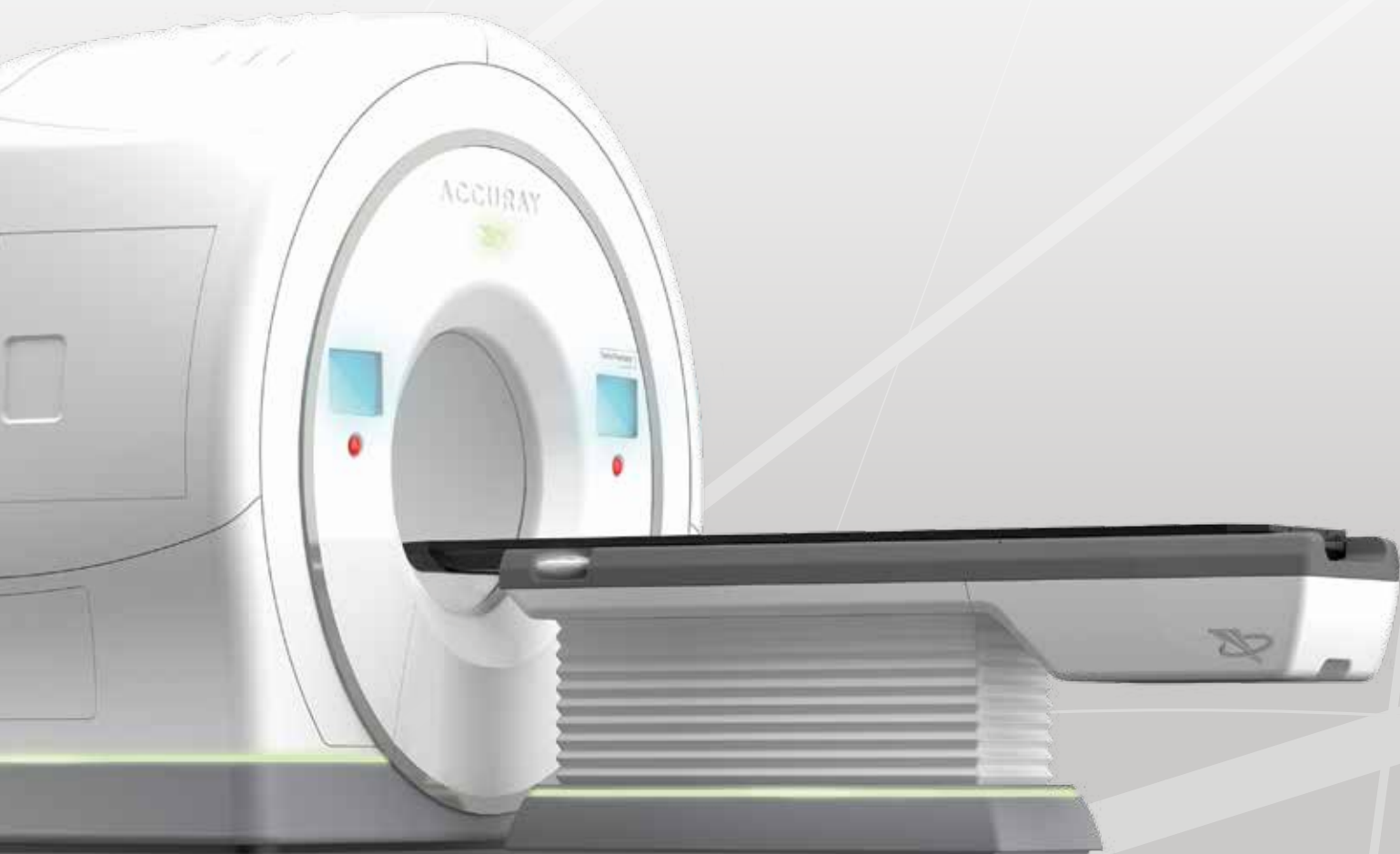




TOMOTHERAPY® H™ SERIES

Tomoh™, TomoHD™ and TomoHDA™ Systems
Technical Specifications



Tomotherapy®

The TomoTherapy® H™ Series is designed to treat the entire spectrum of radiation therapy patients with enhanced speed, precise performance and ease of use. Installation is simple, with over 95% of existing vaults installed to date requiring minimal-to-no retrofitting.¹

