**APPENDIX 3B**

**LOT 2 SPECIFICATION**
**MAGNETIC RESONANCE IMAGING SCANNERS AND ASSOCIATED OPTIONS AND RELATED SERVICES**

## 1. Introduction

1.1. This Lot is for the supply of Magnetic Resonance Imaging (MRI) scanners in systems designed to address routine MRI studies and with configurations to include bore variations to improve the patient experience as well as those dedicated to extremity studies.

1.2. The core product lines within this Lot are as follows:

| Line Number | |
|---|---|
| 1 | Standard 1.5T MRI system |
| 2 | Wide bore 1.5T MRI system |
| 3 | Standard 3.0T MRI system |
| 4 | Wide bore 3.0T MRI system |
| 5 | Open <1.5T MRI system |
| 6 | Extremity 0.2T MRI system |

1.3. All product line(s) must be supplied with a minimum 10 year expected lifecycle under proper use and maintenance.

1.4. Installation is required (excluding any interface) and must be included and undertaken at a location specified by the customer.

1.5. Initial end user training must be included upon installation, or at a time requested by the customer.

1.6. Initial advanced software application training must be included upon installation, or at a time requested by the customer.

## 2. Line 1 – Standard 1.5T MRI system

2.1. This is the core technical specification for a Standard 1.5T (Tesla) MRI System designed with a standard bore (60 cm) and 1.5 T magnetic field strength for all routine MRI studies. This category of system is intended to perform all routine MR studies.

2.2. The core components of a standard 1.5T MRI system:
2.2.1. Magnet including covers.
2.2.2. Gradient sub-system.

2.2.3. Radio-Frequency transmission and receiving sub-system.
2.2.4. Patient table and patient handling.
2.2.5. Image reconstruction computer.
2.2.6. User control terminal.
2.2.7. Ancillary equipment necessary for MRI operation including power distribution and conditioning, chiller, uninterruptible power supply (for computer) where turnkey works are to be completed by the OEM.

2.3. Magnet including covers:
2.3.1. The magnet must be of superconducting design.
2.3.2. The magnetic field must not change more than 0.1ppm per hour.
2.3.3. Active shimming must be used to maintain homogeneity during image acquisition.
2.3.4. The magnetic field must be actively or passively shielded.
2.3.5. The primary magnetic field strength must be 1.5T.
2.3.6. The magnet bore (including covers) must not be less than 60cm at the narrowest point.
2.3.7. The magnet length (including covers) must be no more than 2 metres.
2.3.8. The useful field of view must be at least 45cm x 45cm x 45cm.
2.3.9. The guaranteed field homogeneity must be less than 1.5ppm within a 30cm diameter spherical volume.
2.3.10. The guaranteed field homogeneity must be less than 7.5ppm within a 45cm diameter spherical volume.
2.3.11. The fringe magnetic field must be less than 0.5mT at a distance of 3 metres radially from the isocentre.
2.3.12. The fringe magnetic field must be less than 0.5mT at a distance of 5 metres axially from the isocentre.

2.4. Gradient sub-system:
2.4.1. The maximum gradient strength must be at least 30mT/m.
2.4.2. The maximum gradient slew rate must be at least 100T/m/s.
2.4.3. The minimum repetition time (TR) in spin echo pulse sequences must be no longer than 130 milliseconds against a 256 matrix.
2.4.4. The minimum TR in 2D gradient echo pulse sequences must be no longer than 3.4 milliseconds against a 256 matrix.
2.4.5. The minimum TR in 3D gradient echo pulse sequences must be no longer than 2.5 milliseconds against a 256 matrix.
2.4.6. The minimum echo spacing in echo planar imaging (EPI) must be no longer than 0.8 milliseconds against a 128 matrix.

2.5. Radio-Frequency transmission and receiving sub-system:
2.5.1. Each channel must have a maximum bandwidth of at least 1MHz.
2.5.2. The system must be capable of parallel imaging techniques with a maximum acceleration factor of at least 3.
2.5.3. The system must have at least 8 independent receiving RF channels.
2.5.4. A head coil with at least 6 channels must be included.

