion studies?	
4.3.9	Can the software display beating images of the reconstructed gated data?	
4.3.10	Can the software calculate LVEF from the gated data?	
4.3.11	Can the software provide automatic quantification of myocardial perfusion from gated SPET studies?	
4.3.12	If ‘Yes’, specify the parameters which may be derived	

4.4 Gated cardiac blood pool imaging (MUGA)

This section refers to software for analysing ECG gated cardiac blood pool images acquired using ^{99m}Tc RBC or ^{99m}TC HSA. The software should generate background corrected left ventricular volume curves in order to measure left ventricular function.

4.4.1	Does the system include software for processing MUGA studies as described above?	

4.4.2	Can left ventricular regions of interest be generated by the following methods? a) Manually by the operator b) Semi-automatically from a master region drawn by the operator c) Fully automatically without any operator intervention	
4.4.3	Which of the following parameters of left ventricular function are produced? a) Left ventricular ejection fraction (LVEF) b) Peak filling rate (PFR) c) Peak emptying rate (PER) d) Regional ejection fractions e) Fourier phase and amplitude images f) Factor analysis of dynamic structure (FADS)	
4.4.4	Is specific software provided for processing gated blood pool SPET?	
4.4.5	If 'Yes', specify any quantitative imaging parameters which may be derived	

4.5 Cardiac first pass imaging

This section refers to software for analysing cardiac first-pass images acquired using ^{99m}Tc RBC, ^{99m}Tc HSA or ^{99m}Tc Pertechnetate.

4.5.1	Does the system include software for processing cardiac first pass studies as described above?	
4.5.2	Can the software be used to calculate left ventricular ejection fraction (LVEF)?	
4.5.3	Can the software be used to calculate right ventricular ejection fraction (RVEF)?	
4.5.4	Can the software be used to quantify left to right shunts?	

4.6 Cerebral perfusion imaging

This section refers to software for analysing cerebral perfusion SPET images acquired using ^{99m}Tc HMPAO. The software should produce a quantification of relative perfusion of different segments of the brain.

4.6.1	Does the system include software for processing cerebral perfusion studies as described above?	

4.7 Lung ventilation and perfusion imaging

This section refers to software for analysing lung ventilation and perfusion images acquired using ^{99m}Tc MAA for perfusion and either ^{99m}Tc Technegas, ^{99m}Tc DTPA aerosol, ^{81m}Kr gas or ^{133}Xe gas for ventilation.

4.7.1	Does the system include software for processing lung ventilation and perfusion studies as described above?	

4.7.2	Does the software calculate the following parameters of lung function? a) Ratio of ventilation to perfusion in each lung b) Ratio of ventilation to perfusion in individual lung segments c) Relative perfusion between right and left lung d) Relative ventilation between right and left lung e) Relative perfusion between different lung segments f) Relative ventilation between different lung segments	
4.7.3	Does the system include software for calculation of washout rates from ^{99m}Tc DTPA aerosol or ^{133}Xe ventilation studies?	

4.8 Parathyroid imaging

This section refers to software for analysing parathyroid/thyroid images. These may be acquired using either a dual isotope ^{201}Tl chloride / ^{99m}Tc pertechnetate technique or using ^{99m}Tc MIBI with early and delayed images.

4.8.1	Does the system include software for processing dual isotope ^{201}Tl/^{99m}Tc parathyroid/thyroid studies by a subtraction technique?	
4.8.2	Does the system include software for processing ^{99m}Tc MIBI parathyroid images?	

4.9 Gastric emptying

This section refers to software for analysing dynamic gastric emptying studies acquired using either liquid or solid meals labelled with ^{99m}Tc. The software should allow definition of a gastric region of interest and produce activity-time curves from which an emptying half-time can be calculated.

4.9.1	Does the system include software for processing gastric emptying studies as described above?	
4.9.2	Can the gastric curve be scaled to percent of administered activity?	
4.9.3	Does the software allow the gastric curve to be fitted a) With a single exponential function? b) With a bi-exponential function?	
4.9.4	Is the emptying half-time calculated from the actual curve or from the fit curve?	

