ACCURAY®

Site Planning Guide

TomoTherapy® Treatment Delivery System

TOMOTHERAPY®
H SERIES™

Customer Support

For more information, to request documentation, or if you have a service issue, please contact Accuray Customer Support (North America) at +1-866-368-4807, contact your Distributor, or visit the Accuray Technical Solution Center at www.accuray.com/services-support/accuray-support.

Manufacturer's name: Accuray Incorporated

Manufacturer's address: 1310 Chesapeake Terrace, Sunnyvale, CA 94089

Type of equipment: Radiotherapy equipment

Note: Any modification of the named device without written authorization by Accuray Incorporated will invalidate this declaration.

Copyright Information

Warranty Information

If any Accuray products are modified in any manner all warranties associated with such products shall become null and void. Accuray Incorporated does not assume any responsibility or liability with respect to unauthorized modification or substitution of subsystems or components.

With proper care and maintenance, the expected service life of the system is 10 years.

The Accuray System, including each computer workstation and associated system software, has been validated to demonstrate that the system will perform as expected. The installation of additional software not released by Accuray Incorporated (e.g. third party, off-the-shelf, etc.) on these computer workstations is not permitted. This includes any Microsoft® Windows® updates. Any effect on the safe and intended operation of the Accuray System caused by the introduction of additional software is unknown and Accuray cannot be responsible for any impact caused by adding such software.

Hardware and Software Maintenance

Only qualified service personnel should service or maintain system hardware components. If you feel that Accuray System hardware components or associated features or functions do not perform as expected, or they provide results that are inconsistent with your established clinical and research protocols, call Accuray Customer Support (North America) at 1-866-368-4807, contact your Distributor, or visit the Accuray Technical Solution Center located at www.accuray.com/Services-Support.

Device Disposal

When an Accuray product reaches the end of its useful life and your facility desires to remove the device, contact Accuray Customer Support to decommission, uninstall, and appropriately dispose of the components.

Use of Third-Party Software

Accuray Incorporated's software is being distributed together with certain third party software that is made publicly available under open-source software licenses. Notices relating to such third party software and the license terms under which these software components were obtained by Accuray are located in this user's guide, in any applicable release notes, or in the about box that displays to the customer for the appropriate software program. Source code for an applicable open source software component is available upon written request. Automatic image registration is based on routines in Numerical Recipes: The Art of Scientific Computing, published by Cambridge University Press, which are used with permission.

Use of Third-Party Hardware

Use of other Medical Devices and non-Medical Devices within the Accuray Treatment Delivery system room must be assessed by the responsible party at the customer facility to ensure that use of the device does not introduce possible safety limitations or other compatibility concerns.

Instructions for Use of the Accuray System

Safe operation of the Accuray System requires careful attention to the serious hazards associated with the use of linear accelerators and complex radiation therapy equipment and ways to avoid or minimize the hazards, and familiarity with emergency procedures. Untrained or careless operation of the Accuray System can damage the system, its components or other property; cause poor performance; or lead to serious bodily injury and possibly death. Anyone who operates, services, maintains, or is otherwise associated with the Accuray System must read, understand, and be thoroughly familiar with the information in this manual, and take precautions to protect themselves, their associates, patients, and the equipment. At each step in the installation, specific warnings and cautions are given for specific actions.

Personnel must be trained by Accuray Incorporated before the Accuray System is used for research or clinical purposes. Accuray System documentation was originally drafted, approved, and supplied in English (US).

Prescription Device Statement

Caution: Federal law restricts this device to sale by or on the order of a physician.

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INTRODUCTION

Scope

This guide covers the TomoTherapy® H™ Series

Overview

This guide was written to provide essential information to our customers and their contractors in the design and construction of their TomoTherapy System suite. The information in this guide is meant to provide a starting point of general information, upon which site-specific information can be added.

Each customer will be assigned a dedicated Customer Operations Manager and Site Planner, who will provide both remote and on site assistance.

Accuray Incorporated's goal during the site planning process is to help our customers achieve both a timely and trouble-free TomoTherapy System installation.

Regulatory Requirements

In the United States, Accuray is available to assist our customers with their CON (Certificate of Need) or OSHPD (Office of Statewide Health Planning and Development) processes, if applicable to their state. The Accuray Sales representative will act as the contact for the CON process, and the Customer Operations Manager for the OSHPD process.

Internationally, Accuray, or its distributor, is available to assist our customers with any regulatory requirements that they may have.

The customer is responsible for obtaining all local, state and national permits and requirements associated with site planning, shielding, site preparation, construction, system installation and system maintenance.

Accuray customers are responsible for all reports and submissions to any governing body related to radiation surveys, radiation safety, physics reports as well as for obtaining beam-on licenses prior to installation start (where applicable).

In the United States, the customer is responsible for meeting any requirements of HIPAA (Health Insurance Portability

& Accountability Act of 1996), which may affect the design of the TomoTherapy suite and/or the control of patient data.

Please refer any regulatory questions to your Accuray Sales representative, Accuray Customer Operations Manager or Regulatory personnel.

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Roles and Responsibilities

The Accuray Project Manager (Site Planning - TomoTherapy) assists the customer and their representatives to successfully integrate the TomoTherapy® H™ Series into their facility. The roles and responsibilities are defined below.

Accuray Project Manager Responsibilities

The Accuray Project Manager (Site Planning - TomoTherapy) team or third party distributer team will assist the customer and their representatives to successfully implement the TomoTherapy System into the facility. The roles and responsibilities are defined below.

- Coordinate the A-Z meeting as well as introduce additional Accuray resources such as Training, Reimbursement, Service and Sales Operations.
- Assist with project schedule, aid in achieving critical milestones and support customer timeline.
- Assist in the coordination of facility construction to Accuray specifications.
- Assist with the development of site-specific drawings, entailing the project specifications.
- Interface with the customer's architects, engineers, contractors, IT and other facilities-related personnel.
- Conduct all Accuray inspections and coordinate the installation of the Accuray-supplied equipment.

1.0 System Components, Descriptions and Site Planning Considerations

1.1 Treatment Room (Also known as the Vault or Bunker)

The treatment room typically contains the components in the following table.

Table 1 Treatment Room Equipment Specifications (Accuray supplied)

ITEM	DESCRIPTION	L x W x H (IN)	L x W x H (MM)	WEIGHT (LBS)	WEIGHT (KGS)
1	Gantry and Equipment Enclosures	66.0625 x 110.125 x 99.3125	1678 x 2797 x 2522	10000	4535
2	Treatment Couch	117.75 x 25.6 x 22.625	2991 x 647 x 574	900	408
3	Power Distribution Unit	21 x 22 x 60	533 x 558 x 1524	900	408
4	Dorado Laser Positioning System (5 lasers)	7 x 31.25 x 7.75	178 x 794 x 197		
5	Apollo Laser Positioning System (2 lasers)	4 x 4.25 x 8.5	102 x 108 x 216		
14	Intercom Speaker System	7 x 6.3 x 9.4	180 x 160 x 240		

Note: The item numbers in bold refer to the identifiers on the site-specific drawings.

1.1.1 Accuray Supplied

1. **Gantry and Equipment Enclosures (Item 1 – Floor Mounted)**

   Description: The rotating gantry assembly generates and delivers radiation to patients. The enclosures cover the gantry. The equipment enclosures are designed to detach and roll forward for service access.

   Site planning considerations: There are pit, electrical, HVAC and mechanical considerations for the gantry. Due to gantry clearances, the pit is designed to be at least 10 in (250 mm) deep and has a sloped floor with a moisture sensor. Conduits leading from the PDU to the gantry are noted in the site specific drawings. Supplemental chilled air is required to cool the gantry. Compressed air line is required to supply air to the MLC. During installation, Accuray will drill and anchor the gantry to the floor. Anchor bolt locations for the gantry and the couch must be free from rebar structure, conduits and pipelines.

2. **Treatment Couch (Item 2 – Floor Mounted)**

   Description: The Standard Treatment Couch is used to position the patient during treatment using automatic patient positioning technology. The maximum patient weight load capacity of the Treatment Couch is 440 lbs (200 kg).

   Site planning considerations: During installation, Accuray will drill and anchor the couch to the floor. Anchor bolt locations for the gantry and the couch must be free from rebar structure, conduits and pipelines.

   Note: The PDU's optimal location is in the treatment vault. An optional location is outside the vault but the location of the PDU must be within 30 linear feet (10.5 meters) from the Gantry.

3. **Power Distribution Unit (PDU) (Item 3 – Floor Mounted)**

   Description: The Power Distribution Unit (PDU) isolates the power source for all critical Accuray components in the treatment vault and control area and provides power to system components

   Site planning considerations: During installation, Accuray will install the PDU and run cables from the PDU to the gantry. On sites with specific seismic requirements Accuray will drill and anchor the PDU to the floor.

   NOTE: The PDU's optimal location is in the treatment vault. An optional location is outside the vault but the location of the PDU must be within 30 linear feet (10.5 meters) of the Gantry.

4. **Laser Positioning System (Items 4 & 5 – Wall and Ceiling Mounted)**

   Description: A laser positioning system is used in the treatment room to accurately position patients on the treatment couch. The five Dorado lasers and two Apollo lasers are mounted on the treatment vault walls and ceiling. There are a total of seven lasers included with the TomoTherapy System.

   Site planning considerations: The customer's contractor is required to install the mounting plates and structures that support the laser positioning system. Accuray installation engineers will mount and position the lasers.

5. **Intercom Speaker System (Item 14 – Wall Mounted)**

   Description: The intercom speaker and all its components allow the patient and clinician to communicate during treatment.

   Site planning considerations: The speaker is wall mounted behind the patient on the gantry centerline at 7 ft-6 in (2286 mm) above the finished floor. The maximum length of the signal conduit between the speaker and the back of the gantry cannot exceed 15 ft-0 in (4570 mm). The customer's contractor is responsible for: supply and installation of the conduit for the microphone cable connection. A CAT6 (or higher) signal cable running between the speaker unit in the Treatment Room and the Control Room, and junction box(es) [termination point(s)] in the bunker and in the Control Room, as called out in the site specific drawings. The best practice is to terminate the CAT6 cable (or equivalent) with RJ45 outlets (female connectors) both in the Treatment Room and in the Control Room. These terminations must be installed in close proximity to the intercom speaker unit in the Treatment Room and the desktop unit in the Control Room - to allow for short patch cords connections to these components. Accuray installation engineers will install and connect the speaker and associated components.