2.5.5. A spine coil with at least 8 channels and 48cm superior to inferior coverage must be included.
2.5.6. A torso coil with at least 6 channels and 45cm superior to inferior coverage must be included (may be achieved with multiple coils).

2.6. Patient table and patient handling:
2.6.1. The maximum patient weight with full patient table movement must be at least 150kg.
2.6.2. It must be possible to lower the patient table to at least 70 cm from the floor.
2.6.3. The MR system must have a capability for a detachable patient table or be provided with a MR safe patient transfer trolley.
2.6.4. Padding for patient safety must be provided.
2.6.5. Acoustic noise reduction such as ear protection or alternative method must be provided.
2.6.6. The system must include a 2 way patient to radiographer intercom.
2.6.7. The system must include a patient panic button or alternative.
2.6.8. The system must include adjustable bore ventilation and lighting.

2.7. Image Reconstruction Computer:
2.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
2.7.2. The system must include at least 8GB RAM.

2.8. User Control Terminal:
2.8.1. The user control must include a graphic user interface.
2.8.2. Full multi-tasking must be possible.
2.8.3. The user control terminal must meet the minimum PACS (Picture Archiving and Communication System) connectivity requirements as well as supporting alternative physical storage mechanisms (e.g. DVD, USB):
2.8.3.1. The terminal must connect to the Trust's PACS providing the following DICOM functionality as a minimum:
-DICOM HIS/RIS Interface.
-DICOM Modality Worklist Management (MWM).
-DICOM Query/Retrieve SCU.
-DICOM Query/Retrieve SCP.
-DICOM Storage SCP.
-DICOM Storage Commitment.
-Modality Perform Procedure Step (MPPS).
2.8.4. The user control panel must display the specific absorption rate based on the patient's weight.
2.8.5. The user control must be capable of the automation of routine workflow steps.
2.8.6. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).

2.8.7. Image analysis tools must be provided including region of interest measurements.

2.8.8. In addition to all standard pulse sequences, the following clinical functionality must be available:

2.8.8.1. Patient movement compensated image acquisition.

2.8.8.2. Isometric 3D T1 imaging.

2.8.8.3. Isometric 3D fast spin echo (T2) image acquisition.

2.8.8.4. Gradient Echo including spoiled techniques, rewound techniques, steady state free precession.

2.8.8.5. Inversion Recovery.

2.8.8.6. Magnetisation Transfer Contrast.

2.8.8.7. Susceptibility weighted imaging (SWI).

2.8.8.8. Diffusion Imaging.

2.8.8.9. Contrast Enhanced Imaging.

2.8.8.10. Non-Contrast Angiographic Imaging including time of flight, phase contrast, SSFP (Steady State Free Precession), and ECG (Electrocardiogram) gated.

## 3. Line 2 – Wide bore 1.5T MRI system

3.1. This is the core technical specification for a wide bore 1.5T MRI system designed with a wide bore (>65 cm) and 1.5T magnetic field strength for general imaging. This category of system is intended to perform all routine MR studies and combine the high image quality achievable at 1.5T field strengths with a short 'open bore' design. These designs can improve patient acceptance, for instance in the case of claustrophobics and children, and enable the scanning of bariatric patients.

3.2. The core components of a wide bore 1.5T MRI system:

3.2.1. Magnet including covers.

3.2.2. Gradient sub-system.

3.2.3. Radio-Frequency transmission and receiving sub-system.

3.2.4. Patient table and patient handling.

3.2.5. Image reconstruction computer.

3.2.6. User control terminal.

3.2.7. Ancillary equipment necessary for MRI operation including power distribution and conditioning, chiller, uninterruptible power supply (for computer) where turnkey works are to be completed by the OEM.