4.10 Oesophageal imaging

This section refers to software for analysing dynamic oesophageal swallowing studies acquired using either liquid or solid meals labelled with ^{99m}Tc.

4.10.1	Does the system include software for processing oesophageal imaging studies as described above?:	
4.10.2	Does the software generate parametric images of oesophageal transit?	
4.10.3	Does the software calculate oesophageal transit times?	

4.11 Condensed dynamic images

This section refers to software for creating condensed images from dynamic studies. A condensed image is created by generating a profile at the same position on each frame of a dynamic study and stacking all the profiles together to form an image representing a space-time matrix.

4.11.1	Does the system include software for creating condensed images as described above?	
4.11.2	Can the software be used with oesophageal swallowing studies?	
4.11.3	Can the software be used with a dynamic renal study to demonstrate ureteric peristalsis?	
4.11.4	Can the software be used with a gastric emptying study to demonstrate gastric peristalsis?	

4.12 Movement correction

This section refers to software that can correct for inadvertent patient movement during imaging that might have an adverse effect on the quality of the data. This may apply to either dynamic or SPET studies.

4.12.1	Does the system include software for movement correction as described above?	
4.12.2	Can the software be used with a dynamic study (such as a renogram) to correct for the following movements? a) Vertical and horizontal movement of the patient b) Rotation of the patient by an arbitrary angle c) Rotation of the image by 90 degrees (in case the patient faints and the acquisition is continued with the patient lying down)	
4.12.3	Can the software be used with a myocardial SPET study to correct for the following movement? a) Axial movement of the patient (up and down on the image) b) Transverse movement of the patient (across the image)	
4.12.4	Can the software be used with any other SPET study (non-myocardial) to correct for the following movement? a) Axial movement of the patient (up and down on the image) b) Transverse movement of the patient (across the image)	

4.13 Image registration

This section refers to software for shifting, rotating and magnifying images, or sequences of images, so that they align with some predefined reference. This may apply to static, dynamic or SPET studies and the reference may be another image, possibly from a different modality.

4.13.1	Does the system include software for image registration as described above?	
4.13.2	Can the software be used to register one SPET study with another SPET study of the same organ but from a different patient?	

4.13.3	Can the software be used to register SPET images with CT images of the same patient?	
4.13.4	Can the software be used to register SPET images with MRI images of the same patient?	
4.13.5	Can two such co-registered sets of images be displayed overlaid on one another?	

4.14 Database of normal studies

4.14.1	Provide brief details of any databases of normal studies for any of the software packages described in section 4, including any acquisition or processing dependency inherent in the database	

4.15 Other clinical software packages available

4.15.1	Provide brief details of any additional clinical software packages included.	

5 System utilities

5.1 Patient database management software

5.1.1	Does the system include patient database management software for indexing all patient studies that are stored on the system?	
5.1.2	Can a list of available patient studies include the following fields? a) Patient name b) Patient ID c) Patient date of birth d) Patient sex e) Study name f) Study type (eg bone, renal etc) g) Study date h) Study status (eg processed, archived etc) i) Acquisition mode (static, dynamic, whole body, SPET etc)	
5.1.3	Can the operator choose to display the list of available studies sorted in order by the following fields?. a) Patient name b) Patient ID c) Patient date of birth d) Patient sex e) Study name f) Study type (eg bone, renal etc) g) Study date h) Study status (eg processed, archived etc)	
5.1.4	Can the operator search for studies that match the following criteria? a) Exact patient name b) Patient name including wild cards c) Patient ID d) Date of birth or age e) Date of birth range or approximate age f) Patient sex g) Study name h) Study type (eg bone, renal etc) i) Range of study dates	
5.1.5	Can the searches of 5.1.4 be made for a) Studies currently on this computer? b) Current studies plus archived studies?	

	c) All studies on this and other computers on the network?	
5.1.6	Can the user edit the following details in the patient database? a) Patient details (specify whether none, all or some) b) Study details (specify whether none, all or some) c) Acquisition parameters (specify whether none, all or some)	
5.1.7	What methods are available for deleting old studies that have been processed and archived? a) Manual deletion of individual selected studies b) Manual deletion of a range of selected studies c) Automatic deletion of studies after a given time provided that they have been archived	
5.1.8	Can individual studies be marked as protected so that they cannot be deleted?	
5.1.9	Describe any other mechanisms that exist to prevent accidental deletion of studies before they have been processed and archived	
5.1.10	Does the system have an HL7 HIS/RIS interface?	