1.1.2 Customer Supplied Items (Required)

1. **Steel or Aluminum Plates and Mountings for the Patient Positioning Lasers**
2. **Radiation Warning Lights including cables and a power connection (within 48-240 VAC range)**
3. **Emergency Off / Emergency Stop Buttons and cabling**
4. **Door Interlock and cabling (1 required depending on vault entry configuration)**
5. **Closed Circuit TV Cameras (CCTV)**
6. **Conduits (wired and empty) and cable management system as shown on the site specific drawings.**
7. **SF6 Gas (Contact Accuray Project Manager for details)**

1.1.3 Customer Supplied (Optional – Unless Required by Local Regulations)

1. **Nurse Call Button(s)**
2. **Medical Gas Lines**

   Customers may elect to install medical gas and vacuum outlets directly in the Treatment Room or use mobile gas carts. Please consult with the site administrator and/or physicians to determine the exact needs. These installations may include:

   - Oxygen
   - Air
   - Nitrous Oxide
   - Vacuum
   - Waste Anesthetic Gas Disposal

3. **Remote Patient Monitoring**

   This is typically used for monitoring anesthetized or other critical patients and can be accomplished via several methods:

   - The mobile monitoring system can be kept in the Treatment Room, with one of the pan/tilt/zoom cameras focused on the screen for viewing in the control area.
   - The remote monitoring cables can be run through the physics port that exists between the Treatment Room and the Control Room.
   - The customer can have a system built into the Treatment Room.

4. **Cabinetry**

   Storage for QA tools, patient masks, and body immobilization devices should be taken into consideration. The Site-Specific drawings will indicate areas in the Treatment Room where it is acceptable to install sinks and cabinets.

1.2 Control Room

The Operator Station can be configured in many ways, depending upon the site layout and desire of the customer. Typically, it includes the following equipment:

Table 2 Treatment Delivery Console (TDC) Equipment Specifications

ITEM	DESCRIPTION	L x W x H (IN)	L x W x H (MM)	WEIGHT (LBS)	WEIGHT (KGS)
9	Step Down Transformer Unit	15.75 x 11.75 x 4	400 x 298 x 102	34	15.5
10	Status Console User Interface	8.5 x 4.5 x 3	216 x 114 x 76	N/A	N/A
12	Treatment Delivery Console computer (TDC)	20.75 x 7.5 x 17	527 x 190 x 432	45	21
	Treatment Delivery Console accessories (flat screen monitor, keyboard, mouse) (Monitor size & weight)	Standard	Standard	N/A	N/A
14	Intercom System (desktop unit)	5.9 x 8.7 x 2.8	150 x 220 x 70	N/A	N/A
15	Printer	16.5 x 21.5 x 16.6	457 x 480 x 399	N/A	N/A

1.2.1 Accuray Supplied

1. **Step Down Transformer (Item 9 - Placed Underneath Countertop)**

   Description: The step down transformer is mounted underneath the counter on a customer-supplied shelving unit.

   Site planning considerations: The customer's contractor is responsible for installing the under counter shelf to support the size and weight.

2. **Status Console User Interface (Item 10 – Placed on Countertop)**

   Description: Device that allows the customer to operate the emergency stop, key switch for image/program/treat options, start button, stop button, radiation on notification.

   Site planning considerations: Provide adequate counter space.

3. **Treatment Delivery Console (TDC) (Item 12 – Placed on Countertop)**

   Description: The Operator Station is the computer workstation that the technologists use for calibration, patient positioning, registration, imaging and treatment. The control station is composed of a computer, flat screen monitor, keyboard.

   Site planning considerations: Provide adequate counter space.

4. **Intercom System (Item 14 – Placed on Countertop)**

   Description: The intercom desk control unit.

   Site planning considerations: The intercom desk control unit is placed on Control Room countertop. The customer's contractor is responsible for installing the wired conduit and terminating with RJ45 connections as called out in the site specific drawings. Accuray installation engineers will install the desk control unit and connect to the termination points.

5. **Printer (Item 15 – Placed on Countertop)**

   Description : Standard laser jet printer.

   Site planning considerations: Provide adequate counter space and a power outlet.

1.2.2 Customer Supplied

1. **Main Power Disconnect**

   Description: Please see Section 4.1: Electrical Requirements.

2. **Emergency Off (EO) Push Button**

   Description: The EO push button is provided and installed by the Customer's contractor. It should be installed on the wall in the Control Room. Reference the site specific drawings for exact location.

3. **Phone with Long Distance Access**

   Description: The phone is used for routine service and emergency communication.

4. **Closed Circuit TV (CCTV) Monitoring System**

   Description: See Section 5.8: Closed Circuit TV (CCTV).

5. **Customer Network Data Port with Internet Access or Wireless Internet Access**

   Description: To be used by Accuray personnel during system installation and service activities.

6. **System Status Indicators**

   Description: "X-ray On" light and optional "Power On" and "Room Ready" lights are positioned above the Treatment Room door. Additional warning lights in the treatment vault need to be considered, if required by facility or local safety regulations.

   Site planning considerations: The customer supplies all the materials related to this light, including power, within 48-240VAC range. The facility should provide two conductors for each light to the

front/bottom of the PDU. The two conductors are the facility line in and then the switched line out from the PDU. The Radixact™ System provides solid-state relays that close and complete the circuit to illuminate the light(s). Allow for approximately 6' (2 m) extra length for termination.

7. **Physics Conduit Port (Dosimetry Tube) into the Treatment Room**

   Description: This port is used for running QA and Commissioning tools and equipment cables between the Control Room and Treatment Room.

   Site planning considerations: It is typically a 4 inch (100 millimeters) conduit that runs from the top of the Control Room desk to the lower wall of the Treatment Room at a 45-degree angle, both vertically and horizontally, with access boxes and/or doors on either end.

1.3 Data Server Room

The Data Server Room location can be configured in many ways, depending upon the site layout, and desire of the customer. The Data Server Room is intended to hold the server rack required for the TomoTherapy H-Series product line.

Data Server Rack Specifications

ITEM	DESCRIPTION	L x W x H (IN)	L x W x H (MM)	WEIGHT (LBS)	WEIGHT (KGS)
8	Data Server Rack	38 x 26 x 57	970 x 660 x 1448	1000	726

1.3.1 Accuray Supplied

1. **Data System Server Rack (Item 8 – Floor Mounted)**

   Description: The Data Server Unit is where patient data is imported and stored, and the Optimization Engine where dose optimization and dose calculations are performed.

   Site planning considerations: Refer to the Network Specifications document for maximum cable length between the Data Server and the Operator Station and Treatment Planning Station. Refer to Section 4 for the electrical and environmental requirements for the Data Server Unit.

1.3.2 Customer Supplied (Required)

1. **Air Conditioning Unit**

   Description: Please see Section 4.2: Environmental Requirements of this document for more information.

2. **Network Connections**

   Description: Please see Section 5.4: Information Technology Needs of this document for more information, or refer to the *Network System Requirements* document.

3. **Electrical**

   Description: Please see Section 4.1: Electrical Requirements of this document for more information.

1.4 Mechanical Room

The Mechanical Room is typically located near the Treatment Room and is intended to hold the mechanical equipment required for the TomoTherapy H-Series product line.

Table 3 Mechanical Room Equipment Specifications

ITEM	DESCRIPTION	L x W x H (IN)	L x W x H (MM)	WEIGHT (LBS)	WEIGHT (KGS)
6a	Power Conditioner. (OPTION for 60 Hz mains power sites) Dimensions and weight shown are for the third party power conditioner the purchase of which is facilitated by Accuray.(Facility Supplied)	31.6 x 18.9 x 73.7	803 x 480 x 1872	640	290
6b	Frequency Converter (REQUIRED for 50 Hz mains power sites) Dimensions and weight shown are for the third party frequency converter the purchase of which is facilitated by Accuray. (Facility Supplied)	51.5 x 26.75 x 71.25	1308 x 673 x 1810	1502	680
7	Air Compressor (REQUIRED) Oil-Free Class “0” / Dryer and Air Tank (Facility Supplied)	N/A	N/A	N/A	N/A

1.4.1 Customer Supplied (Required)

1. **Air Compressor and Tank**

   Install a dedicated, facility-supplied oil-free air compressor to meet the flow-rate and quality requirements. We recommend installing a scroll compressor. The facility must supply a 60-gallon (227-liter) or greater air tank and install it in the Mechanical Room near the air compressor. Set the air tank to automatically purge for 4 to 5 seconds every 30 minutes.

2. **Compressed Air Line**

   The facility must supply a dedicated oil-free air compressor. In the floor of the Treatment Room, embed a copper compressed air line from the facility-supplied oil-free air compressor. Add a quick-disconnect fitting to the compressed air line before adding the barbed fitting so that a hose may be attached for system cleaning during planned maintenance procedures.

   Use thick-body or wide-body copper pipe. Use 3/4 in (20 mm) inside diameter for up to a maximum of 300 ft (91.44 m) or 1 in (25 mm) for up to 500 ft (152.4 m). Install tubing within 8 in (200 mm) on either side of the machine isocenter.

Table 4 Air flow rate and quality requirements

	Environmental Requirements
Flow Rate	15 scfm at 90 psig (measured at sea level), 7.1 lps at 6.2 bar (flow rate requirement is per system)
Water Content	Free of condensed water. *Dew point: -40°F (-40°C) or lower at 90 psig (6.2 bar).*
Oil Content	Zero oil content allowed. Compressed air must be completely free of oil droplets and vapor. (Oil filters to reduce oil content are not adequate for this requirement.)
Filtration	Filtered to allow no particulate matter larger than 0.5 microns

3. Dryer

The facility must supply compressed with a dew point at or below -40°F (-40°C) at 90 psig (6.2 bar). This typically requires multiple dryers in series, most often a refrigerated dryer supplemented by a self-regenerating desiccant dryer.

NOTE: If a refrigerated dryer is used, consider placing it between the compressor and the tank to minimize the possibility of icing.

4. Common Supplier for Desiccant dryer

Parker: *http://ph.parker.com/us/en/pneudri-midas-heatless-compressed-air-dryer*

Suggested model for a single system: PNEUDRI MiDAS DAS 7

5. Inline Air Regulator

Install an inline air regulator in an unobstructed, accessible location in the Treatment Room. If unable to place it in the Treatment Room, install it in the Mechanical Room with the air compressor. Install an inline shut-off valve between the air compressor and the air regulator.

1.5 Treatment Planning Room(s)

The Treatment Planning Room(s) can be located anywhere, and configured in many ways, depending upon the site layout and desire of the customer. It is important that this room be ready for equipment and setup prior to system installation. Typically, the Treatment Planning room includes the following equipment.

