MRI Phase 1: Principles of Servicing MRI

RADIOLOGICAL SERVICE TRAINING INSTITUTE

Introduction

The MRI Principles course is a skills development course designed to provide an introduction to MRI service for engineers with no MRI experience. The course will equip engineers with the theory, physics, and safety principles required for servicing MRI systems.
This course will also teach engineers MRI system operation, identification of major system components, PM basics, and basic troubleshooting of MRI systems.

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 MRI system operation including image acquisition and image archival
- Identify major system components found in all MRI systems
- Introduce system calibrations & adjustments
- Follow circuit operations of system detail block diagrams
- Perform basic system repairs
- Perform basic Planned Maintenance
- Perform basic system troubleshooting

Course Outline

Day 1

- Theory & Physics
- What is MRI?
- Why MRI over other imaging modalities
- MRI System Siting Considerations
  - Gauss lines
  - Cryogenics
  - EMC interference
    - Magnetic field affects/effects

Day 2

- Main subsystems
  - Magnetic field (B0)
  - RF field (B1) transmit-receive chain
  - Gradient field chain
  - Control & Computation
  - Colling systems
- Types of magnets
- Process of image creation
  - Proton excitation
  - Receive signal collection & filtration
  - Data processing
  - Image construction & display
- Coils
  - Magnetic field coil
  - Gradient coil
  - RF Body coil
  - RF Receive coils
- System documentation
- System specifications & parameters
- MR terms, acronyms, and terminology
- Safety
  - Magnetic fields
  - Magnet Stop/Quench
  - Electrical
  - RF fields
  - Cryogens
  - MR safe materials
- MRI phantoms

- Lab activities:
  - Identify major components
  - Demonstrate MRI safety

Day 3

- Subsystems common to all MRI systems
  - Control room components
    - Workstation
    - Monitor
    - Patient Intercom System
  - Scan/magnet room components
    - Magnet
    - Gradient Coil Assembly (GCA)
    - RF TX/RX Body Coil
    - Magnet Control Assembly (MCA)
    - Patient Handling System (PHS)
    - RF Filter Panel (RFFP)
  - Equipment room components
    - Power Distribution Cabinet (PDC)

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Hands-On Training Course
Course Length: 1 Weeks
CEU's Awarded: 4 CEU's
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        - System Control Cabinet (SCC)
        - Gradient Amplifier Cabinet (GAC)
        - Heat Exchanger Cabinet (HEC)
    - Support utilities
        - RF/Magnetic Shielded Room
        - Facility or External Chilled Water Source
        - Facility Power with Dedicated Clean Ground
- Basic system operation
    - Power On
    - Phantom setup & imaging
    - Scanning
- Clinical applications principles

- Lab activities:
    - Perform basic operation
        - Power up
        - Power down
        - Phantom setup
        - Phantom scanning

Day 4

- Required tools & test equipment
- Functional/Performance checks
    - SNR
    - Field uniformity
    - Slice thickness
    - Geometric distortion
    - Ghosting
    - Field maps
- Calibration/adjustment basics
    - Field shimming (B0)
    - Eddy current
    - Gradient sizing
    - RF scaling
- Communication busses
    - System block diagrams

- Lab activities:
    - Perform functional checks
    - SNR
    - Field uniformity
    - Slice thickness
    - Geometric distortion
    - Ghosting
    - Field maps

Day 5

- Planned Maintenance Basics
    - QA & System logs
    - Magnet monitoring
    - System performance
        - Head coils
        - Body coils
        - Receive coils
    - Connection integrity checks
    - Coolant and filtration
- Course review
- Final exam

- Lab activities:
    - Perform system maintenance

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