Key Features and Benefits:

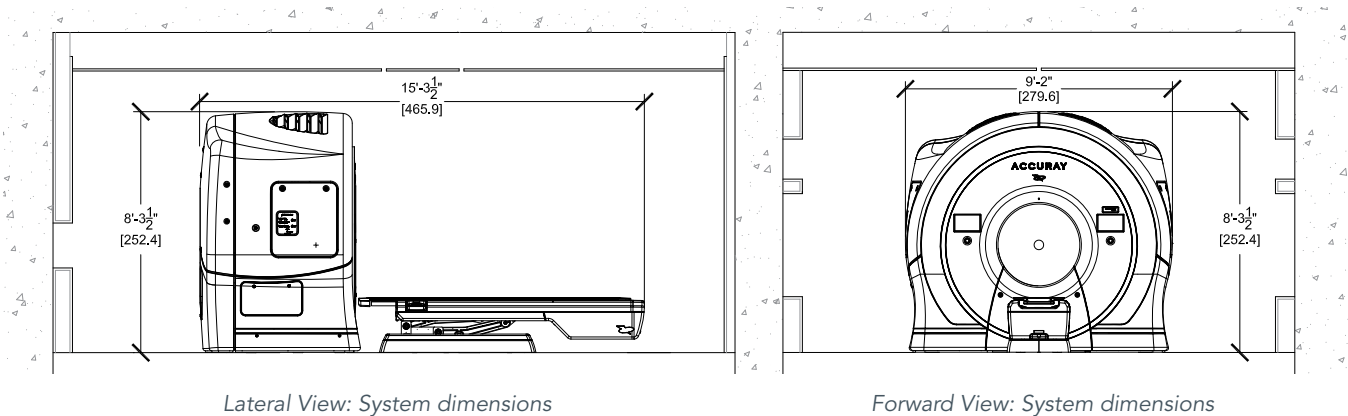
- VoLO™ Planning enables flexibility, speed and efficiency with real time interactive planning.
- CTrue™ Image guidance provides daily 3D CT target localization and enables margin reduction while sparing healthy tissue.
- TomoHelical™ and TomoDirect™ modalities deliver individualized treatments for both routine and complex indications.
- TomoEDGE™ spares more normal tissue while enabling increased throughput.

1. Data on file as of March 19, 2013

1. Complete Treatment System

Overall dimensions

- | | |
|----------|-----------------------------|
| • Height | 8 ft., 3.5 in. (252.4 cm) |
| • Width | 9 ft., 2.0 in. (279.6 cm) |
| • Length | 15 ft., 3.25 in. (465.9 cm) |
| • Weight | 10,000 lbs. (4,536 kg) |



Other dimensions

- | | |
|-----------------------------|------------------------------------|
| • Gantry depth | 66.1 in (167.8 cm) |
| • Couch maximum height | Approx. 43 in (110 cm) above floor |
| • Couch minimum height | Approx. 24 in (60 cm) above floor |
| • Couch width | 25.5 in (64.8 cm) |
| • Table top width | 20.9 in (53.0 cm) |
| • Couch longitudinal travel | Approx. 63 in (160 cm) |



Rendered view of system in room (A, B, C correspond to room dimensions below)

2. Installation

Minimum room size - requirements*

- Height (A) 8 ft., 10.13 in. (269.6 cm)
- Length (B) 19 ft., 6.75 in. (596.2 cm)
- Width (C) 15 ft., 2.00 in. (462.4 cm)

Typical schedule (receipt of system to first treatment)

21 days from installation to acceptance tests signed off

Commissioning

Integrated system completely pre-commissioned in the factory and re-verified at customer site

* Refer to the TomoTherapy Treatment System Site Planning Guide for details of room size requirements.