3.3. Magnet including covers:

3.3.1. The magnet must be of superconducting design.

3.3.2. The magnetic field must not change more than 0.1ppm per hour.

3.3.3. Active shimming must be used to maintain homogeneity during image acquisition.

3.3.4. The magnetic field must be actively or passively shielded.

3.3.5. The primary magnetic field strength must be 1.5T.

3.3.6. The magnet bore (including covers) must not be less than 69cm at the narrowest point.
3.3.7. The magnet length (including covers) must be no more than 1.9 metres.
3.3.8. The useful field of view must be at least 50cm x 50cm x 30cm.
3.3.9. The guaranteed field homogeneity must be less than 1.0ppm within a 30cm diameter spherical volume.
3.3.10. The guaranteed field homogeneity must be less than 2.5ppm within a 45cm diameter spherical volume.
3.3.11. The fringe magnetic field must be less than 0.5mT at a distance of 3.1 metres radially from the isocentre.
3.3.12. The fringe magnetic field must be less than 0.5mT at a distance of 5 metres axially from the isocentre.

3.4. Gradient sub-system:
3.4.1. The maximum gradient strength must be at least 30mT/m.
3.4.2. The maximum gradient slew rate must be at least 100T/m/s.
3.4.3. The minimum repetition time (TR) in spin echo pulse sequences must be no longer than 130 milliseconds against a 256 matrix.
3.4.4. The minimum TR in 2D gradient echo pulse sequences must be no longer than 3.3 milliseconds against a 256 matrix.
3.4.5. The minimum TR in 3D gradient echo pulse sequences must be no longer than 2.5 milliseconds against a 256 matrix.
3.4.6. The minimum echo spacing in echo planar imaging (EPI) must be no longer than 0.8 milliseconds against a 128 matrix.

3.5. Radio-Frequency transmission and receiving sub-system:
3.5.1. Each channel must have a maximum bandwidth of at least 1MHz.
3.5.2. The system must be capable of parallel imaging techniques with a maximum acceleration factor of at least 3.
3.5.3. The system must have at least 8 independent receiving RF channels.
3.5.4. A head coil with at least 8 channels must be included.
3.5.5. A spine coil with at least 8 channels and 48cm superior to inferior coverage must be included.
3.5.6. A torso coil with at least 6 channels and 50cm superior to inferior coverage must be included (may be achieved with multiple coils).

3.6. Patient table and patient handling:
3.6.1. The maximum patient weight with full patient table movement must be at least 150kg.
3.6.2. It must be possible to lower the patient table to at least 70 cm from the floor.
3.6.3. The MR system must either have a detachable patient table or be provided with a MR safe patient transfer trolley if required.
3.6.4. Padding for patient safety must be provided.
3.6.5. Acoustic noise reduction such as ear protection or alternative method must be provided.

3.6.6. The system must include a 2 way patient to radiographer intercom.
3.6.7. The system must include a patient panic button or alternative.
3.6.8. The system must include adjustable bore ventilation and lighting.
3.6.9. Coil connection sockets must be included at one or both ends of the patient table.

3.7. Image reconstruction computer:
3.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
3.7.2. The system must include at least 8GB RAM.

3.8. User control terminal:
3.8.1. The user control must include a graphic user interface.
3.8.2. Full multi-tasking must be possible.
3.8.3. The user control terminal must meet the minimum PACS (Picture Archiving and Communication System) connectivity requirements as well as supporting alternative physical storage mechanisms (e.g. DVD, USB):
3.8.3.1. The terminal must connect to the Trust's PACS providing the following DICOM functionality as a minimum:
-DICOM HIS/RIS Interface.
-DICOM Modality Worklist Management (MWM).
-DICOM Query/Retrieve SCU.
-DICOM Query/Retrieve SCP.
-DICOM Storage SCP.
-DICOM Storage Commitment.
-Modality Perform Procedure Step (MPPS).
3.8.4. The user control panel must display the specific absorption rate based on the patient's weight.
3.8.5. The user control must be capable of the automation of routine workflow steps.
3.8.6. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).
3.8.7. Image analysis tools must be provided including region of interest measurements.
3.8.8. In addition to all standard pulse sequences, the following clinical functionality must be available:
3.8.8.1. Patient movement compensated image acquisition.
3.8.8.2. Isometric 3D T1 imaging.
3.8.8.3. Isometric 3D fast spin echo (T2) image acquisition.
3.8.8.4. Gradient Echo including spoiled techniques, rewound techniques, steady state free precession.
3.8.8.5. Inversion Recovery.
3.8.8.6. Magnetisation Transfer Contrast
3.8.8.7. Susceptibility weighted imaging (SWI).
3.8.8.8. Diffusion Imaging.
3.8.8.9. Contrast Enhanced Imaging.