Table 5 Accuray Precision™ System Room Equipment Specifications

ITEM	DESCRIPTION	L x W x H (IN)	L x W x H (MM)	WEIGHT (LBS)	WEIGHT (KGS)
13	Treatment Planning workstation	Standard	Standard	N/A	N/A
	Treatment Planning accessories (flat-screen monitor, and keyboard) (monitor size & weight)	Standard	Standard	N/A	N/A
15	Printer	16.5 x 21.5 x 15.6	419 x 546 x 395	N/A	N/A

1.5.1 Accuray Supplied

1. **Treatment Planning System (Item 13 – Placed on a Desktop or Countertop)**

   Description: The Planning Station is the computer workstation where the clinician analyzes the patient's computed tomography (CT) data and uses it to create an optimized treatment plan. The facility must have on-site a CT device that generates DICOM images.

2. **Printer (Item 15 – Placed on a Desktop or Countertop)**

   Description: Standard LaserJet printer.

   Site planning considerations: Provide adequate counter space and power outlet – one for the Vidar Scanner and one for the Dosimetry Workstation (optional equipment).

1.5.2 Customer Supplied

1. **Network Connections (Required).**

   Description: Please see the Section 5.4: Information Technology Needs of this document, or Accuray's Network System Requirements document for more information.

2. **Vidar Scanner/Film Analyzer (Item 11 - Placed on A Desktop or Countertop)**

   Description: In addition to standard computer components, the Treatment Planning Room may include a Vidar scanner and a film analyzer work station, which the facility may purchase separately from Accuray.

   Site planning considerations: Provide adequate counter space and power outlet – one for the Vidar Scanner and one for the Dosimetry Workstation (optional equipment).

2.0 Radiation Shielding Guidelines

2.1 Initial Site Planning

Description: TomoTherapy® Treatment System shielded barrier thickness requirements will vary from site to site depending upon many factors including: local regulations, shielding design goals, exposure limits, adjacent area occupancy rates, and the weekly or yearly accelerator workload. It is highly recommended that a qualified radiation physicist estimates the anticipated clinical case workload at each specific facility, paying particular attention to the type, duration and total number of treatments. The customer is ultimately responsible for determining the proper shielding for their treatment room and ensuring compliance with all applicable local, state and country regulations.

2.1.1 System Description and Specifications

The TomoTherapy Treatment System combines the principles of computed-tomography imaging with intensity-modulated radiation therapy (IMRT). The two modalities delivering image guided IMRT are TomoHelical™ and TomoDirect™. Both modalities employ a compact linear accelerator waveguide that produces a 6 MV X-Ray beam.

- Helical TomoTherapy generates a slit beam of radiation that continuously rotates on a slip-ring gantry while the patient is translated through the gantry opening and beam.
- TomoDirect™ Treatment Delivery generates a slit beam of radiation for different static angles, while the patient is translated through the gantry bore opening and radiation beam.

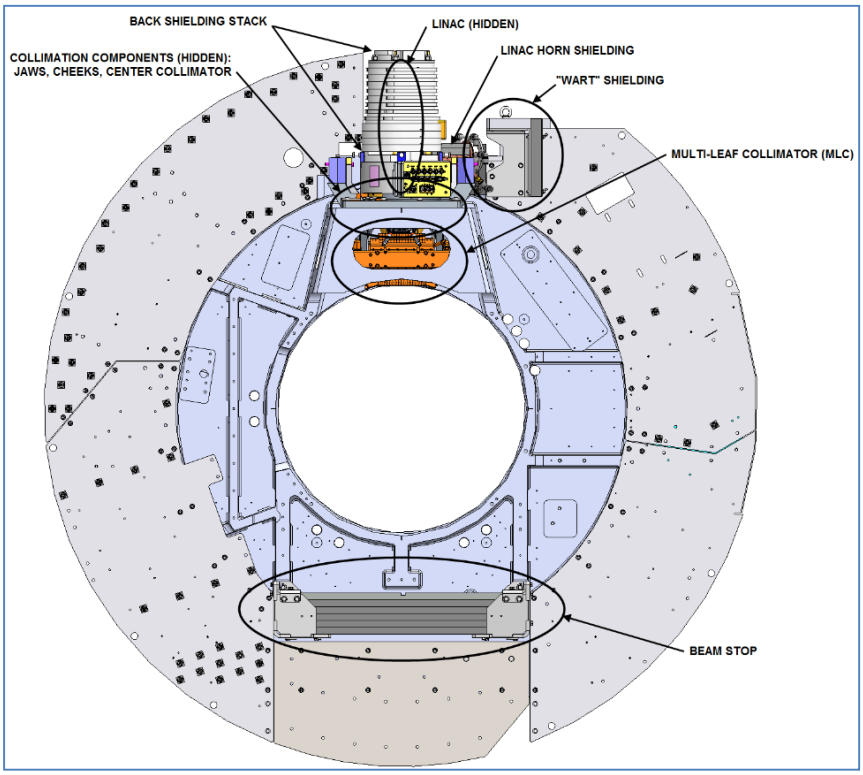

Figure 1 Radixact™ System critical structures related to shielding design

The TomoTherapy Treatment System produces 860 +/- 30 beam monitor units (MU) per minute. Note that 1 MU is nominally equal to 1 cGy, at 85 cm source-axis distance (SAD) in a 5 cm x 40 cm field size at a depth of 15 mm in water (these parameters define the reference beam conditions used in this report). The approximate 860 MU/min output value stated above is intended to aid with shielding design assumptions which are necessarily required in advance of system installation. However, each system's output is uniquely determined after installation. The output of each TomoTherapy Treatment System is calibrated to achieve agreement between planning calculations and delivery measurements for helical IMRT plans. The static, open field output can vary from one machine to another, depending on how various beam and alignment parameters fall within their respective tolerance ranges.

The slit radiation beam is 40 cm wide in the transverse direction. A primary set of moveable tungsten jaws (11.7 cm thick) define the delivery slice width, which can be adjusted from 4 mm at MVCT to 50 mm in the inferior-superior direction of the patient. Therefore, the maximum field size of the primary treatment beam, at isocenter (85 cm SAD), is limited to 5 cm in the longitudinal direction by 40 cm in the transverse direction.

The primary beam is further collimated by 64 binary, pneumatically driven tungsten leaves, with a tongue-and- groove design. The leaves are arranged on a curve with focus that is not coincident with the X-ray Spot. This helps reduce radiation leakage [1]. Each leaf is 10 cm thick and projects to 6.25 mm along the transverse axis at isocenter. By either attenuating the radiation or allowing it to pass through, this multi-leaf collimator (MLC) enables the TomoTherapy Treatment System™ to provide a range of low to high levels of intensity modulation. The system is also equipped with an on-board primary beam stop. The 12.7 cm thick lead-slab beam stop is located on the rotating gantry opposite the beam source and provides a high degree of primary radiation beam attenuation. Figure 1 illustrates the location and arrangement of critical structures pertinent to shielding design. Workload Estimation and Intensity Modulated Radiation Therapy Factor (IMRT Factor)

Since the TomoTherapy® Treatment System is equipped with a primary beam stop, barrier thickness requirements are dominated by secondary radiation. Therefore, properly estimating the site specific

weekly leakage workload (WL) is critical. The following equation is an example calculation for the weekly leakage workload (WL).

W_L = 5 days/wk * 32 fx/day * 6 min/fx * 880 cGy/min = 9.86 x 10^6 cGy/wk

Included within the WL calculation (above) is the recommended IMRT factor of 16 MU/cGy applicable to a 100% IMRT facility. The IMRT factor accounts for the increase in accelerator MU due to small field sizes that are needed to achieve the desired absorbed dose to the patient. In short, for a given absorbed dose, the MU needed for IMRT is much greater than the MU needed for conventional treatment. One methodology for determining the IMRT factor involves multiplying the ratio of max. /avg. leaf open time by the ratio of max. /avg. open leaves during treatment by the ratio of max. /avg. field width (see below).

IMRT Factor = max/avg {leaf open time} * max/avg {# leaves open} * max/avg {field width} IMRT Factor = 100% / 50% * 64 / 16 * 5.0 cm / 2.5 cm = 16

To determine the primary barrier weekly workload (Wpri), simply divide W_L by the IMRT Factor:

Wpri = W_L / 16 MU/cGy = 6.16 x 10^4 MU/wk

NCRP 151 section 3.2.2 provides a thorough treatment of IMRT considerations [2]. Table 14 provides examples of treatment parameters.

Table 6 Example Treatment Parameters

	Total Dose (Gy)	Fraction Dose (Gy)	Beam-On Time (min)	Field Width (cm)	Max. Possible/Avg. (leaf open time)
Prostate	70.0	2.0	2.5	2.5	30.6%
SRS Liver	42.0	4.66	7.9	2.5	53.7%
SBRT Lung	50.2	5.02	7.5	2.5	63.7%
Head & Neck	60.0	2.0	5. 0	2.5	30.4%
Breast / SC with SIB	50.7	2.15	8.4	2.5	55.6%

2.1.2 Primary, Leakage and Scatter Radiation Testing

At Accuray, we determined the levels of primary, leakage, and scatter radiation from a representative TomoTherapy Treatment System™ during both rotating and static beam delivery. We compared this comprehensive set of radiation measurement data to various leakage radiation related compliance tests and also incorporated the standard leakage data obtained from every system we build. The results of this study are intended to provide qualified radiation physicists (shielding design experts) with the information needed to calculate the shielding requirements at our customers' sites.

We used three different radiation measurement techniques to quantify primary, leakage and scatter radiation. The first method involved deploying National Voluntary Laboratory Accreditation Program (NVLAP) dosimetry at all locations of interest (see Figure 2). We also obtained direct measurements, at select locations, using large-volume ion chambers. The third method of data

collection involved the use of sensitive Optically Stimulated Luminescence Dosimetry (OSLD). The data from all three measurement techniques were in close agreement but the NVLAP dosimetry (Radiation Detection Company; Code 82 TLD model XGBN) is considered the principal and official data set. All primary, leakage and scatter radiation values are presented as a percentage or fraction of the calibrated reference beam (85 cm SAD; 1 MU = 1 cGy; 5 cm x 40 cm field; 1.5 cm depth in virtual water).