3. Treatment Vault Environment

SPECIFICATION

Line voltage, VAC

REQUIREMENTS

480 volts, 3-phase; others may be supported

Ambient room temperature

68 - 75 degrees Fahrenheit (20 - 24 degrees Celsius)

Relative humidity

30% - 60%, noncondensing

4. Mechanical Features

SPECIFICATION

Gantry

- Degrees of rotation
- Direction of rotation
- Accuracy of set angles
- Speed of rotation
- Controls
- Source to axis distance
- Mechanical to radiation isocenter offset
- Mechanical isocenter stability
- Position indicators
- Isocenter height
- Cooling

PERFORMANCE

Rotates around IEC-y axis, continuous rotation
 Clockwise viewed from the foot of the couch
 Within 0.1 degrees
 Between 1 and 5 RPM for treatment; 6 RPM for imaging
 Rotational speed set during treatment planning
 85 cm
 Included in beam model (within accuracy 0.25 mm)
 < 0.4 mm
 5-axis laser system
 113 cm typical (dependent upon finished flooring)
 Integrated onboard cooling system eliminates need for facility-chilled water loop

5. Photon Beam

SPECIFICATION

Accelerator type

- Length

Microwave

- Power
- Source

Nominal dose rate at Dmax**

Nominal Dmax**

Percentage depth dose at 10 cm**

Number of beamlets

Nominal energy

Nominal spot size

Penumbra of treatment beam - IEC-y axis

Field size range at isocenter – IEC-y x IEC-x

Treatment volume - TomoHelical™

Treatment volume - TomoDirect™ (optional)

PERFORMANCE

Standing Wave
 0.3 meters

2.5 MW
 Magnetron

850 cGy/min

1.5 cm

Typical 61.4%

Treatment plan dependent; system capable of efficiently delivering tens of thousands of beamlets which allows for very high fidelity intensity modulation