3.8.8.10. Non-Contrast Angiographic Imaging including time of flight, phase contrast, SSFP (Steady State Free Precession), and ECG (Electrocardiogram) gated.

## 4. Line 3 – Standard 3.0T MRI System

4.1. This is the core technical specification for a Standard 3.0T MRI system designed with a standard bore (60cm) and 3.0T magnetic field strength for general imaging. This category of system is intended to perform all routine MR studies. In addition, the system must be able to perform spectroscopy and functional imaging if required.

4.2. The core components of a standard 3.0T MRI system:

4.2.1. Magnet including covers.
4.2.2. Gradient sub-system.
4.2.3. Radio-Frequency transmission and receiving sub-system.
4.2.4. Patient table and patient handling.
4.2.5. Image reconstruction computer.
4.2.6. User control terminal.
4.2.7. Ancillary equipment necessary for MRI operation including power distribution and conditioning, chiller, uninterruptible power supply (for computer) where turnkey works are to be completed by the OEM.

4.3. Magnet including covers:

4.3.1. The magnet must be of superconducting design.
4.3.2. The magnetic field must not change more than 0.1ppm per hour.
4.3.3. Active shimming must be used to maintain homogeneity during image acquisition.
4.3.4. The magnetic field must be actively or passively shielded.
4.3.5. The primary magnetic field strength must be 3T.
4.3.6. The magnet bore (including covers) must not be less than 60cm at the narrowest point.
4.3.7. The magnet length (including covers) must be no more than 2 metres.
4.3.8. The useful field of view must be at least 45cm x 45cm x 45cm.
4.3.9. The guaranteed field homogeneity must be less than or equal 0.3ppm within a 30cm diameter spherical volume.
4.3.10. The guaranteed field homogeneity must be less than 4.0ppm within a 40cm diameter spherical volume.
4.3.11. The fringe magnetic field must be less than 0.5mT at a distance of 4 metres radially from the isocentre.
4.3.12. The fringe magnetic field must be less than 0.5mT at a distance of 6.5 metres axially from the isocentre.

4.4. Gradient sub-system:

4.4.1. The maximum gradient strength must be at least 30mT/m.
4.4.2. The maximum gradient slew rate must be at least 100T/m/s.

4.4.3. The minimum repetition time (TR) in spin echo pulse sequences must be no longer than 130 milliseconds against a 256 matrix.
4.4.4. The minimum TR in 2D gradient echo pulse sequences must be no longer than 3.3 milliseconds against a 256 matrix.
4.4.5. The minimum TR in 3D gradient echo pulse sequences must be no longer than 2.5 milliseconds against a 256 matrix.
4.4.6. The minimum echo spacing in echo planar imaging (EPI) must be no longer than 0.4 milliseconds against a 128 matrix.

4.5. Radio-Frequency transmission and receiving sub-system:
4.5.1. Each channel must have a maximum bandwidth of at least 1MHz.
4.5.2. The system must be capable of parallel imaging techniques with a maximum acceleration factor of at least 3.
4.5.3. The system must have at least 16 independent receiving RF channels with the option of increasing to 32 channels.
4.5.4. A head coil with at least 8 channels must be included.
4.5.5. A spine coil with at least 8 channels and 90 cm superior to inferior coverage must be included.
4.5.6. A torso coil with at least 12 channels and 50cm superior to inferior coverage must be included (may be achieved with multiple coils).

