HACKETTSTOWN REGIONAL MEDICAL CENTER
JOAN KNECHEL CANCER CENTER
QA Linear Accelerator - Daily

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SCOPE:

Linear Accelerator in the Department of Radiation Oncology

DEFINITIONS:

Qualified Medical Physicist – A board certified medical physicist who is qualified to perform QA procedures for linear accelerators and treatment simulators and is registered in the State of New Jersey.

Solid Water – a synthetic material used for treatment beam calibration. This material has an electron density close to that of water and it is therefore commonly referred to as being radiologically tissue equivalent.

Morning warm up – is the act of performing the daily quality assurance procedures.

PURPOSE

To ensure all quality measurements meet calibrated standards.

POLICY

The daily QA performed by the Radiation Therapists ensure the linear accelerator is calibrated to provide the prescribed radiation dosage for each patient's treatment plan.
Any items out of tolerance must be noted and a Qualified Medical Physicist is notified as soon as possible that day. The Medical Physicist is responsible for determining corrective action necessary, performing such corrective action, if within his capability, otherwise calling the Vendor Service engineer and documenting corrective action. If daily output readings are outside the 5% tolerance range, the Radiation Therapist are directed to: DO NOT TREAT.

PROCEDURE

The Radiation Therapist performing morning warm-up will be responsible for the Daily QA of the Linear Accelerator and recording all information.

A. Linear Accelerator parameters, safety & mechanical checks using the QA_3 device:

1. Record Water Level

Procedure: Check water level against mark
Tolerance: Pass/ Fail
Corrective Action: If level too low, add distilled water. If problem persists notify physics.

2. Record Water Temperature

Procedure: Record water temp from gauge on form
Tolerance:<40°C for Varian

Corrective Action: If temperature too high alert service engineer and HRMC plant operations.

3. Record Water Pressure

Procedure: Record Water pressure from gauge on form
*Tolerance:*70±5psi
Corrective Action: If out of tolerance, alert physics and call service engineer.

4. Record Filament Hours

Procedure: Record value on form
Tolerance: NA
Corrective Action: none

5. Record Beam On Hours

Procedure: Record value on form
Tolerance: N/A
Corrective Action: none

6. Record Freon/SF6 Pressure (Gas Pressure)

Procedure: Record value on form
Tolerance:>28psi for Varian 21EX
Corrective Action: If out of tolerance add gas. If problem persist notify physics.

7. Test Motion Stop

Procedure: Check functioning by activating motion stop while gantry is rotating
Tolerance: Pass/Fail
Corrective Action: If not functioning, alert physicist, service engineer and HRMC plant operations. Perform all motions inside treatment room with 2 therapists present until service has resolved the problem.

8. Test Lasers

Procedure: Check left and right lasers, in both horizontal and vertical direction against wall marks.

To check sagittal and ceiling lasers set up morning check jig on couch. Level jig and align crosshairs on side panels using the left and right wall lasers. Set a 10x10 cm field size and align jig in lateral direction using crosshairs. Check sagittal lasers versus crosshair on jig. Rotate gantry 45 off vertical and while blocking the sagittal laser, check transverse and radial laser versus cross-hair on jig.
Tolerance: 2mm
Corrective Action: If out of tolerance adjust lasers back to wall marks and alert physics during that treatment day. If out of tolerance alert physics as soon as possible. Continue to treat using the light field projection of the cross hairs to align the patients in the sagittal direction.

9. Test Light Field Size (FS) vs. Digital FS

Procedure: With the morning check jig still in place return gantry to zero. Check the light field against 10x10 cm scribed line on jig.
Tolerance: 2mm
Corrective Action: If out of tolerance alert physics and call service engineer to recalibrate field size.

10. Test Light Field Center vs. Gantry Angle

Procedure: Rotate gantry to 90°. Check that light field projection of crosshairs is within circle on morning check jig. Rotate gantry to 270° repeat check for that angle.
Tolerance: 2mm
Corrective Action: If crosshairs are outside 2mm circle, reset jig paying careful attention to leveling. If problem persists, continue to treat but alert a physicist as soon as possible.

11. Test ODI

Procedure: With the morning check jig still in place return gantry to zero. Turn on the ODI.
Tolerance: 2mm
Corrective Action: If out of tolerance alert physics and call service engineer to recalibrate ODI. Continue treating using lasers, table top measurements and rulers to set up patients.