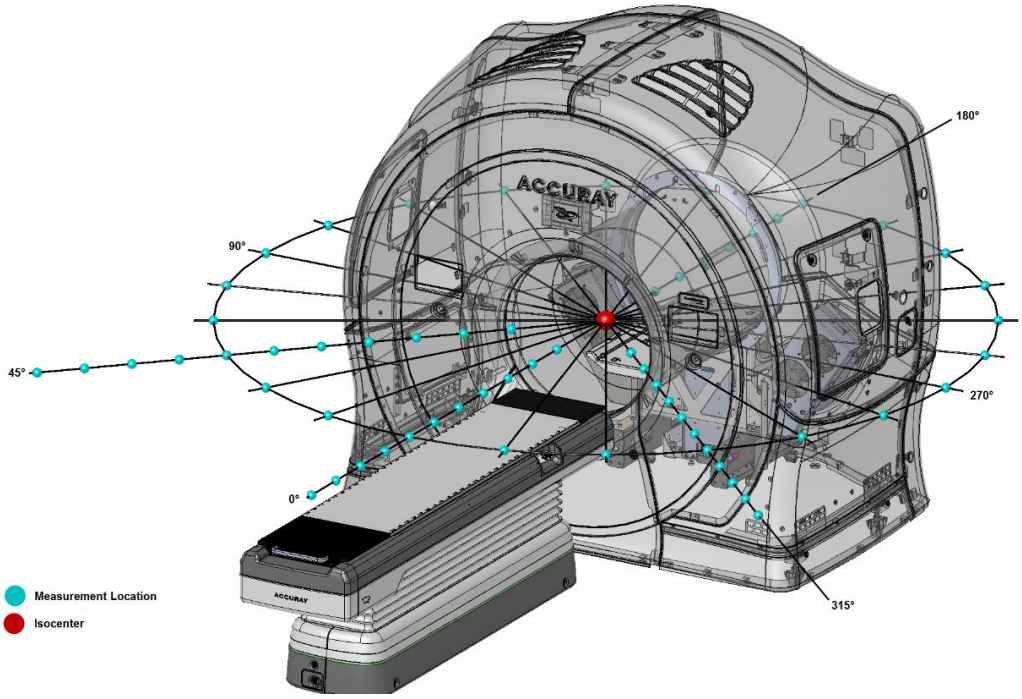

Figure 2 Measurement locations for leakage and scatter radiation within the horizontal plane

2.1.3 Leakage Radiation with Continuous Rotation

Leakage radiation was measured as a function of angle and distance from isocenter with the jaws and MLC closed while the gantry rotated at 3 rotations per minute (RPM) (20 second period). Data were collected using the three techniques outlined above at 52 locations of interest. The maximum observed %Gy/Gy values, 2 meters from isocenter, were at dosimeter positions of 90 and 270 degrees (see Figures 2 and 3) – in the plane of gantry rotation where primary beam transmission and head leakage are expected to be at a maximum. The leakage values at 2 meters from isocenter, within the plane of gantry rotation, did not exceed 3.5 x 10-3% Gy/Gy or 3.5 x 10-5 as a fraction of the calibrated reference beam. Table 7 and Figures 3 and 4 illustrate measurement locations and results.

2.1.4 Leakage and Maximum Scatter Radiation with Continuous Rotation

Leakage and maximum scatter radiation were measured as a function of angle and distance from isocenter with the jaws and MLC set to their maximum aperture (5 cm x 40 cm) while the gantry rotated at 3 RPM. A large, cylindrical solid water phantom (top half of the TomoTherapy Commissioning Phantom [Virtual Water™] which is 30 cm in diameter and 18 cm thick) was placed at isocenter to simulate patient scatter. Data were collected using the three techniques outlined above at 52 locations of interest. The maximum observed %Gy/Gy values, 2 meters from isocenter, were found at dosimeter positions between 30 to 75 degrees and 285 to 330 degrees (see Figures 2 and 3). The leakage and maximum scatter values at 2 meters from isocenter did not exceed 1.0 x 10-2 %Gy/Gy (1/10,000th of the reference dose at isocenter; 1E-4). Table 7 and Figures 3 and 4 provide greater details on measurement locations and results.

2.1.5 Leakage and Clinically Relevant Patient Scatter Radiation with Continuous Rotation

Leakage and clinically relevant scatter radiation were measured as a function of angle and distance from isocenter with the jaws and MLC configured to simulate an IMRT factor of 16 while the gantry rotated at 3

RPM. With the Virtual Water phantom in the bore, data were collected using the three techniques outlined above at 52 locations of interest. The maximum observed %Gy/Gy values, 2 meters from isocenter, were found at dosimeter positions between 30 to 90 degrees and 270 to 330 degrees (see Figures 2 and 3). While simulating an IMRT factor of 16, the maximum leakage and scatter values at 2 meters from isocenter did not exceed 4.0 x 10-3 %Gy/Gy. Table 7 and Figures 3 and 4 provide greater details on measurement locations and results.

Table 7 %Gy/Gy values during continuous rotation for leakage and scatter radiation

Angle (degrees)	Distance (meters)	Leakage Only	Leakage & Clinically Relevant Scatter	Leakage & Maximum Scatter
0	2.0	1.0E-03	1.3E-03	4.3E-03
15	2.0	1.4E-03	1.5E-03	5.9E-03
30	2.0	1.9E-03	2.3E-03	7.5E-03
45	2.0	2.1E-03	2.6E-03	7.3E-03
60	2.0	2.5E-03	3.4E-03	9.6E-03
75	2.0	2.4E-03	3.1E-03	6.5E-03
90	2.0	3.1E-03	3.0E-03	5.0E-03
135	2.0	8.4E-04	1.0E-03	1.8E-03
180	2.0	1.8E-04	5.8E-04	3.7E-03
225	2.0	8.5E-04	9.8E-04	2.0E-03
270	2.0	3.0E-03	3.1E-03	5.5E-03
285	2.0	2.4E-03	3.0E-03	7.2E-03
300	2.0	2.9E-03	3.5E-03	8.6E-03
315	2.0	2.1E-03	2.7E-03	7.6E-03
330	2.0	2.0E-03	2.3E-03	7.5E-03
345	2.0	1.2E-03	1.6E-03	6.0E-03
0	1.0	3.2E-03	3.6E-03	2.0E-02
0	1.5	1.6E-03	2.2E-03	8.4E-03
0	2.0	1.0E-03	1.3E-03	4.3E-03
0	2.5	6.2E-04	8.5E-04	2.8E-03
0	3.0	4.6E-04	6.4E-04	2.2E-03
45	1.0	3.8E-03	5.3E-03	2.4E-02
45	1.5	3.2E-03	3.8E-03	1.5E-02
45	2.0	2.1E-03	2.6E-03	7.3E-03
45	2.5	1.4E-03	1.6E-03	4.8E-03
45	3.0	1.1E-03	1.3E-03	3.9E-03
180	1.0	3.4E-04	2.1E-03	1.3E-02
180	1.5	1.9E-04	8.1E-04	5.5E-03

Angle (degrees)	Distance (meters)	Leakage Only	Leakage & Clinically Relevant Scatter	Leakage & Maximum Scatter
180	2.0	1.8E-04	5.8E-04	3.7E-03
315	1.0	3.6E-03	5.4E-03	2.5E-02
315	1.5	3.1E-03	4.0E-03	1.4E-02
315	2.0	2.1E-03	2.7E-03	7.6E-03
315	2.5	1.4E-03	1.8E-03	5.2E-03
315	3.0	1.1E-03	1.4E-03	3.9E-03

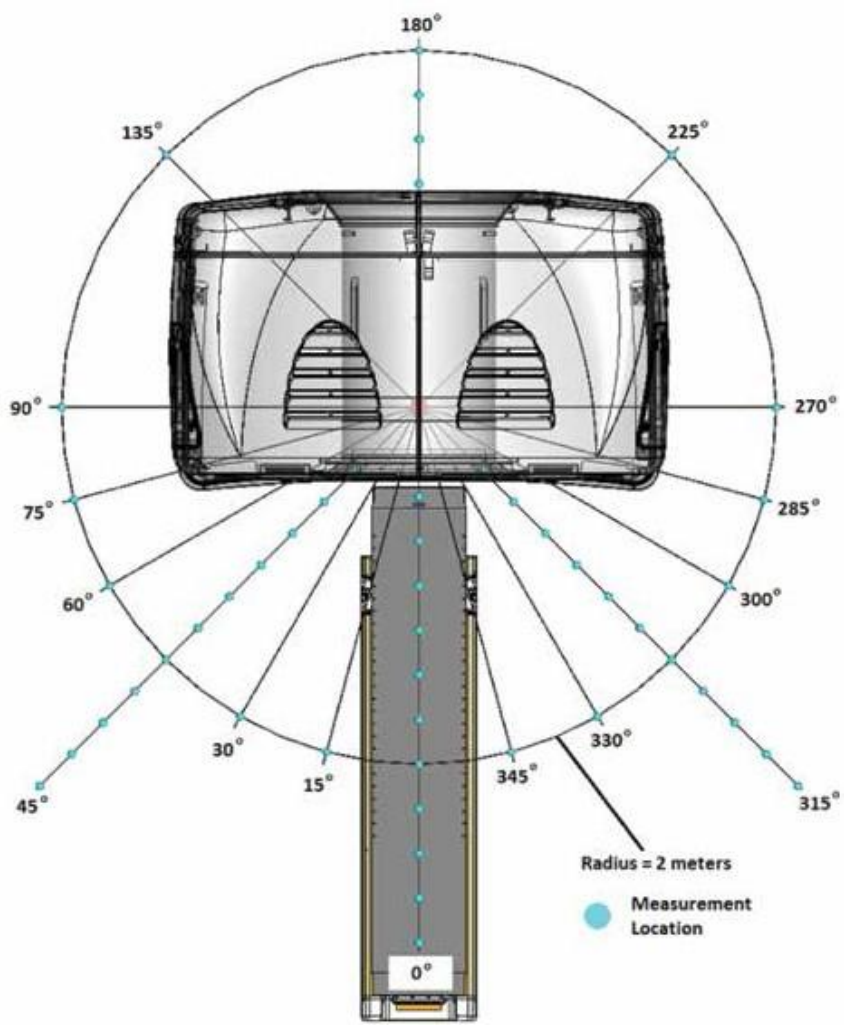

Figure 3 Top view of TomoTherapy System with angles defined for leakage and patient scatter radiation testing within the horizontal plane (intersecting the isocenter).