4.6. Patient table and patient handling:
4.6.1. The maximum patient weight with full patient table movement must be at least 150kg.
4.6.2. It must be possible to lower the patient table to at least 70cm from the floor.
4.6.3. The MR system must either have a detachable patient table or be provided with a MR safe patient transfer trolley if required.
4.6.4. Padding for patient safety must be provided.
4.6.5. Acoustic noise reduction such as ear protection or alternative method must be provided.
4.6.6. The system must include a 2 way patient to radiographer intercom.
4.6.7. The system must include a patient panic button or alternative.
4.6.8. The system must include adjustable bore ventilation and lighting.
4.6.9. Coil connection sockets must be included at one or both ends of the patient table and/or on the magnet.

4.7. Image reconstruction computer:
4.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
4.7.2. The system must include at least 8 GB RAM.

4.8. User control terminal:
4.8.1. The user control must include a graphic user interface.
4.8.2. Full multi-tasking must be possible.

4.8.3. The user control terminal must meet the minimum PACS (Picture Archiving and Communication System) connectivity requirements as well as supporting alternative physical storage mechanisms (e.g. DVD, USB):

4.8.3.1. The terminal must connect to the Trust's PACS providing the following DICOM functionality as a minimum:
-DICOM HIS/RIS Interface.
-DICOM Modality Worklist Management (MWM).
-DICOM Query/Retrieve SCU.
-DICOM Query/Retrieve SCP.
-DICOM Storage SCP.
-DICOM Storage Commitment.
-Modality Perform Procedure Step (MPPS).

4.8.4. The user control panel must display the specific absorption rate based on the patient's weight.

4.8.5. The user control must be capable of the automation of routine workflow steps.

4.8.6. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).

4.8.7. Image analysis tools must be provided including region of interest measurements.

4.8.8. In addition to all standard pulse sequences, the following clinical functionality must be available:

4.8.8.1. Patient movement compensated image acquisition.
4.8.8.2. Isometric 3D T1 imaging.
4.8.8.3. Isometric 3D fast spin echo (T2) image acquisition.
4.8.8.4. Gradient echo including spoiled techniques, rewound techniques, steady state free precession.
4.8.8.5. Inversion recovery.
4.8.8.6. Magnetisation Transfer Contrast.
4.8.8.7. Susceptibility weighted imaging (SWI).
4.8.8.8. Diffusion imaging.
4.8.8.9. Contrast enhanced imaging.
4.8.8.10. Non-Contrast Angiographic Imaging including time of flight, phase contrast, SSFP (Steady State Free Precession), and ECG (Electrocardiogram) gated.

## 5. Line 4 – Wide bore 3T MRI system

5.1. This is the core technical specification for a wide bore 3T MRI system designed with a wide bore (>65 cm) and 3T magnetic field strength for general imaging. This category of system is intended to perform all routine MR studies and combine the high image quality achievable at 3T field strengths with a short 'open bore' design. These designs can improve patient acceptance, for instance in the case of claustrophobics and children, and enable the scanning of bariatric patients.

5.2. The core components of a wide bore 3T MRI system:

5.2.1. Magnet including covers.
5.2.2. Gradient sub-system.
5.2.3. Radio-Frequency transmission and receiving sub-system.
5.2.4. Patient table and patient handling.
5.2.5. Image reconstruction computer.
5.2.6. User control terminal.
5.2.7. Ancillary equipment necessary for MRI operation including power distribution and conditioning, chiller, uninterruptible power supply (for computer) where turnkey works are to be completed by the OEM.