12. Test Intercom

Procedure: Check functioning
Tolerance: Pass/Fail

Corrective Action:
If not functioning, replace with spare and alert biomedical engineering to fix.

13. Test TV/Visual Monitor

Procedure:
Check that both cameras & monitors are functioning.

Tolerance: Pass/Fail

Corrective Action:
If one system is not functioning continue to treat and call biomedical engineering to repair. If both systems are not functioning DO NOT TREAT. Call biomedical engineering to repair.

14. Test Door Interlock

Procedure:
With the beam on open the treatment room door. Beam should interrupt.

Tolerance: Pass/Fail

Corrective Action:
If interlock does not function call HRMC plant operations to repair. DO NOT TREAT.

B. Output Constancy Photons & Electrons

1. Test Output Constancy Photons & Electrons using the Sun Nuclear **Daily QA$_2$** device

Procedure:

1. Set the device to 100 cm SSD making sure the crosshairs are aligned.
2. Set a field size of 20cm x 20 cm for Photons making sure the field is covering the outlined border.
3. Adjust the LEVEL of the QA device using three screws below device (two on the sides and one on the front side)
4. Place the applicable photon build up (1.7 cm, with hole) on top of the device. It should fit on the device. Also make sure that the high density material window build up should go on the energy (E) detector.
5. Connect the cable to the device.
6. From the treatment console turn on the computer HCCANCER08 next to the printer. Find the icon for DAILY QA2 and double click on it.
7. The window will pop out. It will say daily device is connected, click ok.
8. Wait until you see the temperature (°C) and pressure (kPa) on the lower right hand corner of the screen.

(Note: If you don't see the window with "Daily Check Device is Connected" and No temperature, pressure comes on, Go to setup on the top and then go to port, make sure it is on Comm1. If it is not on Comm1, click on Comm1 and click OK. Then you will see a window will pop out saying Daily Check Device is connected.)

9. Double click on "Machine Name" DAILY QA –the list of days will pop up. Double click on the appropriate day. At this time the energy buttons will pop up.

Double click on all the energies. Make sure you can see Exposure 1 button under all the energy buttons.

10. Click on Exposure 1 under Low X (6MV). Then click the start button on the top left-hand corner.
11. Turn on the machine and deliver 100 MU.
12. After the beam off DO NOT touch anything. Wait few seconds, the green window will say acceptable. Click on Accept. Then you will see the check mark on exposure 1 under that energy. Then hit on the STOP button if it is highlighted, then you can go to EXPOSURE 1 on the next energy and click on it and repeat this step. (If the acceptable green light does not come out and the read window comes out it means that it exceeded the tolerance, then do not click on acceptable, instead click on the Redo button and repeat this step by clicking on EXPOSURE 1 and delivering 100 MU. You will also have to do this if machine shuts down before delivering all monitor units.) Repeat step #10 for high X (15MV).
13. For electrons, place the 20x20 electron cone and change the buildup: for 6 MeV NO BUILD UP is used, for the rest of the electron energies 9,12,16,20 MeV use Solid Water Buildup.

14. After all the exposures are done. Then click on GRAPH at the bottom of the computer. At the bottom right hand corner, click on the appropriate energy. The window will pop up. Enter the central axis reading on the Daily QA form. Then click on the close button. Keep going through different energies until complete. (Make sure on the bottom right hand corner it is displaying the correct date)

15. After you note down all the readings, click on the MANAGER button at the bottom.

16. Double click on the day then double click on "Machine Name" DAILY QA it will close all the days. Go to file and EXIT out of the Daily QA or click on crosshair on the top right hand corner to close the window.

Tolerance: Pass/Fail

Corrective Action:
If Output reading is outside 3% tolerance range, but less than 5%, have a second person repeat the reading. If reading persists have a physicist repeat the reading that day. If Output reading is outside 5% tolerance range **DO NOT TREAT**. Again, have a second person repeat the reading and if reading persists have a physicist repeat the reading as soon as they get in.

NB: Daily QA2 is now a backup device:
See separate attached sheets for Daily QA3 device

REFERENCES:

AAPM TG40 – American Association of Physicists in Medicine Task Group 40 "Comprehensive QA for Radiation Oncology", 1994.