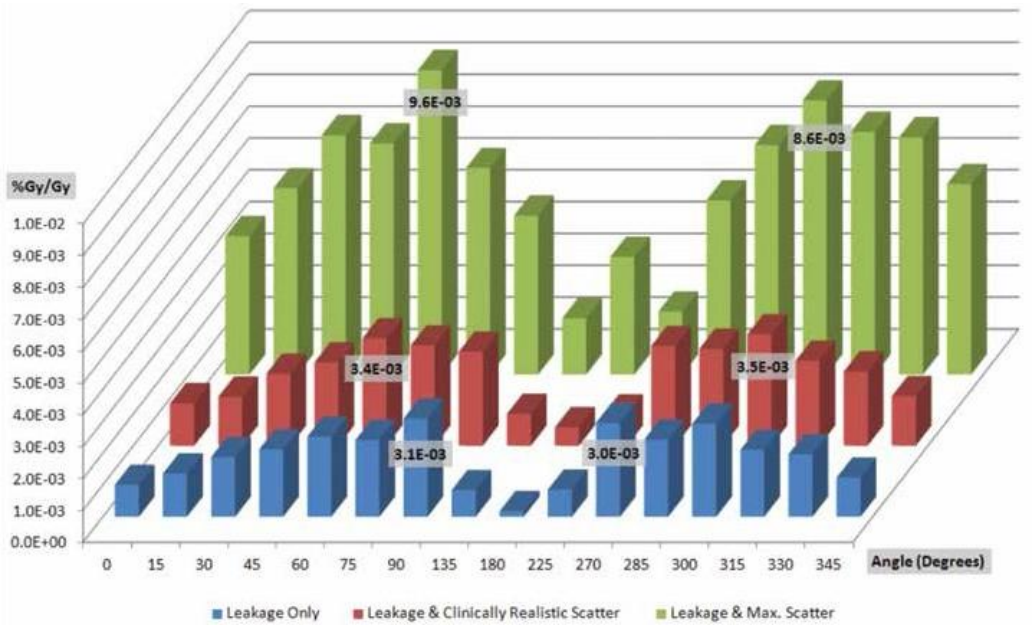

Figure 4 Graphical representation of %Gy/Gy values for leakage and scatter radiation within the horizontal plane at 2 meters from isocenter (Figures 2 and 3 indicate the angles of measurement).

2.1.6 Leakage Radiation near the Head Area with a Static Gantry

Leakage radiation near the head area was measured as a function of angle and distance from the Bremsstrahlung target with the jaws and MLC closed. This trial was conducted with a non-rotating (static) gantry. Data were collected using the three techniques outlined above at five locations of interest. The maximum observed %Gy/Gy value, 1 meter from the target, was found along the reference axis, opposite the primary beam direction (back shielding radiation leakage). The maximum observed leakage values at 1 meter from target did not exceed 1.3 x 10-2 %Gy/Gy. Table 8 and Figure 5 provide greater details on measurement locations and results.

2.1.7 Primary Radiation Transmission through the Lead Beam Stop

Primary radiation transmission through the lead beam stop was measured with the jaws and MLC at their maximum aperture. We placed an array of XGBN dosimeters at a distance of 1 meter from the back side of the beam stop (271.4 cm from the target). The maximum observed %Gy/Gy value was 7.81x10-3.

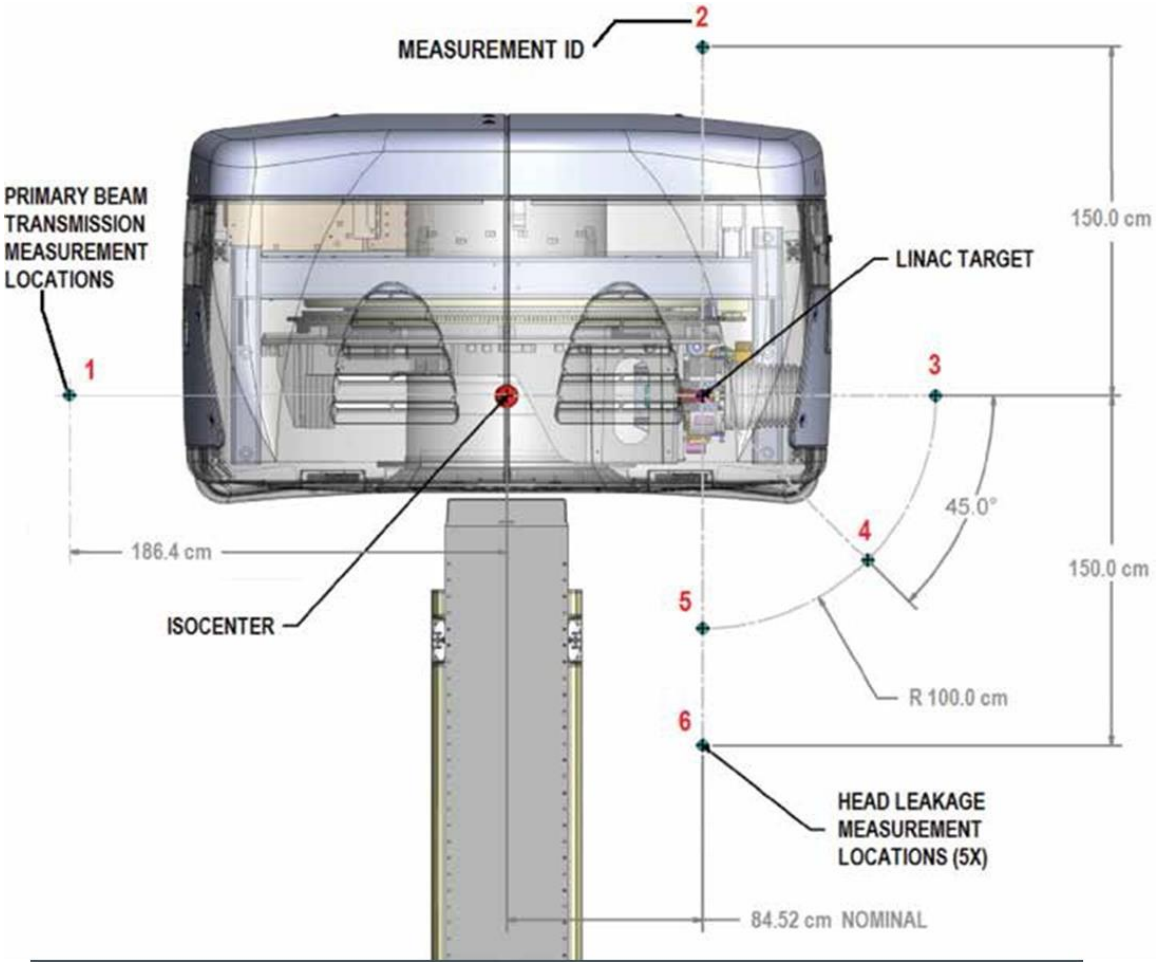

Figure 5 Top view of TomoTherapy® Treatment System with radiation measurement locations (1 – 6) for head leakage and primary beam transmission

Table 8 %Gy/Gy values during continuous rotation for leakage and scatter radiation (the maximum observed values)

Primary Beam Stop Transmission			
Measurement ID	**Distance from Target**	**%Gy/Gy**	**%Gy/Gy @ 2 m**
1	2.71 m	Max Value = 0.00781	0.0144
Anticipated %Gy/Gy with Rotating Gantry (Use Factor = 0.10)			0.0059
Head Leakage			
Measurement ID	**Distance from Target**	**%Gy/Gy**	**%Gy/Gy @ 2 m**
2	1.5 m	0.00160	0.00090
3	1.0 m	0.01243	0.00311
4	1.0 m	0.01101	0.00275
5	1.0 m	0.00716	0.00179
6	1.5 m	0.00304	0.00171

2.1.8 Tenth Value Layers (TVLs)

The TVL for leakage radiation was measured using the standard measurement setup as described by Nelson and LaRiviere [3]. A cylindrical lead shield was used to reduce room scatter from contributing to the measurements. The leakage radiation TVL measured in ordinary concrete (ρ = 2.35 g/cm3) was 29 cm; TVL lead = 5.7 cm.

Similarly, the TVL for primary radiation was measured, but in this case the ion chamber was positioned beyond the lead beam stop. The primary radiation TVL measured in ordinary concrete (ρ = 2.35 g/cm3) was 34 cm; TVL lead = 5.7 cm.

2.1.9 Discussion and Recommendations

Leakage only radiation (jaws and MLC closed; no solid water phantom) was at a maximum in the plane of gantry rotation (90º and 270º). Primary radiation transmission through the lead beam stop, when modified for gantry rotation (Use factor = 0.10), was negligible compared to head leakage values. We conservatively estimate that the primary beam stop reduces transmission by 10-3 at isocenter. Leakage and full scatter radiation at two meters from isocenter, in the horizontal plane, is at a maximum at

+/- 60º from the couch centerline (60º and 300º). However, the full scatter conditions used during this study with an isocenter beam projection of 5 x 40 cm2 is not clinically relevant.

Considering that head leakage and primary beam stop transmission were contributing to leakage and scatter radiation measurements (especially at 90º and 270º) when the jaws and MLC were set to simulate a clinically relevant IMRT factor of 16, the angular specific leakage values listed in Table 9 are most appropriate for determining therapy vault shielded barrier thickness requirements. The values in Table 9 have been adjusted upward by 10% to account for measurement uncertainty and potential system variances. The leakage and scatter fractions at 1 meter from isocenter (listed in Table 9) were calculated using the inverse square law and are based on the leakage and scatter fraction values measured at two meters. The inverse square law applies

to TomoTherapy Treatment System™ at distances applicable to therapy vault shielding design (dose points > 3.0 meters from isocenter). See example equations and calculations (next page). Additional conservatism will be achieved by applying the “two source rule” or “add HVL rule” that is applicable when the calculated, required barrier thickness is comparable among two or more sources of radiation (primary, scatter and/or leakage).

Table 9 Fraction (not percentage) of secondary radiation (relative to calibrated reference beam) for various room angles and radial distances that are most applicable to therapy vault shielding design

Angle (degrees)	Leakage Radiation Only @ 1 m	Leakage & Clinically Relevant Scatter @ 1 m	Clinically Relevant Scatter Only @ 1 m
0	4.42E-05	5.87E-05	1.44E-05
15	5.98E-05	6.75E-05	7.67E-06
30	8.24E-05	9.95E-05	1.71E-05
45	9.32E-05	1.15E-04	**2.22E-05**
60	1.11E-04	**1.49E-04**	**3.76E-05**
75	1.06E-04	**1.39E-04**	**3.24E-05**
90	**1.36E-04**	**1.30E-04**	7.98E-06
135	3.68E-05	4.41E-05	7.32E-06
180	7.93E-06	2.55E-05	1.76E-05
225	3.75E-05	4.31E-05	5.60E-06
270	**1.30E-04**	**1.38E-04**	7.98E-06

Angle (degrees)	Leakage Radiation Only @ 1 m	Leakage & Clinically Relevant Scatter @ 1 m	Clinically Relevant Scatter Only @ 1 m
285	1.07E-04	**1.34E-04**	**2.73E-05**
300	1.29E-04	**1.54E-04**	**2.55E-05**
315	9.25E-05	1.17E-04	**2.50E-05**
330	8.62E-05	1.03E-04	1.63E-05
345	5.42E-05	6.84E-05	1.43E-05

Sample Equations and Calculations (at 90º) for Barrier Thickness Requirements

Bsec (leakage or scatter) = (P * d2) / (Ψ * WL * T);

Bpri = (P * d2) / (Wpri * BSR * U * T);

n(TVL) = - log (B)

B = Barrier Transmission Factor for leakage, scatter or primary radiation: B_{leak}; B_{scat}; B_{pri}

Ψ = Tomo System angular specific leakage or scatter fraction at 1 m (Table 9).

