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Linac Commissioning Overview

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Objective

- To provide an overview of linac commissioning process
  - Relates to ‘sensitivity to infrastructure’

Consider Basic 6 MV Linac with MLC, EPID & 3D CRT

- Assume technology is mature
- Steps in clinical implementation
  - Installation … by vendor
  - Acceptance testing … by Medical Physicist with vendor
  - Commissioning … by Medical Physicist
  - On-going QC … by MP, MP assistant, or RTT

Requirements for Clinical Implementation

- Qualified Medical Physicist
- Dosimetry tools
  - Calibrated ion chamber + thermometer, barometer
  - 3D water phantom, dosimetry scanning system
  - Additional ancillary tools: front pointer, level, …

Acceptance Testing

- 3-5 days
- To prove accelerator meets specifications
- Radiation safety tests
- Interlocks
- Mechanical tests
- Light/radiation field tests
- Parameter readouts … collimator, gantry, couch, lasers
- Isocentre coincidence (radiation/mechanical)
- Beam energy, flatness, symmetry
- Dose delivery … reproducibility

Commissioning

- ~2-3 months
- Data for treatment planning system
- Beam calibration
- Depth dose
- Dose profiles
- Output factors
- Beam modifier or beam mode measurements
- Data for special procedures
  - TBI, stereotactic, …
- Staff training
- Documented operational policies and procedures
- Procedures for scheduled & unscheduled down-times

Quality Control

- On-going tests to prove compliance
  - Daily (possibly by RTTs)
  - Weekly
  - Monthly
  - Yearly
- Documented process with tolerances and policies and procedures
  - What to do when measurements are outside of tolerance
- Responsibility … Medical Physicist

Year: _____ Machine type: _____

Month: _____ Unit: _____

A/S	Test	Date / Frequency	M	T	W	T	F	M	T	W	T	F
1	Calibration/flatness	2/week										
2	Emergency switches	Daily										
		Signature:										
R/T												
1	Control warning lights											
2	Room warning lights											
3	Door interlock											
4	TV monitor											
5	Intercom											
6	Treatment stop/counter											
7	Gantry angle											
8	Optical distance indicator											
9	Wall lights											
10	Light/numerical field x-rays											
11	Cross-hair alignment											
12	Dead-man switches											
13	Couch locks/hand pendant											
14	Asymmetric jaws											
15	Light/rad'n. field vs. readout											
16	Electron cone inspection											
17	Electron cone/radiation field											
18	Electron cone/light field											
19	Shield inspection											
20	Wedge/accessory rails											
21	Tangential breast accessory											
22	Wedge inspection											
23	Emergency pendant/ backup counter											
24	Portal imager											
25	MLC leaf motion											
26	MLC communication link											
27	Couch position readout											
28	Ext. interlock/auto setup											
		Signature:										

A/S = Accelerator service staff
R/T = Radiation therapy staff

☐ Monthly QA of log done

_____ _____
(Date) (Signature)

Rev. 99/01/01

Other Options

- Multiple photon and electron energies
  - Similar data for TPS for each energy
  - Added QC
- IMRT/VMAT
  - See AAPM TG and other reports
  - Treatment planning integrity
  - MLC delivery
  - Patient specific QC
- IGRT
  - See AAPM TG and other reports
  - Geometric & image registration integrity

Task Group 142 report: Quality assurance of medical accelerators[a)]

Eric E. Klein[b)]

Med. Phys. 36: 4197-4212; 2009

Quality assurance for image-guided radiation therapy utilizing CT-based technologies: A report of the AAPM TG-179

Jean-Pierre Bissonnette[a)]

Med. Phys. 39: 1946-1963; 2012

New Technologies

- TomoTherapy
  - Installed precommissioned
  - Acceptance testing is almost ≡ commissioning
  - Time from installation to clinical treatment much reduced

QA for helical tomotherapy: Report of the AAPM Task Group 148[a)]

Katja M. Langen[b)] *et al.* Med. Phys. 37: 4817-4853; 2010

- Varian Halcyon
  - Similar precommissioning
    - Varian … "accelerated installation timeframes, expedited commissioning, simplified training, and automated treatment."
- Requires stable technologies with reproducible characteristics from factory to clinic

Linac Commissioning/QC Summary

- Linac implementation and QC is challenging
- Common QA elements to fully loaded linac commissioning
  - Team effort
  - Training
  - Safety
  - Detailed commission measurements
  - Dose delivery accuracy
  - Detailed TPS commissioning
  - Image quality
  - Geometric fidelity
    - Scaling
    - Treatment-imaging isocenter coincidence
    - Registration/table shifts
  - Policies/procedures/criteria for adjustment