SEMEM386

Servicing radiotherapy equipment

Overview

This standard identifies the competences you need to carry out servicing activities on radiotherapy equipment, in accordance with approved procedures. You will be required to service a range of radiotherapy equipment. This will involve dismantling, removing and replacing faulty items on a variety of different types of radiotherapy equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or that are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. You will be expected to work with a minimum of supervision, taking personal responsibility for your own actions, and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work, and will provide an informed approach to applying the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the radiotherapy equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification and remains compliant with all standards and regulations.

You will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. You will also understand your responsibilities for safety, and the importance of taking the necessary safeguards to protect yourself and others in the workplace.

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation and other relevant regulations, directives and guidelines
2. follow the relevant servicing schedules to carry out the required work
3. carry out the servicing activities within the limits of your personal authority
4. carry out the servicing activities in the specified sequence and in an agreed timescale
5. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
6. complete and store all relevant servicing documentation in accordance with organisational requirements
7. dispose of waste materials in accordance with safe working practices and approved procedures and leave the work area in a safe condition

Knowledge and understanding

You need to know and understand:

1. the health and safety, infection control and de-contamination requirements of the work area, equipment being serviced, and the responsibility these requirements place on you
2. the statutory and advisory documentation relating to radiotherapy equipment (such as warnings and mandatory requirements from regulatory authorities and British and European standards)
3. the ionising radiation and other regulations, and the responsibility they place on you when servicing radiotherapy equipment.
4. the importance of reporting any equipment adverse incidents to the UK regulatory authorities and what internal procedures exist
5. the importance of wearing protective clothing, personal radiation dose monitors and other appropriate safety equipment during the servicing activities
6. the hazards associated with carrying out servicing activities on radiotherapy equipment (such as exposure to live conductors, moving heavy equipment, radiation, use of tools, contaminated work areas), and how to minimise them and reduce the risks
7. the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material including equipment that may contain patient data and be WEEE or radioactive materials
8. the working practices of, and the need to respect, the Radiotherapy department / Clinical environments policies and procedures.
9. how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid and basic life support and resuscitation).
10. the risks to the human body from ionising radiation and what measures are in place to reduce this risk to the patient, radiographer and other staff working in Radiotherapy.
11. the patient pathway through the radiotherapy department and what external performance targets exist that must be met.
12. the role of the "Treatment Planning" team and describe how the position of a Tumour is determined in a patient and what exists to ensure that the radiation beam delivers the therapeutic dose to the tumour whilst avoiding other vulnerable

organs
13. what the "isocentre" is and how it is determined and verified
14. the importance of Radiotherapy Quality Assurance (QA) checks on a range of equipment and how and when these QA checks are carried out, what they determine and how they are documented.
15. the basic principles and operation of the radiotherapy equipment being serviced, such as: typical voltages, pressure, vacuums and safety features
16. the application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps, magnetrons, klystrons, thyratrons, KV generators)
17. the areas on a Linear accelerator, CT simulator and Superficial treatment machine where high Voltages are present and what precautions you need to take when working on or near these areas
18. how a vacuum is generated and then maintained in the waveguide and the precautions you need to take when working on or near the waveguide
19. how equipment movements, such as: gantry, collimators, patient couches and supports, are manipulated and how the positions can be determined by the control systems and why it is important that this is accurate
20. the safety interlocks and emergency stops that exist in the radiotherapy treatment suite
21. the construction of the bunker rooms where the linear accelerators are used
22. the isolation procedure that applies to servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices, locking isolators
23. how to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols)
24. the care, handling, calibration and application of multi-meters and other electrical measuring instruments (including dedicated specialist test equipment)
25. why some measuring equipment needs to be calibrated and how non-calibrated equipment is identified
26. organisational policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
27. how to check that replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying

capacity, voltage rating, power rating, and working temperature range)
28. the techniques used to safely dismantle/reassemble radiotherapy equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, and removal of pipes, hoses and mechanical components)
29. the methods of removing and replacing components without causing damage to the equipment or other components
30. the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
31. the different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), flexible and screened cables, data cables) and their application
32. the use of current wiring regulations, and other regulations that apply when replacing wires & cables and installing medical equipment either portable or fixed installations
33. the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
34. the tools and equipment used in the servicing activities, such as: the use of cable stripping tools, crimping tools, soldering irons, KV and MAS meters and other specialist equipment
35. the methods of checking that components are fit for purpose and the need to replace 'lifed' items
36. how to make adjustments to components, assemblies or systems to ensure that they function correctly and to specification.
37. how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose
38. where and why dielectric gas is used and how and why it needs to be controlled and contained
39. why it is important for the couches in the radiotherapy treatment area and the simulator suite to be identical and what other equipment ensures a patient is positioned correctly for their treatment
40. the importance of making visual checks before proving the equipment with the electrical supply on
41. the generation of documentation and/or reports following the servicing activity
42. the equipment operating and control procedures to be applied during the servicing activity
43. how equipment is handed over to external contractors, what "SOP" are in place and what responsibility contractors have once the equipment has been handed

over to them

44. the problems that can occur during the servicing activity and how they can be overcome.