6 MV, single energy

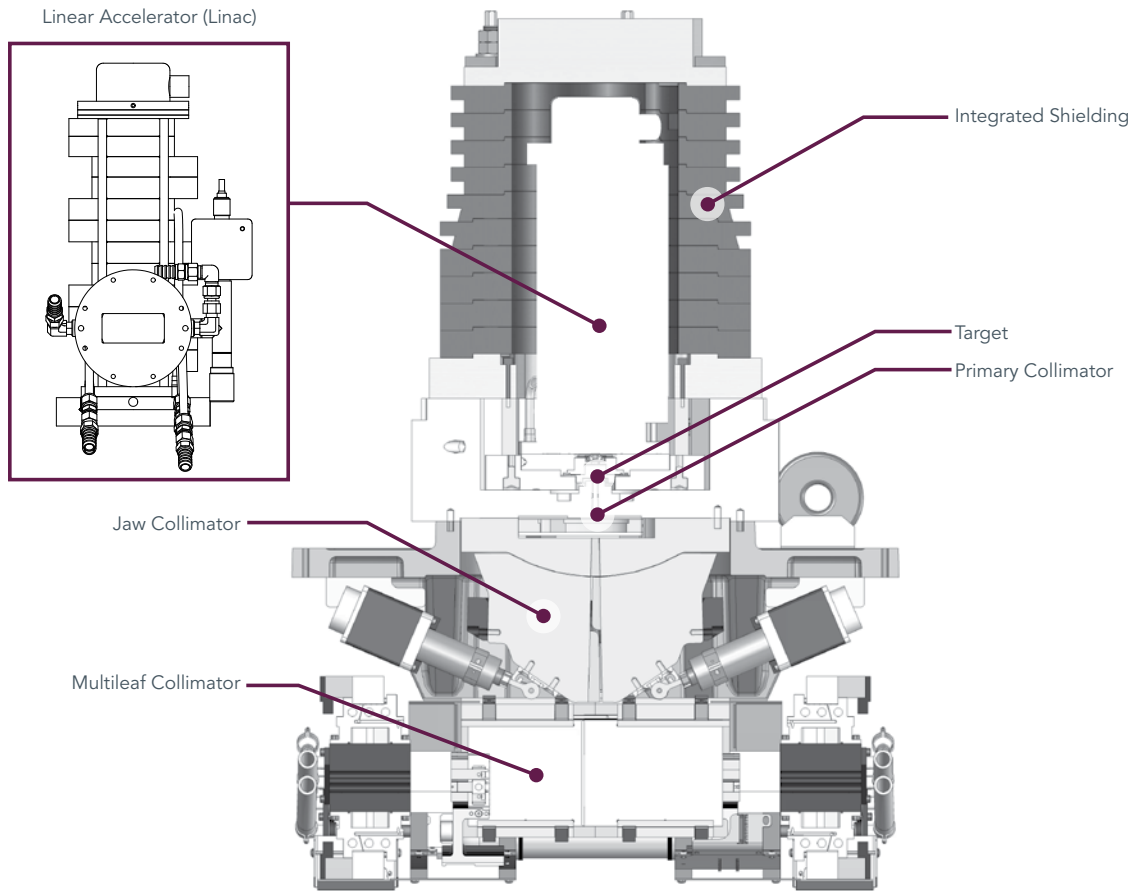
2 mm

The 80% - 20% penumbra widths are approximately 4.9 mm, 4.6 mm, and 4.1 mm (respectively for the 5.0 cm, 2.5 cm, and 1.0 cm field widths).

Selectable 1.0 cm x 40 cm (fixed)
 2.5 cm x 40 cm (fixed)
 5.0 cm x 40 cm (fixed)
 1.0-2.5 cm x 40 cm (optional dynamic)
 1.0-5.0 cm x 40 cm (optional dynamic)

Maximum treatment volume length is approximately 135 cm with a typical couch height. The 40 cm wide MLC allows irradiation of all target points within a 40 cm diameter cylinder, throughout each 360° gantry rotation. Points outside a 40 cm cylinder can be irradiated from a reduced, location-specific, range of gantry angles.

Maximum treatment volume length is approximately 135 cm with a typical couch height. Target points within a 40 cm diameter cylinder can be irradiated by beams from any user defined gantry angle throughout 360°. Points outside a 40 cm cylinder can be irradiated from a reduced, location specific, range of gantry angles.



Accelerator and collimator subsystems

Average MLC leakage

Primary collimation

Jaw collimation

- Jaw positions (per jaw)
- Axis of travel
- Speed of travel

- Basic dimensional description

Multileaf collimation

- Number of leaves
- Basic dimensional description
- Mode of operation
- Axis of travel
- Speed of travel
- Resolution
- Leaf drive mechanism
- Position indicator

0.25% (typical)

Tungsten block with rectangular, fixed aperture

0.5 cm, 1.25 cm or 2.5 cm from mid-line in static mode

-1.5 cm (across mid-line) to 2.5 cm in optional dynamic mode IEC-y

Jaws set to planned width in static mode

Single jaw opening/closing at speed of couch at beginning/end of delivery when in optional dynamic mode

13.5 cm tungsten thickness

64 binary interlaced leaves (tongue and groove side profile)

10 cm leaf thickness in beam direction

Binary leaves either fully in or fully out of beam path

1 axis, longitudinal direction (IEC-y)

Binary leaf state changed within 20 msec

0.625 cm leaf widths in IEC-x direction at isocenter

Pneumatic

Continuous monitoring with interlock, checks that leaves open and close at correct time

6. Dosimetry

SPECIFICATION

Monitor chamber type
 Monitor chamber precision
 Monitor chamber linearity
 Beam-off interlocks

PERFORMANCE

Full beam transmission, hermetically sealed dual chamber
 Within 1%
 Within 1%
 Radiation System; Dose Monitoring, Patient Table Position; Gantry Angle; Computer Communications; Vault Door; Facility E-stops

7. CTrue™ Imaging

SPECIFICATION

Geometry
 Dose per MVCT image (typical)
 Detector configuration
 Image resolution (xy)
 Slice spacing available
 Scan time
 Field of view (FOV)
 Source to detector distance
 Isocenter to detector distance
 Image noise
 Image uniformity
 Spatial resolution
 Contrast resolution
 Image reconstruction algorithm
 Image reconstruction time
 Image registration tools