5.2 Data transfer

5.2.1	Is the processing workstation capable of connecting to other systems using standard Ethernet protocols?	
5.2.2	What is the speed of the network interface?	
5.2.3	Does the network system support the following protocols? a) TCP/IP b) OSI c) NFS d) DICOM e) Other (specify)	
5.2.4	Can the system be connected to remote networks via a dial-up modem?	
5.2.5	Can the system be connected to remote networks via ISDN link?	
5.2.6	Can processed images be exported to a remote system in the following formats? a) The systems own internal format b) DICOM c) Interfile d) Other (specify)	
5.2.7	Do these export functions work with all image types? If no, specify any limitations of format and image type	
5.2.8	Do you hold an Interfile 3.3 Conformance Claim (ref: COST B2)?	

5.2.9	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)?	
5.2.10	Can an operator sitting at the processing workstation send selected image files to another workstation (Push function)?	
5.2.11	Can an operator sitting at another workstation transfer selected image files from the processing workstation (Pull function)?	

5.3 Archiving and backup

5.3.1	Is software supplied to enable acquired data to be archived for long term storage using any of the following media? a) Floppy disk b) ZIP disc c) CD d) DVD e) WORM optical disc f) Re-writable optical disk g) Tape cartridge h) Other (specify)	
5.3.2	What format is used for the above data archive? a) Interfile b) DICOM c) Other public format (specify) d) Manufacturer's proprietary format	
5.3.3	If the archive uses data compression please state a typical compression ratio, otherwise state 1:1 a) For loss-less compression b) For lossy compression	
5.3.4	What data can be archived? a) Patient and study details b) Acquired images c) Processed images d) Regions of interest e) Curves	
5.3.5	How can archiving be initiated? a) Manually using operator selected data b) Manually using all non-archived data c) Automatically at a given time of day	
5.3.6	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?	

5.3.7	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)	
5.3.8	If studies have been archived more than once (eg to two different media) can this be determined from the main patient listing?	
5.3.9	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?	
5.3.10	Does the above index allow archived studies to be located by the following criteria? a) Patient name b) Patient ID c) Study name d) Study type e) Study date	
5.3.11	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.?	
5.3.12	Is it possible for the user to make a backup of system software (other than acquired study data) using any of the following media? a) Floppy disk b) ZIP disc c) CD d) DVD e) WORM optical disc f) Re-writable optical disk g) Tape cartridge h) Other (specify)	
5.3.13	What files can be included in this backup? a) Complete software b) Changed files only c) All files modified by the user d) User written programs e) User customisation f) Study data archive index	

5.4 Data security

5.4.1	Does the system provide log-on/log-off facilities with appropriate password protection? a) No passwords required b) One login name and password shared by all users	

	c) Separate login name and password for administrators and service personnel, but all other users share the same password d) Individual login name and password for every user	
5.4.2	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?	
5.4.3	Can the highest level user ('administrator') define access rights for individual users?	
5.4.4	Can security of unattended workstations be provided without actually logging-off (eg by use of a password-protected screensaver)?	
5.4.5	Does the system provide facilities for the encryption of data for transmission over public networks?	

6 Hard copy

The next four sections request information about hard copy devices that are available with the system. These may be manufactured by the supplier or by a third party. However, suppliers should only include hard copy devices that they are able to supply and support. Four different categories of device are included; monochrome film, colour film, colour prints and paper prints. If suppliers are able to offer more than one device in any category then they should include an additional copy of the relevant section.

6.1 Monochrome film

Please specify here details of the hard copy device that you recommend for producing high resolution monochrome images on transparent film. The image quality should be suitable for reporting from a viewing box.