45. the extent of your own authority and to whom you should report if you have a problem that you cannot resolve

Scope/range

1.

Carry out all of the following during the servicing activities:

1.1 plan and communicate the servicing activities so as to minimise disruption to normal working
1.2 obtain and use the correct issue of organisational and/or manufacturers' drawings and servicing documentation, standard operating procedures or Quality Management System (QMS)
1.3 adhere to procedures or systems in place for risk assessment, COSHH, PPE and other relevant safety regulations, procedures and local rules to realise a safe system of work
1.4 ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
1.5 ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
1.6 provide and maintain safe access and working arrangements for the servicing area
1.7 carry out the servicing activities, using appropriate techniques and procedures
1.8 return the equipment to service on completion of the activities
1.9 dispose of waste materials in accordance with safe working practices and approved procedures, and leave the work area in a safe condition

2.

Carry out servicing on all of the following radiotherapy equipment:

2.1 radiotherapy treatment and planning equipment
2.2 Kilovolt X-ray volume imager
2.3 patient support system
2.4 megavolt portal imager
2.5 accessories
2.6 applicators
2.7 external computer control

3.

Carry out all of the following servicing activities, as applicable to the equipment been serviced:

3.1 isolate the equipment
3.2 apply electrostatic discharge (ESD) precautions
3.3 dismantle equipment to the appropriate level
3.4 disconnect and reconnect wires and cables
3.5 solder and de-solder components and connectors (as applicable)
3.6 replace appropriate 'lifed' items
3.7 remove / refit or replace electrical units/components
3.8 remove / refit or replace electronic units/components

3.9 remove / refit or and replace mechanical units/components
3.10 check components for serviceability
3.11 attach suitable cable identification markers
3.12 replace damaged/defective components
3.13 set and adjust replaced components
3.14 tighten fastenings to the required torque
3.15 make visual checks before powering up
3.16 carry out electrical safety tests
3.17 check equipment operating parameters
3.18 re-calibrate and/or adjust equipment
3.19 functionally test the serviced equipment
3.20 check safety circuits and warning signs prior to handing over equipment to users

4.

Remove and replace / install / configure a range of components to include twenty of the following:

4.1 hoses / pipe work
4.2 semiconductors
4.3 capacitors
4.4 seals
4.5 switches
4.6 sensors
4.7 batteries
4.8 low voltage power supplies
4.9 lamps / bulbs
4.10 switches
4.11 transformers
4.12 mechanical valves
4.13 gears
4.14 gearboxes
4.15 pumps
4.16 regulators
4.17 integrated circuits
4.18 motors
4.19 gauges
4.20 cross-wires
4.21 potentiometers/resistors
4.22 bearings
4.23 overload devices
4.24 locking devices
4.25 filters
4.26 cables / connectors
4.27 magnetron / klystron
4.28 ion pump
4.29 fans
4.30 wedge assembly
4.31 X-ray tube

4.32 vacuum devices
4.33 safety interlocks
4.34 uninterruptable power supply
4.35 ion chambers
4.36 filament gun
4.37 brakes
4.38 computer components
4.39 high voltage power supplies
4.40 lasers
4.41 waveguide
4.42 leaf reflector
4.43 optics
4.44 printed circuit boards
4.45 di-electric gas
4.46 drive belts

5.

Carry out the servicing activities within an agreed timescale, for all of the following requirements:

5.1 organisational guidelines, codes of practice, QMS and local rules
5.2 equipment manufacturers operation range
5.3 relevant and current HTM, MHRA and IEC documentation
5.4 the equipment functions to specification
5.5 the equipment remains compliant with all standards and regulations
5.6 all potential defects are identified and reported for future action
5.7 in accordance with BSEN standards CE marking and wiring regulations (where appropriate)
5.8 essential or mandatory safety action bulletins or updates installed in accordance with manufacturer's instructions

6.

Complete and store all relevant servicing documentation in accordance with organisational requirements, using one of the following:

6.1 job cards job/PPM update
6.2 servicing logs or reports medical Equipment log book
6.3 organisational-specific documentation
6.4 electronic reporting system

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