W_L = 9.86 x 10^3 Gy/wk

W_{pri} = 4.45 x 10 Gy/wk (IMRT Factor = 16; adjusted to 1m)

P = 1 x 10^{-4} Sv/wk

d = distance from isocenter to a dose point of concern

U = use factor to account for primary beam workload directed at a given barrier

T = occupancy factor (adjacent vault = 1/2)

BSR = Beam Stop Reduction Factor at isocenter (1 x 10^{-3})

n(TVL) = the number of tenth value layers required

Assuming a dose point of interest located 4 m from isocenter in an adjacent vault 90º; Ψleak = 1.36 x 10-4; Ψscat = 7.98 x 10-6; U = 0.10; T = 0.5; P = 1 x 10-4 Sv/wk

B_{Leak} = (P * d^2) / (Ψ_{leak} * W_L * T) = 0.0024 => nTVL = **2.62**

B_{scat} = (P * d^2) / (Ψ_{scat} * W_L * T) = 0.0407 => nTVL = **1.39**

B_{pri} = (P * d^2) / (W_{pri} * BSR * U * T) = 0.072 => nTVL = **1.14**

2.1.10 References

1) Balog, J., et al. Multileaf collimator interleaf transmission. Med Phys., 26 (2), 1999.
2) National Council on Radiation Protection and Measurements, 2005. NCRP 151: Structural shielding design and evaluation for megavoltage x- and gamma-ray radiotherapy facilities (Bethesda, MD: National Council on Radiation Protection and Measurements).
3) Nelson, W.R. and P.D. LaRiviere. Primary and leakage radiation calculations at 6, 10, and 25 MeV. Health Phys. 47 (6), 811-18, 1984.

3.0 Room Specifications

3.1 Treatment Room

Figure 6 Reference picture for room dimensions

3.1.1 Floor Space

Recommended: The recommended TomoTherapy H Series dimensions for the treatment room are 23 ft long (B) x 17 ft wide (C) (7 m x 5.2 m) between the finished walls. If you are including an equipment room for the PDU behind the vault, please add a minimum of 5 ft in length (1.5 m) but the PDU cannot exceed 35 ft (10.7 m) from the back of the gantry. The recommended dimensions will provide ample space for sink, countertops and storage cabinets.

3.1.2 Ceiling Cap Height

Recommended: 9 ft 10 in (3 m) or greater between finished floor and rough ceiling cap (whether concrete or steel). This allows ample room for HVAC, lighting, etc. to be located between the finished ceiling and the ceiling cap.

Finished Ceiling Height: 8 ft 10-1/8 in (2700 mm) (A) height between the finished floor and finished ceiling.

3.1.3 Minimum Door Clearance

Noted below are the required rigging clearances for installation:

Minimum Clearances: 4 ft (1220 mm) wide x 6 ft x 10 in (2083 mm) tall for rigging on wheels (standard option), at least 7 ft (2130 mm) tall for rigging on skates (depends on the skates' design)

3.1.4 Recommended Equipment Orientation within the Treatment Room

Your Accuray Project Manager or Accuray Distributor Project Manager will help to determine the optimal orientation for your TomoTherapy™ System based on:

- Ease of patient loading
- Exact system configuration
- System clearances
- Shielding considerations
- Ease of access to sinks and cabinets
- Customer preferences

3.2 Control Room

3.2.1 Recommended Floor Space

150 square ft (14 m^2), will provide adequate counter space for at least 2 people and 3 – 4 workstations. This room should be large enough to easily accommodate 4 – 5 people during training and go-live activities. Do not use floor covering that produces static electricity to cover the floors in the Control Room. Select an ion-resistant, antistatic carpet or a carpet treated with an anti-static solution

3.2.2 Recommended Location

The Control Room should be located within view of the Treatment Room door and should be designed in accordance with the facility private healthcare information policy and local healthcare informant privacy regulations. Cable lengths to the Treatment vault will limit the distance. Note: Refer to the site specific drawings for actual distances.

3.2.3 Minimum Door Clearance

Standard door clearances are acceptable for moving equipment into the Control Room.

NOTE: If the Mechanical Room is located off of the Control Room, the door into the Control Room must meet the same minimum door clearance as the Mechanical Room to accommodate the designated equipment.

3.3 Data Management System Server Room

3.3.1 Recommended Floor Space

45 square feet (4.2 m^2).

3.3.2 Fixed Rule about Floor Space

Additional floor space must be built into the Data Server Room for any customer-supplied equipment such as power conditioners (voltage stabilizers), floor mounted air conditioning units, data and server equipment, phone equipment, storage cabinets, etc. Service access and regulatory requirements must be considered when planning for adequate space around each piece of Accuray or customer-supplied equipment.

3.3.3 Recommended Location

The Data Server Unit can be located anywhere in the facility. When using Cat 6 copper cable connection between the Planning Station and the Data Server, the distance must not exceed a maximum cable length of 300 ft (91.44 m). When using 6 strand multi-mode 50/125 laser-optimized fiber-optic cable, do not exceed 1,640 ft (500 m).

3.3.4 Minimum Finished Ceiling Clearance

7 ft (2130 mm) between finished floor and finished ceiling.

3.3.5 Minimum Door Clearance

3 ft wide x 7 ft high (900 x 2130 mm) for rigging the equipment into the Data Server Room, door clearances for the rig path need to be 82-83 inches, the United States standard measurement.

NOTE: The Data Server Room door(s) must be secure, ensuring that the room cannot be accessed during treatment by anyone other than trained operators.

3.4 Mechanical Room

3.4.1 Recommended Floor Space

160 square feet (15 m^2)

3.4.2 Fixed Rule about Floor Space

Additional floor space must be built into the Mechanical Room for any customer-supplied equipment such as transformers, power conditioners (voltage stabilizers), floor mounted air conditioning units, data and server equipment, phone equipment, storage cabinets, etc. Service access and regulatory requirements must be considered when planning for adequate space around each piece of Accuray or customer-supplied equipment.

3.4.3 Recommended Location

The mechanical room should be located near the treatment vault.

3.4.4 Minimum Finished Ceiling Clearance

7 ft (2130 mm) between finished floor and finished ceiling.

3.4.5 Minimum Door Clearance

3 ft wide x 7 ft high (914 x 2130 mm) for rigging the equipment into the Mechanical Room, door clearances for the rig path need to be the United States standard measurement of 82–83 in.

NOTE: The Mechanical Room door(s) must be secure, ensuring that the room cannot be accessed during treatment by anyone other than trained operators.

3.5 Treatment Planning Room(s)

3.5.1 Recommended Floor Space

Insure enough workspace for two or more workstations and a desktop color laser printer. Accuray will attempt to show the exact number of purchased workstations on the customer site-specific drawings. Otherwise, we will show a generic workspace. Contact your Accuray Project Manager for additional information.

3.5.2 Recommended Location

The Treatment Planning Room can be located anywhere in the facility. The distance between the Treatment Planning Room and the Data Server Room will determine which network cabling option is required. Please see the *Network System Requirements* for more information.

3.5.3 Minimum Door Clearance

Standard door clearances are acceptable for moving equipment into the Treatment Planning Room.

3.6 Sample Drawings

The following two illustrations show two typical floor plan layouts. For a complete package of sample drawings and design details, please contact your Accuray Regional Project Manager.

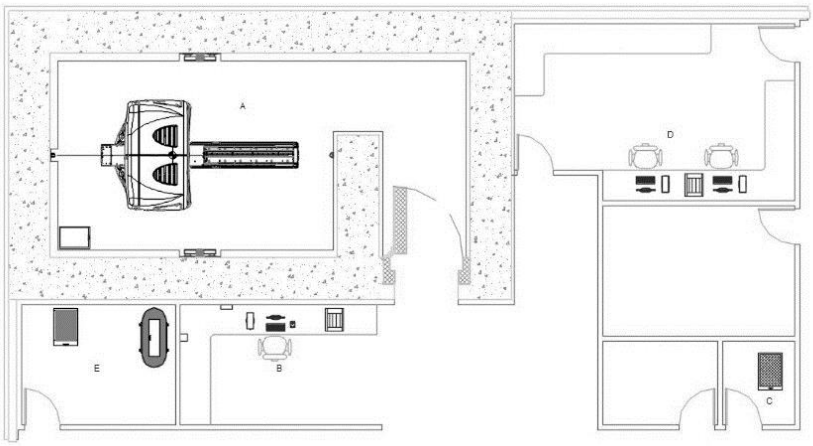

Figure 7 Typical TomoTherapy Floor Plan with Maze Walkway

Legend:

A = Treatment Room (vault)
B = Control Room
C = Data Server Room
D = Treatment Planning Room
E = Mechanical Room

Note: For additional example drawings (in AutoCAD or PDF format), please contact your Accuray Customer Operations Regional Manager.

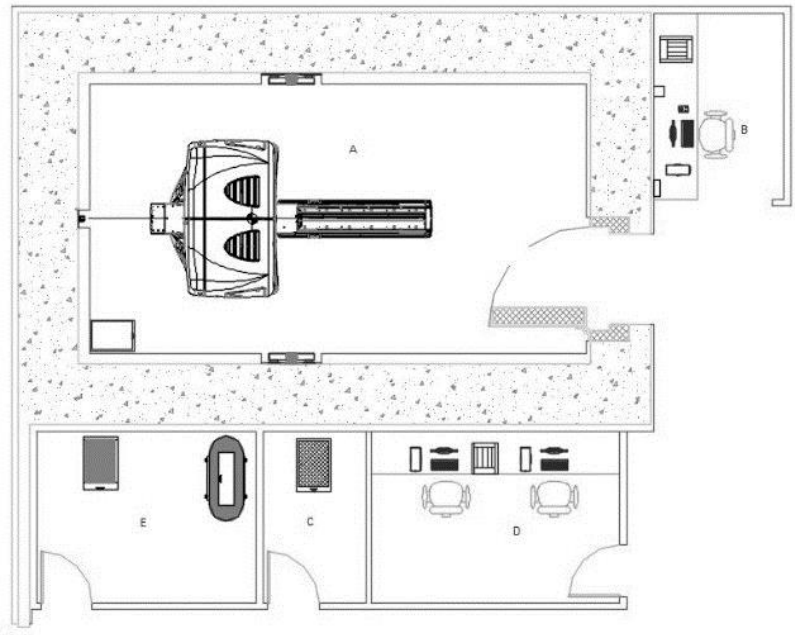

Figure 8 Typical Radixact™ System Floor Plan without Maze Walkway

4.0 Electrical and Environmental Requirements

4.1 Electrical Requirements

4.1.1 Power Monitoring Expectations

1. **New customers are responsible for initiating a power monitoring study to understand existing power conditions.**
2. **Accuray will provide a power monitoring study for Trade In-Trade Up (TITU) customers on a service contract.**
3. **The Customer's electrical engineer will evaluate the power monitoring results and the decision related to the purchase of a power conditioner/ Uninterrupted Power Source (UPS). The customer is responsible for the maintenance of that equipment.**
4. **During planning and project execution, the Accuray Project Manager will schedule a dedicated site specific environmental meeting.**

4.1.2 Facility-Supplied and Installed Equipment

The table below lists the electrical equipment that the facility must supply and install.