6.1.1	Specify the make and model of the device?	
6.1.2	What is the capital cost of the device (if not included with the system)?	
6.1.3	What is the cost of consumables (expressed as cost per film)?	
6.1.4	What printing method is used by the device? Specify whether this is a ‘dry’ or ‘wet’ process. (eg direct thermal transfer dry process)	
6.1.5	What is the print resolution (expressed as pixels/image or dpi)?	
6.1.6	How many distinct grey levels can it reproduce?	
6.1.7	What is the size of each film?	
6.1.8	What output media is available (eg blue base film, clear base film)?	
6.1.9	What image format options are available (e.g. 1, 4, 9, images per film)?	
6.1.10	How long does it take to print a typical film (seconds)?	
6.1.11	How is the device physically connected (eg analogue video, network)?	
6.1.12	What data input formats are supported (eg monochrome video, DICOM, Postscript etc)?	
6.1.13	Does the device include user accessible adjustment of image brightness and contrast?	
6.1.14	Does the device include user accessible adjustment of the film response curve?	

6.2 Colour film

Please specify here details of the hard copy device that you recommend for producing high resolution colour images on transparent film. The image quality should be suitable for reporting from a viewing box.

6.2.1	Specify the make and model of the device?	
6.2.2	What is the capital cost of the device (if not included with the system)?	
6.2.3	What is the cost of consumables (expressed as cost per film)?	
6.2.4	What printing method is used by the device? Specify whether this is a 'dry' or 'wet' process. (eg direct thermal transfer dry process)	
6.2.5	What is the print resolution (expressed as pixels/image or dpi)?	
6.2.6	How many different colour tones can it reproduce?	
6.2.7	What is the size of each film?	
6.2.8	What output media is used?	
6.2.9	What image format options are available (e.g. 1, 4, 9, images per film)?	
6.2.10	How long does it take to print a typical film (seconds)?	
6.2.11	How is the device physically connected (eg analogue video, network)?	
6.2.12	What data input formats are supported (eg RGB video, DICOM, Postscript etc)?	
6.2.13	Does the device include user accessible adjustment of image brightness and contrast?	
6.2.14	Does the device include user accessible adjustment of the film response curve?	

6.3 Colour prints

Please specify here details of the hard copy device that you recommend for producing photographic quality colour images on opaque film. The image quality should be suitable for journal publication.

6.3.1	Specify the make and model of the device?	
6.3.2	What is the capital cost of the device?	
6.3.3	What is the cost of consumables (expressed as cost per print)?	
6.3.4	What printing method is used by the device (eg dye-sublimation)?	
6.3.5	What is the print resolution (expressed as pixels/image or dpi)?	
6.3.6	How many different colour tones can it reproduce?	
6.3.7	What is the size of each print?	
6.3.8	What output media is used (eg glossy paper)?	
6.3.9	What image format options are available (e.g. 1, 4, 9, images per film)?	
6.3.10	How long does it take to print a typical film (seconds)?	
6.3.11	How is the device physically connected (eg analogue video, network)?	
6.3.12	What data input formats are supported (eg RGB video, DICOM, Postscript etc)?	

6.3.13	Does the device include user accessible adjustment of image brightness and contrast?	
6.3.14	Does the device include user accessible adjustment of the film response curve?	

6.4 Paper prints

Please specify here details of the hard copy device that you recommend for producing general purpose colour and monochrome images. The image quality should be suitable for inclusion in patient notes but need not be reporting quality.

6.4.1	Specify the make and model of the device?	
6.4.2	What is the capital cost of the device?	
6.4.3	What is the cost of consumables (expressed as cost per print)?	
6.4.4	What printing method is used by the device (eg laser, ink-jet)?	
6.4.5	What is the print resolution (expressed as pixels/image or dpi)?	
6.4.6	Can the device print true monochrome (black ink), colour or both?	
6.4.7	What is the size of each print?	
6.4.8	What output media is used (eg plain paper)?	
6.4.9	What image format options are available (e.g. 1, 4, 9, images per film)?	
6.4.10	How long does it take to print a typical film (seconds)?	
6.4.11	How is the device physically connected (eg network)?	
6.4.12	What data input formats are supported (eg DICOM, Postscript etc)?	
6.4.13	Does the device include user accessible adjustment of image brightness and contrast?	
6.4.14	Does the device include user accessible adjustment of the film response curve?	