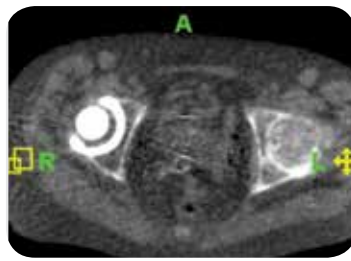
PERFORMANCE

Helical Fan-beam
 0.5 - 3 cGy depending on resolution and body thickness
 Single row xenon ion chamber array used for image acquisition
 512 x 512 (0.78 mm pixels)
 1 mm, 2 mm, 3 mm, 4 mm, 6 mm reconstruction intervals
 Scan pitch dependent: Typically 2 minutes per 15 cm length at 3 mm slice spacing
 39 cm diameter
 145 cm
 60 cm
 2% - 4%
 Within 2.5%
 Nominal 0.5 lp/mm at 10% MTF
 2% density for 2 cm object (typical)
 Filtered backprojection
 Real-time; slice-by-slice at time of acquisition
 MVCT/kVCT image overlay with adjustable checkerboard; manual or automatic registration (maximization of mutual information) using bone and/or soft tissue; translations and pitch/roll/yaw determination
 X, Y, Z translations applied via couch, roll applied via gantry as determined by image registration
 None required; rigid ring gantry platform
 Daily 3D MVCT matched with 3D kVCT

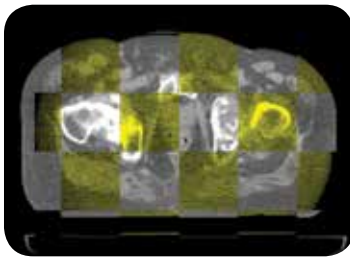
Application of adjustments obtained
 Frequency of correction for geometry flexion
 Image guidance mode



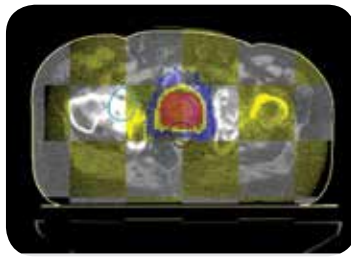
Prostate visibility



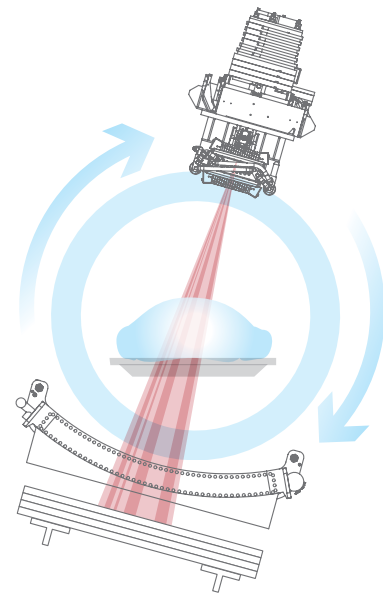
No high-Z artifact



Multi-planar image overlay



Overlay images, structures, dose



Common imaging and treatment subsystem

8. Safety Features

Integrated treatment planning: Planning and treatment systems use a common database

Integrated quality assurance: Patient-specific QA via a dedicated application on the planning station

Integrated procedure verification: Built-in procedure verification in addition to DICOM/IHE compliant MOSAIQ® and Aria® OIS interfaces*

Single database: Common database for planning, imaging and treatment data

No plan data transfer: Planning data retrieved by treatment system from common database

Common imaging and treatment beam source: Imaging geometry consistent with treatment geometry (imaging and treatment source are the same), thus avoiding the need for repeated geometric calibration of 2 different sources

Fully enclosed gantry: Integrated gantry enclosures protecting the patient from beam delivery system components

No auxiliary beam collimation: Integrated binary MLC (multileaf collimator) provides all beam collimation and modulation, removing the possibility of incorrect component installation and maintaining maximum physical patient clearance; also reduces handling of hazardous material

No bending magnet: No beam bending required, therefore eliminating the possibility of geometry errors resulting from redirection of the beam

No electron mode: The treatment system cannot be set to an unintended mode of delivery (note that helical IMRT with 6 MV x-rays can be planned to deliver treatments similar to electron mode treatments)

Full system integration: Level of system integration results in software for all components being designed and tested in unison, reducing concerns of disparate system interfaces and compatibility concerns across products and across companies

Noise eliminating intercom system: Facilitates clear two-way communication between the clinician and the patient, utilizing Digital Signal Processing technology, throughout the imaging and treatment process

* Please contact Accuray for a current list of compatible software versions.