5.3. Magnet including covers:

5.3.1. The magnet must be of superconducting design.
5.3.2. The magnetic field must not change more than 0.1ppm per hour.
5.3.3. Active shimming must be used to maintain homogeneity during image acquisition.
5.3.4. The magnetic field must be actively or passively shielded.
5.3.5. The primary magnetic field strength must be 3T.
5.3.6. The magnet bore (including covers) must not be less than 69cm at the narrowest point.
5.3.7. The magnet length (including covers) must be no more than 1.9 metres.
5.3.8. The useful field of view must be at least 50cm x 50cm x 40cm.
5.3.9. The guaranteed field homogeneity must be less than or equal to 0.3ppm within a 30cm spherical volume.
5.3.10. The guaranteed field homogeneity must be less than 4.0ppm within a 40cm diameter spherical volume.
5.3.11. The fringe magnetic field must be less than 0.5mT at a distance of 3.1 metres radially from the isocentre.
5.3.12. The fringe magnetic field must be less than 0.5mT at a distance of 5 metres axially from the isocentre.

5.4. Gradient sub-system:

5.4.1. The maximum gradient strength must be at least 30mT/m.
5.4.2. The maximum gradient slew rate must be at least 100T/m/s.
5.4.3. The minimum repetition time (TR) in spin echo pulse sequences must be no longer than 130 milliseconds against a 256 matrix.
5.4.4. The minimum TR in 2D gradient echo pulse sequences must be no longer than 3.3 milliseconds against a 256 matrix.
5.4.5. The minimum TR in 3D gradient echo pulse sequences must be no longer than 2.5 milliseconds against a 256 matrix.
5.4.6. The minimum echo spacing in echo planar imaging (EPI) must be no longer than 0.4 milliseconds against a 128 matrix.

5.5. Radio-Frequency transmission and receiving sub-system:

5.5.1. Each channel must have a maximum bandwidth of at least 1MHz.

5.5.2. The system must be capable of parallel imaging techniques with a maximum acceleration factor of at least 3.
5.5.3. The system must have at least 8 independent receiving RF channels.
5.5.4. A head coil with at least 8 channels must be included.
5.5.5. A spine coil with at least 8 channels and 90 cm superior to inferior coverage must be included.
5.5.6. A torso coil with at least 6 channels and 50 cm superior to inferior coverage must be included (may be achieved with multiple coils).

5.6. Patient table and patient handling:
5.6.1. The maximum patient weight with full patient table movement must be at least 150kg.
5.6.2. It must be possible to lower the patient table to at least 70 cm from the floor.
5.6.3. The MR system must either have a detachable patient table or be provided with a MR safe patient transfer trolley if required.
5.6.4. Padding for patient safety must be provided.
5.6.5. Acoustic noise reduction such as ear protection or alternative method must be provided.
5.6.6. The system must include a 2 way patient to radiographer intercom.
5.6.7. The system must include a patient panic button or alternative.
5.6.8. The system must include adjustable bore ventilation and lighting.
5.6.9. Coil connection sockets must be included at one or both ends of the patient table.

5.7. Image reconstruction computer:
5.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
5.7.2. The system must include at least 8GB RAM.

5.8. User control terminal:
5.8.1. The user control must include a graphic user interface.
5.8.2. Full multi-tasking must be possible.
5.8.3. The user control terminal must meet the minimum PACS (Picture Archiving and Communication System) connectivity requirements as well as supporting alternative physical storage mechanisms (e.g. DVD, USB):
5.8.3.1. The terminal must connect to the Trust's PACS providing the following DICOM functionality as a minimum:
-DICOM HIS/RIS Interface.
-DICOM Modality Worklist Management (MWM).
-DICOM Query/Retrieve SCU.
-DICOM Query/Retrieve SCP.
-DICOM Storage SCP.
-DICOM Storage Commitment.
-Modality Perform Procedure Step (MPPS).

5.8.4. The user control panel must display the specific absorption rate based on the patient's weight.
5.8.5. The user control must be capable of the automation of routine workflow steps.
5.8.6. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).
5.8.7. Image analysis tools must be provided including region of interest measurements.
5.8.8. In addition to all standard pulse sequences, the following clinical functionality must be available:
5.8.8.1. Patient movement compensated image acquisition.
5.8.8.2. Isometric 3D T1 imaging.
5.8.8.3. Isometric 3D fast spin echo (T2) image acquisition.
5.8.8.4. Gradient Echo including spoiled techniques, rewound techniques, steady state free precession.
5.8.8.5. Inversion Recovery.
5.8.8.6. Magnetisation Transfer Contrast.
5.8.8.7. Susceptibility weighted imaging (SWI).
5.8.8.8. Diffusion Imaging.
5.8.8.9. Contrast Enhanced Imaging.
5.8.8.10. Non-Contrast Angiographic Imaging including time of flight, phase contrast, SSFP (Steady State Free Precession), and ECG (Electrocardiogram) gated.