Table 10 Facility-Supplied Equipment

Equipment	Specifications	Installed by
Main Disconnect Panel for incoming power	Rated for supply voltage, 70 A at PDU input. Shunt trip breaker required.	Facility
Emergency Off and Emergency Stop Buttons	Push to operate, twist to reset.	Facility
Door/Entrance Switch	Local regulations/facility requirements.	Facility
System Status Indicators (Power On, Room Ready, Radiation On).	Incandescent bulbs, 40 to 200 W fluorescent bulbs, fluorescent lamp with electronic or inductive ballast, or auditory indicators.	Facility
Thermostats	2°F /1°C response	Facility
Temperature Sensors	Alarm activated if Data Server Room temperature exceeds 68°F (20°C).	Facility
Junction Boxes and Receptacles	Local regulations/facility requirements.	Facility
Power and Signal Conduits	Local regulations/facility requirements.	Facility
Electrical Trenches	Local regulations/facility requirements.	Facility
Lighting	Local regulations/facility requirements.	Facility
Fire Safety Equipment	Local regulations/facility requirements.	Facility
Emergency Power System (optional)	Configured to meet system power requirements.	Facility
Power Conditioner (double conversion)	Configured to meet system power requirements	Facility

Physics Conduit	Local regulations/facility requirements.	Facility
Closed-Circuit TV Cameras	Local regulations/facility requirements.	Facility

4.1.3 Incoming Electrical

The Accuray-supplied Power Distribution Unit (PDU) supplies power to components in the Treatment Vault and the Control Room. Power must be derived directly from a main distribution panel and be dedicated to the TomoTherapy Treatment System.

Any peripheral devices must be powered directly by facility power and not through the PDU; for example:

- Accuray-supplied printers
- Lasers
- The Accuray Precision™ System workstation components
- Any facility-supplied devices such as cameras, viewing monitors, and system-status indicators.

Table 11 Power source for Radixact™ System and facility-supplied components

IMPORTANT: This rack system* is intended to be used in a location having equi-potential bonding (such as a telecommunication center, a dedicated computer room or a Restricted Access Location). The building installation shall provide a means of connection to protective earth and the equipment shall be connected to that means.

Equipment	PDU Power	Facility Power
Power Distribution Unit (PDU)		X
Gantry and Patient Table	X	
Operator Station computer components (except printer)	X	
Planning Station computer components		X
Apollo Lasers (2)		X
*Database Server and Optimizer (Rack System)		X
Dorado Lasers (5)	X	X
Accuray-supplied printers		X
Facility-supplied Door Interlock switch	n/a Low-voltage signal	n/a
Facility-supplied System Status Indicators		X
Facility-supplied CCTV		X
Facility-supplied Viewing Monitors		X
Facility-supplied optional Frequency Convertor Unit (Required for 50Hz mains power site)		X
Facility-supplied Power Conditioner (Option for 60 Hz mains power site)		X

4.1.4 Input Power Requirements

Table 12 Input Power Requirements

	Requirements
Power Factor	0.85 at maximum load
Power Rating	58 kVA maximum
Grounding Conductor	For all routings, dedicated earth ground (conductor) should be at least the same size as the power wires. Do not use electrical conduits or electrical raceways as the sole grounding conductors. Add a ground electrode to the PDU.
Transformers	Locate power conditioners, step-down transformers (at the Operator Station) or isolation transformers close to the Treatment Vault.
Conduit	Do not locate electrical conduit or junction boxes under the gantry or patient table anchor locations.
Lighting	Ensure that all lighting fixtures remain outside of the equipment service areas.
Emergency Power	Emergency power supply is not required for the TomoTherapy Treatment System If you do establish an emergency power supply, use the same power requirements that are specified for the PDU. Also, provide emergency power for all HVAC systems that support the TomoTherapy Treatment System. It is critical that room temperature be maintained when operating the TomoTherapy Treatment System. If facility power is lost, there will be an interruption in voltage during transfer to emergency power and, therefore, an interruption in treatment.

Table 13 PDU Power Requirements

	Power
Input Frequency	60 +/- 2Hz
Nominal Input Voltage	480 VAC line voltage, 3 Phase Delta Configuration. Other voltages allowed with approval: 380, 400, 415, 440, 460 VAC. All voltages utilizer a circuit breaker set to a current limit of 90A per phase by input circuit breaker on the PDU **Unloaded Voltage Range:** +5% nominal voltage with no load **Loaded Voltage Range:** +/-5% nominal voltage at full load
Input Power Cable	4 AWG (25 mm^2) wire per phase and 4 AWG (25 mm^2) wire for ground, minimum. Use the same size as the phase conductors. Rated for 194°F (90°C) The PDU accepts up to #2/0 AWG (70 mm^2) Encase incoming power in a 2” diameter (50 mm maximum) connector to the face of the PDU. The facility-contracted electrician must provide separation by means of flexible conduit within the PDU junction box for exposed wire. The input wire gauge should be sized for voltages/currents shown in table below and meet local codes.
Phase Balance	Phase voltages balanced within 2%
Main Circuit Breaker or Disconnect	70A (all voltages) wired to the PDU. If the main disconnect cannot be placed at the Control Room, contact the Accuray Project Manager to review alternatives.
Grounding Input Conductors	The local ground should have an earth ground conducted impedance of 25 Ohms or less. Use dedicated safety grounds that are not used for grounding any functional currents from other equipment. Wiring must comply with local and national codes for safety ground conductors. The PDU requires a local grounding electrode for optimal equipment performance. Use building steel, metal water pipe, or grounding rod. If water pipe is used, it must have ground exposure for a minimum of 10 ft (3.05 m). **Important: Do not use any pipe related to gas supplies as a grounding electrode.**

4.1.5 Treatment Room Component Minimum Power Recommendations

Table 14 Treatment Room Components Minimum Power Requirements

Component	Power	Power Supplied by
Gantry	400 VAC, 3 phase	Accuray PDU
Patient Table	230 VAC, 3 phase	Accuray PDU
Power Distribution Unit (PDU)	See Table 3	Facility
Apollo Lasers	North America: 120 VAC, 1 phase International: 240 VAC, 1 phase	Facility
Dorado Lasers	North America: 120 VAC, 1 phase International: 240 VAC, 1 phase. Facility must provide over- current protection	Accuray PDU
System Status Indicators (System Power On, Room Ready, Radiation On)	8A maximum 50/60 Hz, 48-240 VAC Minimum ON load current: 50 mA Minimum OFF load current: 10 mA Facility must provide over-current protection for all three indicator outputs.	Facility
Frequency Convertor Unit (for 50 Hz mains power facilities)	Typically, 380 – 400 VAC input in EIMEA region, Japan – 200 VAC, adjustable	Facility

4.1.6 Data Server Room Component Minimum Power Recommendations

Table 15 Data Server Room Component Minimum Power Requirements

Component	Facility-Supplied Power/ Rated Component Power
Optimizer circuit 1	200-240 VAC, 20 A, 50/60 Hz
Optimizer circuit 2	200-240 VAC, 20 A, 50/60 Hz
Optimizer circuit 3	200-240 VAC, 20 A, 50/60 Hz

4.1.7 Conduits

Power cables must be separated from signal cable. Install dedicated conduits from the PDU to the TomoTherapy Treatment System components.

Due to the complexity and variety of requirements of local, state, and country electrical codes, facility-employed electrical contractors must determine the size of input conduit and the actual layout of embedded electrical conduits that meet both code requirements and Accuray specifications.

4.1.8 Component Minimum Power Recommendations

Table 16 System Wiring

Wiring from	Wiring to	Details
Power and Signal Conduits	Main Bunker Ground	
Facility-supplied System Status Indicators (System Power On, Room Ready, and Radiation On)	Back of the Gantry (SSI Box)	Must meet local regulations. 24-10 AWG Accuray recommends that facility wires be comprised of insulated conductors with an overall cable jacket. Do not use or coil excessive cable length to avoid introducing noise that could interfere with the SSI signals. Label the wire ends accordingly: System Power On, Room Ready, and Radiation On. Pull the wires back to the back of the gantry via the electrical trench. Accuray will make the connection to the System Status Interface assembly
Door/Entrance Interlock	PDU	24 VDC, 3 A For safe machine operation and compliance with local regulations, install a normally open switch. Use minimum 20 AWG (0.5 mm^2) shielded, twisted-pair wire or wire specified by local regulations. Pull the wire back to the PDU junction box. Accuray will make the final connection.
Power for Dorado & Apollo Lasers	PDU	230 VAC, 20 A (Dorado Laser Rating) Use 14 AWG (2.08 mm2) wire in a line / neutral / ground configuration. Lasers wired in parallel to the JB3 ceiling junction box, then wired in series from this box to the PDU. This is a series parallel circuit. Power is supplied by the PDU.
Emergency Stop Buttons	PDU	Set the switch in the normally closed position. Use twist-to-reset style, wired in series. 24VDC, 3A. Use minimum 20 AWG (0.5 mm^2) shielded, twisted-pair wire or gauge specified by local regulations. Pull the end wire back to the PDU junction box. Accuray will make the final connection.
Emergency Off Button	Shunt trip breaker in Main Disconnect	

4.1.9 Lighting

Install lighting outside the service clearance areas. Ensure that lighting is operational before the system is installed. Accuray recommends:

- Fixtures which are flush with the finished ceiling.
- A combination of incandescent and fluorescent lighting.

- Dimmers to control light levels at the Control Room and in the Treatment Vault.

4.2 Environmental Requirements

4.2.1 Treatment Room

The table below lists the mechanical equipment that the facility must supply and install.

Table 17 Facility Supplied Equipment

Equipment	Specifications	Installed by
Treatment Vault HVAC equipment	Capable of cooling to 68-75°F (20-24°C).	Facility
Data Server Room HVAC equipment	Capable of cooling to 68°F (20°C).	Facility
Remote temperature-monitoring system or temperature alarm	Alarm activated if Data Server room temperature exceeds 68°F (20°C).	Facility
Air Compressor, tank, and dryer	See specifications below.	Facility
Fire Safety Equipment	Local regulations/facility requirements	Facility
Floor Pit Moisture Sensor	Sensor: Comply with local regulations/facility requirements	Facility

4.2.2 Treatment Room HVAC

A dedicated Heating Ventilation and Air Conditioning (HVAC) system is required to maintain the environmental specifications. An acceptable alternate would be to dedicate a separate zone on the facility HVAC system. Environmental specifications to be maintained 24/7.