9. TomoHelical™ Treatment Delivery Mode

The TomoHelical delivery mode provides IMRT and 3D CRT treatment delivery in a continuous (360°) helical pattern. The TomoHelical mode is suited to the majority of clinical situations, where rotational delivery and beam modulation enhance target dose conformality and uniformity.

The user is able to create a treatment plan that defines dose goals and constraints for target and avoidance structures, the level of modulation for the plan, as well as the fractionation schedule.

During treatment delivery, the linear accelerator completes multiple 360° rotations around the patient while the couch passes through the bore of the system, initiated by a single turn of the operator console key.

Fixed jaw and optional dynamic jaw (TomoEDGE™) modes are available with TomoHelical. With TomoEDGE, field width varies during delivery to increase dose gradient outside the target (also see section 5).

Targets of up to 135 cm in length* can be treated, with no need to reposition the patient and with no field junctioning.



The gantry rotates around the patient in TomoHelical delivery mode, delivering radiation in a continuous spiral pattern

10. TomoDirect™ Treatment Delivery Mode (optional)

The TomoDirect delivery mode provides IMRT and 3D CRT treatment via a discrete angle, non-rotational delivery mode. TomoDirect allows creation of treatment plans that include between 2 and 12 target-specific gantry angles. TomoDirect complements TomoHelical in situations where a fixed-angle delivery is most appropriate.

During treatment delivery, beams are delivered sequentially with the couch passing through the bore of the system at an appropriate speed for each beam. The complete treatment delivery is initiated by a single turn of the operator console key.

Fixed jaw and optional dynamic jaw (TomoEDGE) modes are available with TomoDirect. With TomoEDGE, field width varies during delivery to increase dose gradient outside the target (also see section 5).

Targets of up to 135 cm in length* can be treated, with no need to reposition the patient and with no field junctioning.



2 – 12 discrete gantry angles can be used in TomoDirect delivery mode

11. High Performance Couch

The High Performance Couch, with Medical Intelligence indexing system, provides sub-millimeter accuracy and precision in point-to-point and translational positioning.

Clinical workflow is enhanced with ergonomically designed dual Couch Control Keypads mounted to each side of the couch. The Couch Control Keypads allow motorized patient position modification in the X, Y and Z directions with simple, single-handed operation.

The custom patient couch has a high strength carbon-fiber top with an indexing system designed to accommodate immobilization systems from multiple vendors.

See High Performance Couch brochure for additional specification information.

12. Laser Positioning System

TomoTherapy® H™ Series configuration includes stationary green lasers for virtual isocenter and moveable red lasers for patient positioning and registration.

* Typical patient set-up; Actual treatment volume lengths are variable depending upon couch height.

13. Computing Hardware

Includes the following items, housed in a rack enclosure (dimensions: 59"/150 cm H x 26"/66 cm W x 38"/97 cm D):

- The Generation 5, dual-node optimization cluster for dose calculation and optimization during treatment planning.
- The optional VoLO™ or High Performance (dual node) VoLO System for dose calculation and optimization during treatment planning. VoLO technology uses computer nodes with high-performance Graphics Processing Units (GPUs), coupled with Accuray's Non-Voxel Broad Beam (NVBB) algorithm.
- The Data Server and Storage Area Network (SAN), which stores data required to run the treatment system and deliver prescribed treatments to the patient. It also stores patient planning information (CT images, contours, dose volumes, and plans). The Data server is connected to the Optimization Server, Planning Stations, Operator Station and the Treatment Delivery System. The SAN provides 1.8 TB of storage in a RAID 6 configuration.
- The TomoGateway™ system hardware enables remote system monitoring by Accuray
- Technical Support (note: additional software may be required).
- Tape drive system for database backup.
- LCD display for administration of the Optimizer/Data Server assembly.
- Uninterruptible Power Supplies (UPS) to support the complete Optimizer/Data Server assembly;
- Network switch and firewalls.