## 6. Line 5 – Open <1.5T MRI System

6.1. This is the core technical specification for an open MRI system designed with an open bore for general imaging. This category of system is intended to perform all routine MR studies with the ability to accommodate claustrophobic and bariatric patients. In addition, the design must facilitate interventional MR procedures.

6.2. The core components of an open <1.5T MRI system:
6.2.1. Magnet including covers.
6.2.2. Gradient sub-system.
6.2.3. Radio-Frequency transmission and receiving sub-system.
6.2.4. Patient table and patient handling.
6.2.5. Image reconstruction computer.
6.2.6. User control terminal.

6.3. Magnet including covers.
6.3.1. The magnet must be of superconducting or permanent design.
6.3.2. The magnetic field must not change more than 0.5ppm per hour.
6.3.3. Active shimming must be used to maintain homogeneity during image acquisition.

6.3.4. The magnetic field must be actively or passively shielded.
6.3.5. The primary magnetic field strength must be at least 0.25T.
6.3.6. The patient opening must be at least 34cm high/wide (allowing for the patient table).
6.3.7. The useful field of view must be at least 35cm x 35cm x 32cm.
6.3.8. The guaranteed field homogeneity must be less than 1.0ppm within a 30cm diameter spherical volume.
6.3.9. The fringe magnetic field must be less than 4.2mT at a distance of 4 metres radially from the isocentre.
6.3.10. The fringe magnetic field must be less than 3.3mT at a distance of 3 metres axially from the isocentre.

6.4. Gradient sub-system:
6.4.1. The maximum gradient strength must be at least 20mT/m.
6.4.2. The maximum gradient slew rate must be at least 30T/m/s.
6.4.3. The minimum TR in spin echo pulse sequences must be no longer than 50 milliseconds.
6.4.4. The minimum TR in 2D gradient echo pulse sequences must be no longer than 30 milliseconds.
6.4.5. The minimum TR in 3D gradient echo pulse sequences must be no longer than 8 milliseconds.
6.4.6. The minimum echo spacing in echo planar imaging (EPI) must be no longer than 2 milliseconds.

6.5. Radio-Frequency transmission and receiving sub-system:
6.5.1. Each channel must have a maximum bandwidth of at least 16KHz.
6.5.2. The system must have at least 2 independent receiving RF channels.
6.5.3. A head coil with at least 2 channels must be included.
6.5.4. A torso coil with at least 2 channels and 32cm superior to inferior coverage must be included.
6.5.5. A coil with at least 1 channel suitable for lower extremity studies must be included.

6.6. Patient table and patient handling:
6.6.1. The maximum patient weight with full patient table movement must be at least 150 kg.
6.6.2. The MR system must either have a detachable patient table or be provided with a MR safe patient transfer trolley if required or applicable.
6.6.3. Patient table movement automatic or manual controls must be located in the middle or on either side of the magnet or on the magnet.
6.6.4. Coil connection sockets must be included at one or both ends of the patient table or the magnet.
6.6.5. Padding for patient safety must be provided.
6.6.6. Active or passive acoustic noise reduction must be provided.

6.7. Image reconstruction computer:

6.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
6.7.2. The system must include at least 4 GB RAM.

