

Principles of Servicing MRI Systems



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Introduction

The Principles of Servicing MRI course is a skills development course designed to introduce multivendor MRI service to engineers with little to no MRI experience. The course will equip engineers with the knowledge of the theory, safety principles and technical knowledge required for calibrating and servicing MRI systems.

The engineer will learn the operation and the identification of major system components to effect basic system repairs of the MRI system, as well as concepts of advanced imaging techniques. These techniques include both image creation and image analysis. MRI image artifact recognition, image analysis, and corrective action will be emphasized. A strong emphasis will be placed on hands-on labs to support the presentation of advanced principles.

Prerequisites

To attend this course, the service professional must have formal electro-mechanical and electronic/computing schooling or relevant experience.

Objectives

At the conclusion of this course participants will be able to:

- Demonstrate the theory and physics principles behind MR technology
- Demonstrate proper safety and precautionary measures when servicing MRI systems
- Perform system power-up and power-down
- Perform basic & advanced MRI system operation including image acquisition and image archival
- Identify major system components found in all MRI systems
- Understand system calibrations & adjustments
- Understand system operation through block diagrams and detailed service documentation
- Perform basic system repairs
- Understand magnet functionality & monitoring.
- Understand MRI subsystems such as the RF chain, the Gradient chain, the cooling system & the MRI network.
- Diagnose and correct image artifacts and system failures
- Perform all Planned Maintenance (PM) activities
- Magnet siting requirements
- Control Room
- Equipment Room
- Exam Room
- Lab Activities
 - MRI Safety
 - System Architecture

Course Outline

Day 1

- Introduction to MRI
 - What is it?
 - History of MRI Imaging
 - How it works
 - Imaging Advantages
- MRI Safety
 - Magnet Safety
 - Site Considerations
 - Cryogen Safety
 - Thermal Issues
 - Electrical/Mechanical Safety
 - Acoustic Noise
 - MR safe devices / materials
- System Architecture

Day 2

- Image Creation: RF Chain
 - RF Transmit Chain
 - RF Receive Chain
 - RF Sequence Types
 - RF Coils
- Lab Activities
 - Performing Scans
 - RF TX/RX Chain

Day 3

- Image Creation: Gradient Chain
 - Gradient Chain
 - Spatial Encoding
 - Raw Data Collection
 - Image Creation
- Lab Activities
 - Gradient Chain
 - Multi Echo Imaging

Day 4

- System Operation: Documentation
 - System Documents (IFU)
 - System Specifications
 - Block Diagrams
 - System Logging
- System Operation: Scanning
 - Scanning Basics

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- o Image Database Management
- o Image Evaluation
- o Image Analysis Tools
- MRI Tools & Test Equipment
 - o Phantoms & Phantom Holders
 - o RF Coils & Pads
 - o Service Tools
 - o Steel Hand Tools
 - o Titanium Hand Tools
 - o Torque Wrenches
 - o Specialty Tools
- Lab Activities
 - o Patient Support
 - o Power Distribution

Day 5

- Basic System Calibration
 - o Magnet Calibrations
 - o RF Chain Calibrations
 - o Gradient Calibrations
 - o Cooling System Calibrations
- Performance Verification
 - o QA Performance Testing
 - o SNR
 - o Field uniformity
 - o Slice thickness
 - o Geometric distortion
 - o Ghosting
- Lab Activities
 - o Image viewing & manipulation
 - o Scan parameters & image quality

Day 6

- Advanced MRI principles:
 - o Advanced RF Receive Chain
 - o Advanced Spatial Encoding

- o Advanced Raw Data Collection
- o 3T RF Transmit Chain
- Lab Activities
 - o Coil testing

Day 7

- Advanced Scanning Techniques
 - o Advanced Scan Sequences
 - o Image Evaluation
 - o Image Artifacts
 - o Field Maps
 - o ACR Testing
- Workstation Management
 - o Operating Software Loading
 - o Application Software Loading
 - o Cloning / Ghosting
 - o Backup / Restore
- Lab Activities
 - o System backup & restore
 - o System ghosting & restore

Day 8

- Advanced System Calibration
 - o Magnet Procedures
 - o RF Chain Procedures
 - o Gradient Chain Procedure
 - o Cooling System Procedures
- Troubleshooting Diagnostics
 - o Daily QA
 - o RF Receive Only Coils
 - o System Logging Operations
 - o Error Codes
 - o Manual Image Analysis
 - o Service Documentation
- Lab Activities
 - o Image quality verification
 - o Image artifacts

Day 9

- System Level Troubleshooting
 - o Remote Troubleshooting
 - o Facility Checks
 - o System Logs
 - o Status Lights
 - o Corrective Actions
- Lab Activities
 - o Troubleshooting

Day 10

- Preventive Maintenance (PM)
 - o PM Document Review
 - o PM Schedule
 - o PM Recording Keeping
 - o PM Tasks Review
- Course Review
- Final Exam