14. Planning Stations

Two TomoTherapy® Planning Stations allow the definition and management of treatment plans and initiation of plan optimization. Delivery Quality Assurance (DQA) tools are also provided on the Planning Station platform. The Planning Stations further include the Data Management System application software, for archiving and management of patient data. An Uninterruptible Power Supply, high-resolution LCD monitor, keyboard, mouse, and required cables are included with each Planning Station. A color printer for printing treatment plans and reports is also included.

An optional third Planning Station is available for purchase.

15. Operator Station

One TomoTherapy Operator Station, which connects to the treatment system database and provides control of CTrue™ MVCT imaging, patient treatment and quality assurance delivery, procedure verification functionality and delivery of calibration procedures. Operator Station Couch Control is included, allowing patient shifts to be made remotely from the Operator Station after image registration. The Operator Station is provided with a color printer capable of printing CTrue images and treatment data, plus an LCD monitor, keyboard, mouse, and required cables.

16. Planned Adaptive Software (optional)

The Planned Adaptive™ software license enables simple and effective dose verification for single or multiple treatment fractions, via daily MVCT images. The impact on delivered dose of changes in patient anatomy throughout the treatment course can be monitored and quantified using 3D isodose images, dose difference maps and dose volume histograms.

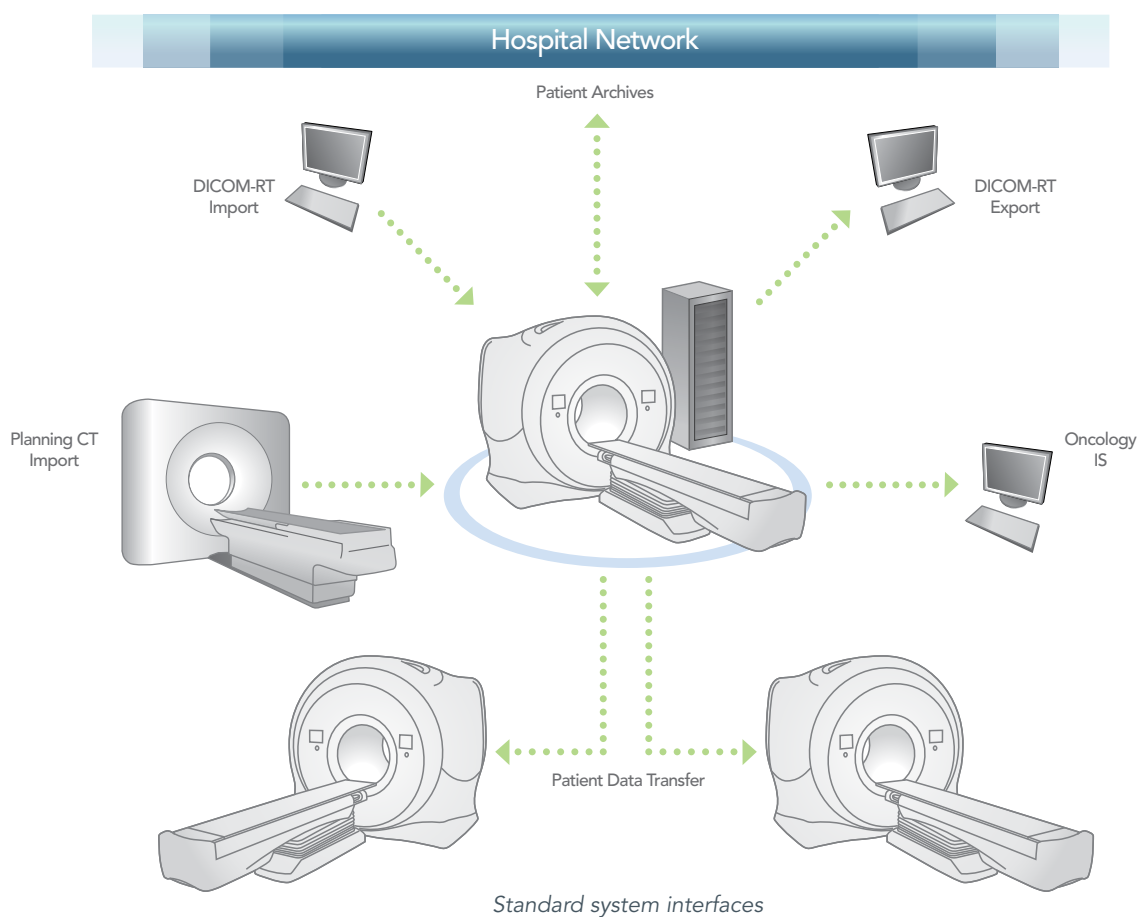
17. Remote Software Solutions – Remote Planning and TomoPortal™ (optional)

