

# Multi-Vendor Computed Tomography Systems Maintenance (Phase II)



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## Introduction

Multi-Vendor Computed Tomography Systems Maintenance is a skills development course designed as a continuation of the Principles of Servicing Computed Tomography Systems course (Phase I). Through attending this course, the service professional will become self-confident in working on the gantry, patient transport, detector assembly, DAS, SRU, X-ray control systems, and operator workstation sub-systems. Special attention will be given to x-ray tube changes. Hands-on lab time is emphasized, and makes up approximately 80% of the overall course content.

## Prerequisites

To attend this course, the service professional must have a good knowledge of CT physics and procedures gained through attendance at the RSTI Principles of Servicing Computed Tomography Systems (Phase I) course or equivalent experience.

## Objectives

Following attendance of this course, participants will be able to:

- Change the X-ray tube, realign and recalibrate the X-ray generator
- Calibrate, replace and align the hardware associated with the gantry and patient transport
- Troubleshoot gantry, patient transport and X-ray systems

- Troubleshoot the digital acquisition system and detector array
- Troubleshoot the scan reconstruction unit
- Troubleshoot the operator workstation

## Course Outline

**All lab functions will be repeated on each system available**

### Day 1

- System Operation and Power Distribution
  - o Systems operational parameters
    - Major system component identification
    - System controls
      - Safety
      - Interlocks
    - Patient registration/scheduling
    - Exam/technique settings
  - o System architectures
    - System block diagrams
  - o Power distribution
    - Power distribution diagrams
      - Main AC power
      - Sub-system AC power
      - DC power supplies

### Lab Activities

- System Operation and Power Distribution
  - o Scheduling an exam
    - Patient registration
    - Selecting technique parameters
    - Scout view

- Axial views
- Helical views
- o Power distribution
  - Verify AC power supplies
    - Main power distribution
    - Gantry AC power
    - Table AC power
    - Console Power
  - Verify DC power supplies
    - Control system DC power supplies
    - Gantry DC power supplies
      - Stationary
      - Rotating
    - Table DC power supplies
    - X-ray system DC power supplies
      - X-ray generator
      - X-ray tube rotor control
      - Collimator
    - Detector/DAS area DC power supplies

### Day 2

#### Lab Activities

- System Operation and Power Distribution
  - o Scheduling an exam
    - Patient registration
    - Selecting technique parameters
      - Scout view
      - Axial views
      - Helical views
  - o Power distribution continued
    - Verify AC power supplies
      - Main power distribution
      - Gantry AC power
      - Table AC power
      - Console Power

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- Verify DC power supplies
  - Control system DC power supplies
  - Gantry DC power supplies
    - Stationary
    - Rotating
  - Table DC power supplies
  - X-ray system DC power supplies
    - X-ray generator
    - X-ray tube rotor control
    - Collimator
  - Detector/DAS area DC power supplies

## Day 3

- Motor/Motion Controls and Position Indication
  - o Motor verification and replacement
    - Gantry rotation
      - Axial speed control
      - Axial motor driver
      - Harmonization/Encoding
      - Patient transport/table movement and indexing
        - Tabletop horizontal control
          - Speed control
          - Motor drivers
          - Harmonization
          - Encoding
        - Table vertical travel
          - Speed control
          - Motor drive
          - Position indication
  - Laser and light knife position indicators
    - Operation
    - Alignment

## Lab Activities

- Motor/Motion Control and Positioning
  - o Gantry rotation
    - Axial driver verification
      - Axial motor driver waveforms
      - Rotational speed tests
    - Drive assembly mechanical adjustments
    - Encoder verification
  - o Patient transport
    - Vertical motor driver waveforms
    - Vertical position indication
    - Horizontal motor driver waveforms
    - Encoder verification
  - o Laser/Light knife adjustments

## Day 4, Day 5

- X-ray system
  - o X-ray generation
    - High voltage control
    - Filament controls
      - Filament drive
      - Position (Z control)
      - Z position detection
    - Rotor controller
    - Collimator controls
      - Pre-patient
      - Post-patient
    - Filter control
  - o X-ray tube change
    - Tube selection
    - De-install/install issues
    - Required calibrations and alignments

## X-ray System Lab Activities

- X-ray tube change
  - o De-install procedures
  - o Installation procedures
- High voltage control waveforms
  - o Intermediate voltage verification
  - o kV demanded
  - o kV actual
  - o VCO frequency
  - o IGBT/SCR gate drive
- kV calibration
- Filament drive waveforms
  - o Filament drive demanded
  - o Filament drive actual
  - o mA demanded
  - o mA actual
- mA calibration
- Z position alignment

## Day 6, Day 7

- Detector and DAS
- Detector architectures
  - Maintenance issues
  - Detector replacement
- DAS architectures
  - Pre-amp/channel boards
  - DAS control
  - Data convolution
- Data transmission
  - Fiber optics
  - Slip ring data transfers
    - Optical transmission
    - Brushes
    - RF transmitters

## Lab Activities

- Pre-amp/Channel board verification
  - o Detector output mapping

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- o Pre-amp measurements
- Detector/DAS replacement
  - o Removal procedures
  - o Installation and alignment
- Data transfer verification
  - o DAS data output
  - o Data transfer through slip ring verification
  - o Data to image processing verification

## Day 8

- Image processing and handling
  - o Front end processing
  - o Temporary preprocessed data storage
  - o Image reconstruction
  - o Processed image handling
    - Image generation for display
    - Image storage
      - System disk
      - MOD
      - CD/DVD ROM
      - Print services
      - DICOM

## Lab Activities

- Image reconstruction system testing
  - o Image processor
  - o Image generator
- Image reconstruction testing
  - o Real time reconstruction
  - o Retro-reconstruction
- Manage image files
  - o Image disks
    - Replacement
    - Managing storage space
  - o MOD

- o DICOM setup
- o Printer setup

## Day 9

- System control and Image Quality
  - o System host computer
    - Field replaceable units
    - System hard drive
  - o System to Gantry control
    - Stationary controls
    - Rotating controls
  - o System to X-ray system control
    - X-ray generation
    - Collimation
  - o System to image processing/handling
  - o Image quality control tests

## Lab Activities

- System control and Image Quality Labs
  - o System control communications verification
  - o System state back-up and restore
  - o QC phantom image evaluation
    - Resolution
    - Contrast
    - CT number tracking
    - Image noise
  - o System troubleshooting
    - Electronic
    - Software assisted

## Day 10

- Course review
- Final exam
- Course evaluation