6.5 General printing features

6.5.1	Can the full screen display be printed exactly as shown on the monitor, including all text annotation?	
6.5.2	Can individual screen images be printed on their own without displaying the required image full screen?	
6.5.3	How long does it take for the workstation to become re-usable once printing has been initiated?	
6.5.4	Can the system print to a local printer connected directly to the computer?	
6.5.5	Can the system print to a networked printer connected elsewhere on the network?	
6.5.6	Can the system be interfaced to a radiology department laser imager? If yes, specify the models which can be interfaced.	
6.5.7	Can grey level correction (gamma correction) be applied by the system before data is sent to the printer so that monochrome hard copy images can be corrected for non-linear film response?	

6.5.8	Can colour correction be applied by the system before data is sent to the printer, so that the colours of hard copy images can be adjusted to closely match the image displayed on screen?	
6.5.9	Can the screen display be captured to a disc file in the following formats? a) JPEG b) GIF c) AVI (for cine displays) d) Other (specify)	

7 General

7.1 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.

7.1.1	Assuming average use, indicate the anticipated useful life expectancy of the data processing system (years).	
7.1.2	Is there a guarantee that sufficient spares will be kept to ensure the operation of the system for a full 5 years from the date of purchase?	
7.1.3	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.	
7.1.4	Provide details of any alternative arrangements, including geography and training, in the event of the above engineer(s) not being available.	
7.1.5	Have you enclosed details of the full range of service contracts available (hardware and software), including prices?	
7.1.6	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.	
7.1.7	Is some type of on-line diagnostic tool for hardware fault detection available?	
7.1.8	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.	
7.1.9	Are additional discounts available if service contracts are paid for in advance (i.e. at time of equipment purchase).	
7.1.10	If so, have you included details of these additional discount offers?	
7.1.11	What is the hourly charge (excl. VAT) for non-contract call-outs?	
7.1.12	Is travelling time charged for (for non-contract work)?	
7.1.13	If so, at what rate (excl. VAT) is travelling time charged?	
7.1.14	Is there a minimum call-out charge?	
7.1.15	If so, what is the minimum charge (excl. VAT)?	

7.2 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.

7.2.1	Specify the weight and packed size of the data processor and all major hardware components to be installed.	

7.2.2	Specify the electrical power requirements of all hardware to be installed	
7.2.3	Specify any necessary pre-installation work, with particular emphasis on power points and network connections	

7.3 Purchase, installation and training

7.3.1	Specify the guaranteed delivery time from placement of order (weeks)	
7.3.2	Specify the time required on site to install the system to the point where it can be handed over for acceptance testing (working days).	
7.3.3	Specify the standard provision for on-site operator training post-installation.	

7.4 Quality management

7.4.1	Is your company accredited under BS EN ISO 9000 (formerly BS 5750)?	
7.4.2	If 'Yes', give the certificate number and date achieved.	
7.4.3	Does your company employ a recognised software development methodology?	
7.4.4	If 'Yes', please state name of the method.	
7.4.5	Is your company accredited under the UK TickIT scheme for software quality?	
7.4.6	If 'Yes', give certificate number and date achieved.	
7.4.7	Is your company accredited to any other IT-specific standards?	
7.4.8	If 'Yes', please name them and the date they were achieved	

7.5 Supporting documentation

7.5.1	Is the system supplied with an Operator's Manual that includes following: a) A basic description of system operation? b) A detailed description of utility software? c) A detailed description of the operating system, including file structures / formats? d) A detailed description of clinical software, including intended application(s) and references to scientific papers? e) A detailed description of data backup procedures?	
7.5.2	Are all software upgrades fully documented, including the ways in which changes to subroutines, etc, may affect user protocols and programs?	