Remote Planning securely and easily provides fully functional operation of the TomoTherapy Planning Station application from outside of the TomoTherapy® H™ Series Treatment System network, via the internet. It allows a remote user to operate the Planning Station application and develop plans without being physically present in the facility where the TomoTherapy H Series Treatment System is installed.

The TomoPortal™ application also resides on the same Remote Software Solutions computer node as the Remote Planning application. The TomoPortal Remote Viewer securely and easily provides a web-enabled link to patient information stored in the TomoTherapy H Series Treatment System. It is possible to review a plan, registration, and treatment data from down the hall or across a continent.

Typical configurations include server computer hardware with one or two Remote Planning licenses and two TomoPortal licenses.

Note: These features do not allow remote operation of the radiation delivery system.



18. System Interfaces

DICOM Export

The DICOM Export Data Services Package allows the following DICOM objects to be sent from the TomoTherapy H Series Treatment System to third-party systems and clinical/research databases:

- DICOM-CT Image Set
- DICOM-RT Dose
- DICOM-RT Structure Set
- DICOM-RT Plan

OIS Connect™ (optional)

The OIS Connect software provides the ability to interface a TomoTherapy® H™ Series Treatment System to a compatible Oncology Information System (OIS). Elekta Mosaic® and Varian Aria® systems are currently supported. The software facilitates greater integration of the TomoTherapy H Series Treatment System into the radiation oncology department, by:

- Allowing scheduling of TomoTherapy treatments on the OIS;
- Providing automatic capture of TomoTherapy procedures on the OIS;
- Aiding in charge capture and billing (where applicable);
- Aiding in integrating TomoTherapy treatments into patients' electronic medical records, via the OIS.

The OIS Connect software is based on DICOM-RT Worklist communication, as specified in DICOM Supplements 74 and 96.

Network Data Storage (optional)

This feature allows patient archives created on the TomoTherapy H Series Treatment System to be sent to, or retrieved from, a storage location outside of the treatment system network.

Network Data Storage provides configuration of the system firewall, workstation configuration and FTP system set up for data transfer via network.

Patient Data Transfer (optional)

Patient Data Transfer allows the transfer of patient data from the TomoTherapy H Series Treatment System upon which it is installed, to another TomoTherapy treatment system.

Patient Data Transfer provides configuration of the system firewall, workstation configuration and FTP system set up for data transfer via network, and an external USB hard drive for physical data transfer.

19. Quality Assurance

TomoTherapy® Quality Assurance (TQA™) Essentials Package (Machine quality assurance)

The TQA application is a calendar-based productivity tool that simplifies the collection and analysis of machine performance data for the TomoTherapy H Series Treatment System.

The application leverages internally-generated data to provide results quickly and easily. The TQA application offers trending and reporting of many system and dosimetric parameters that allow physicists to monitor the performance of the TomoTherapy H Series Treatment System. All data may be exported.

The Essentials Package includes the Basic Dosimetry, Air Scan and System Monitor modules as well as TomoLink for automated remote monitoring of system operation and performance.

The optional TQA Total package includes extra modules such as Daily QA, Helical and Static Step Wedge, as well as modules for QA of dynamic jaw functionality.

See TQA brochure for more information.

20. Installation Services

Includes:

- Pre-installation Site Planning and Project Management services;
- Installation and commissioning;
- Completion of Acceptance Test Procedure (ATP) and system handover.

TomoTherapy[®]



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