6.8. User control terminal:
6.8.1. The user control must include a graphic user interface.
6.8.2. Full multi-tasking must be possible.
6.8.3. The user control terminal must meet the minimum PACS requirements as well as supporting alternative physical storage mechanisms (e.g. DVD, USB):
6.8.4. The user control panel must display the specific absorption rate.
6.8.5. The user control must display suggested scanning parameters to aid the radiographer.
6.8.6. The user control must enable the automation of routine workflow steps.
6.8.7. The user control must include automatic or semi automatic contrast and respiratory triggering if applicable.
6.8.8. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).
6.8.9. Image analysis tools must be provided including region of interest measurements.
6.8.10. In addition to all standard pulse sequences, the following clinical functionality must be available:
6.8.10.1. Patient movement compensated image acquisition.
6.8.10.2. Isometric 3D T1 imaging.
6.8.10.3. Isometric 3D fast spin echo (T2) image acquisition or or isometric 3D steady state T2.
6.8.10.4. Gradient echo including spoiled techniques, rewound techniques, steady state free precession.
6.8.10.5. Inversion recovery.
6.8.10.6. Contrast enhanced imaging.

## 7. Line 6 – Extremity 0.2T MRI System

7.1. This is the core technical specification for an extremity 0.2T MRI system designed for dedicated extremity MRI scans.

7.2. The core components of an extremity 0.2T MRI system:
7.2.1. Magnet including covers.
7.2.2. Gradient sub-system.
7.2.3. Radio-Frequency transmission and receiving sub-system.
7.2.4. Patient table/chair and patient handling.
7.2.5. Image reconstruction computer.
7.2.6. User control terminal.

7.3. Magnet including covers:
7.3.1. The primary magnetic field strength must be at least 0.2T.

7.3.2. The magnet bore must be designed to accommodate the lower and/or upper extremities.
7.3.3. The bore diameter must be at least 30 x 18cm.
7.3.4. The magnet length must be no more than 2.5 metres.
7.3.5. The magnetic field must not change more than 10ppm per hour.
7.3.6. The useful field of view must be at least 14cm x 14cm x 14cm.
7.3.7. The guaranteed field homogeneity must be less than 0.8ppm within a 10cm diameter spherical volume.
7.3.8. The fringe magnetic field must be less than 0.5mT at a distance of 1.7 metres radially from the isocentre.
7.3.9. The fringe magnetic field must be less than 0.5mT at a distance of 2.5 metres axially from the isocentre.

7.4. Gradient Sub-System:
7.4.1. The maximum gradient strength must be at least 10mT/m.
7.4.2. The maximum gradient slew rate must be at least 40T/m/s.

7.5. Radio-Frequency transmission and receiving sub-system:
7.5.1. The system must have at least 2 independent receiving RF channels.
7.5.2. Each channel must have a maximum bandwidth of at least 0.6 MHz and must be provided with at least 3 coils to cover:
7.5.2.1. Knees.
7.5.2.2. Ankle/Foot/Elbow.
7.5.2.3. Hand/Wrist.

7.6. Patient table and patient handling:
7.6.1. The patient table/chair must be able to support a minimum of 150kg.
7.6.2. Padding for patient safety must be provided.
7.6.3. Acoustic noise levels must be less than 99 dB without ear protection.

7.7. Image reconstruction computer:
7.7.1. It must be possible to reconstruct at least 5 images per second (256 x 256 matrix).
7.7.2. The system must include at least 3 GB RAM.

7.8. User control terminal:
7.8.1. The user control must include a graphic user interface.
7.8.2. Full multi-tasking must be possible.
7.8.3. The user control terminal must meet the minimum PACS requirements.
7.8.4. The user control must display suggested scanning parameters to aid the radiographer.
7.8.5. The user control must enable the automation of routine workflow steps.
7.8.6. The user interface must include a flat panel monitor with a minimum 19" screen (measured diagonally corner to corner).
7.8.7. The user control must include a means to store images on portable media (DVD or USB).

7.8.8. The user control panel must include individual user log in and configurable auto log-off time or a screensaver which can be configured.

7.8.9. Image analysis tools must be provided including region of interest measurements.

7.8.10. Standard spin echo and gradient echo pulse sequences must be provided.

7.8.11. The following clinical functionality must be available:

7.8.11.1. Isometric 3D T1 imaging.

7.8.11.2. Inversion Recovery.