Table 18 Treatment Room environmental requirements

	Environmental Requirements
Heat output	40000 BTU/h (11.7 kW) (sensible only)
Room Temperature	68-75°F (20-24°C)
Relative Humidity	30-60%, non-condensing
Supply Air Temperature (maximum)	55°F (12.8°C)

NOTE: Of the 40,000 BTU/h (11.7 kW) heat output in the Treatment Vault, the gantry generates up to 38,000 BTU/h (11.14 kW) and the PDU generates up to 2000 BTU/h (0.59 kW). If you place the PDU in an equipment room that is separate from the Treatment Vault, consider the heat output of all components in that room, including the added heat output of the PDU, when determining cooling needs. These numbers only represent the sensible heat load, and additional margins must be accommodated in the calculations to satisfy additional latent heat loads that are largely dependent on HVAC system losses and the ambient humidity for that geographic location.

4.2.3 Thermostat Location

Install a dedicated thermostat behind the machine isocenter on the wall and 5 ft (1530 mm) above the finished floor as per the site drawings.

The thermostat should have a 2°F/1°C response range.

4.2.4 Return Air Duct

Install two or more return-air vents above the patient table. Air vents should be placed approximately 4-5 ft (1-2 meters) from the machine isocenter.

4.2.5 Gantry Supply Air

Provide dedicated cooling unit if possible. Install three supply-air vents behind the gantry for the cooling air intakes. Supply 95% of the coldest air (preferably 55°F / 12.8°C) to the cooling air intakes. Provide a separate thermostat if possible for gantry supply air.

4.2.6 Vault Supply Air

For patient comfort, provide patient side supply-air vents from the facility HVAC system. Provide a separate thermostat if possible for vault supply air.

4.2.7 Supplemental Air

Facility to provide 55°F (12.8°C) (30 - 60% relative humidity) supplemental air flow of 70-140 cfm (33-66 lps). Install an under-slab 12 in x 10 in (305 mm x 200 mm) air duct or 12 in (305 mm) round (or equivalent minimum cross-sectional area) PVC duct to the underside of the gantry covers.

Route the duct under the slab and terminate no more than 2 in (50 mm) total height above the finished floor 2 ft- 5 in (736 mm) from isocenter (see M-101 of the Accuray site specific drawings). Leave open the exposed portion of the air duct under the gantry covers and include a debris screen.

4.2.8 Treatment Room HVAC Design Summary

The TomoTherapy® gantry is air cooled. It has four air intakes at the backside of the gantry built into the cosmetic covers. The cooling air is supplied to the rear of the gantry through (quantity 3) ceiling mounted supply grilles. The supplied cooling enters the gantry intake grilles, cools the equipment, and then is discharged from the top of the gantry through two built-in grilles, towards the ceiling return diffusers. The location of the return grilles is important as it's critical to not allow the discharged air to re-circulate to the intakes at the rear of the gantry. The gantry discharges approximately 4100 m3/h (the gantry pulls in 3850 m3/h of room air plus the max. 244 m3/h of supplemental air delivered at the bottom of the gantry), so it's critical to supply the quantity of cooling outlined above. The actual required air volume is to be calculated by the customer's HVAC engineer. The AHU that supplies cooling to the gantry should be on a dedicated thermostat separate from the vault supply thermostat. The recommended location of the thermostat is described above as well as contained on the Accuray site specific drawings.

Figure 9 Radixact™ System Gantry HVAC Schematic

4.2.9 Control Room

There are no special environmental requirements with regard to the TomoTherapy® System in the Control Room.

4.2.10 Data Server Room

Place the Data Server components in a dedicated room that can be independently temperature-controlled. The Data Server components generate an average combined heat output of 18,000 BTU/h (5.28 kW). Install a dedicated HVAC system on 24-hour operation with emergency power backup. Install a thermostat with 2°F /1°C response range within 4 ft (122 cm) of the Data Server Unit.

Table 19 Server Room environmental requirements

	Environmental Requirements
Heat output	18,000 BTU/h (5.3 kW) (sensible)
Room Temperature	68°F (20°C) or cooler
Relative Humidity	30-60%, non-condensing
Supply Air Temperature (maximum)	53°F (12°C)

NOTE: These numbers only represent the sensible heat load, and additional margins must be accommodated in the calculations to satisfy additional latent heat loads that are largely dependent on HVAC system losses and the ambient humidity for that geographic location.

4.2.11 Remote Monitoring

Install a remote temperature-monitoring system or temperature-activated alarm. If the Data Server Room becomes overheated, you will have less than two hours to perform a controlled shut down of the TomoTherapy® System. A temperature-monitoring system will alert you and allow you to respond quickly to overheating.

4.2.12 Mechanical Room

The Mechanical Room houses the oil-free air compressor, air tank, dryer, and filter. For 50-Hz sites, it also holds the Frequency Converter Unit (FCU). The Mechanical Room should include an acoustical barrier due to noise generated by the equipment if located near patient areas.

4.2.13 Treatment Planning Room(s)

There are no special environmental requirements with regard to the TomoTherapy System.

5.0 Other System Implementation Considerations

5.1 Patient Positioning Lasers

Description: A laser positioning system is mounted in the Radixact™ System room to accurately position patients on the table. The five Dorado lasers and two Apollo lasers are mounted on the treatment room walls and ceiling.

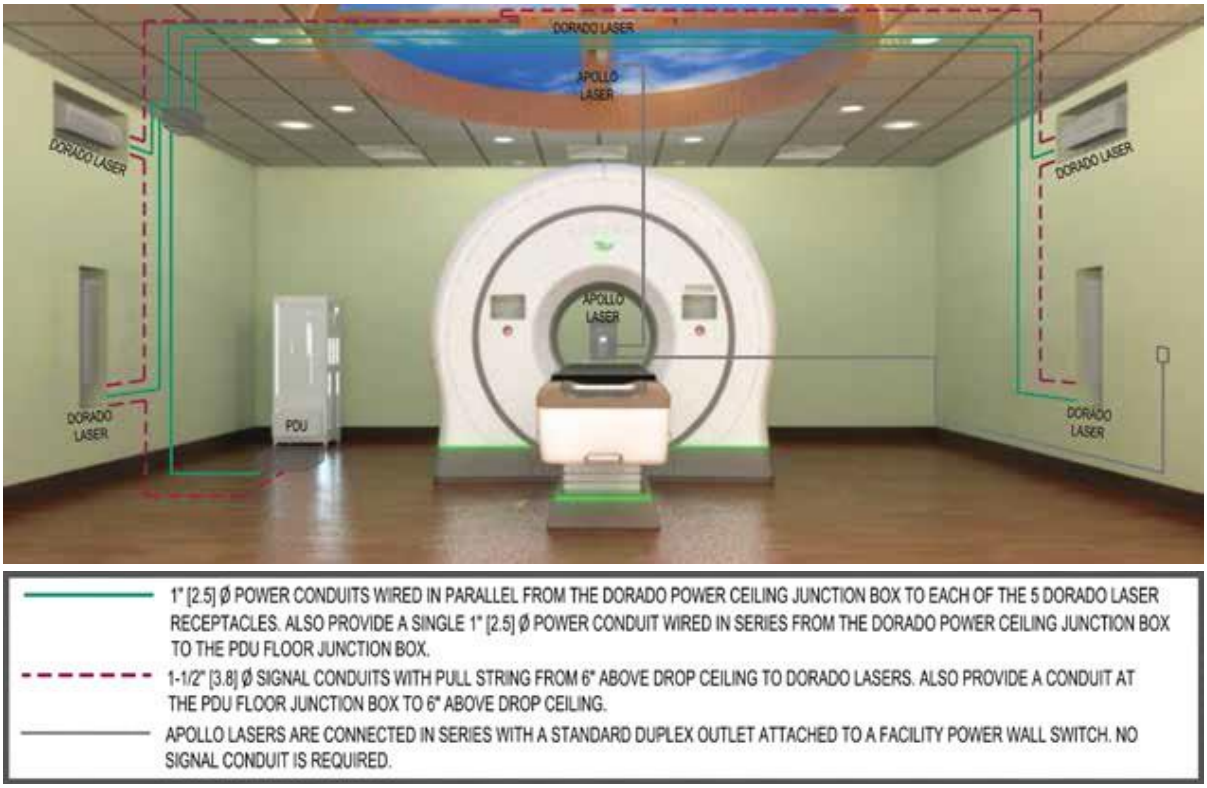

Figure 10 Required Routing of Laser Conduits

5.1.1 Laser Mounting Plates

Laser mounting plates must be spaced 1/2 in (12 mm) off any concrete surface. Five Dorado lasers and two Apollo lasers will be mounted to the walls and ceiling of the Treatment Room by Accuray. To prepare for laser installation, provide and install 3/8 in (10 mm) aluminum or 1/4 in (6 mm) steel laser mounting plates either directly on the wall and ceiling surface or in recessed openings. Lasers are used to help accurately position the patient, so it is important to install the laser mounting plates precisely in the positions listed in this guide. See the Accuray site specific drawings for clearance and mounting information, and laser cabinet and laser guard specifications. If you protect the lasers with cabinets or doors, keep the openings free from obstructions. Do not insert windows into the cabinet or door openings. As you plan for construction or renovation, consider which of the three mounting options described below will work best for the site.

5.1.2 Fully Recessed Openings

Recommended to provide fully recessed openings within the finish walls for the lasers. Consider providing additional protection by installing doors over the lasers.

5.1.3 Partially Recessed Openings

If the Treatment Vault lacks enough available space for a fully recessed opening, consider constructing a partially recessed open. You can provide additional protection for the lasers by constructing cabinets around them.

5.1.4 Surface

When a recessed opening is not feasible, you must mount the laser plates to the wall and ceiling surfaces. Construct cabinets around the lasers or install laser guards to ensure their protection.

NOTE: If you plan to install doors over the lasers, a facility physicist must mark the position of the openings in the cabinet doors, with help from the Accuray Installation Technician, and a facility contractor must cut the door openings to allow the 60º divergent laser beam projection.

5.1.5 Surface-Mounted Lasers

Construct the mounting surface with unistrut or concrete.

Install steel bars or a plastic laminate enclosure on either side of wall-surface-mounted lasers to protect them. An 8 in (203 mm) minimum recessed laser guard is required.

Table 20 Surface-Mounted Laser Plate Locations

Laser	Vault Location	Plate/Surface	Placement
Apollo Overhead	Ceiling	18 in x 12 in x 1/4 in thick steel or 3/8 in aluminum (457 mm x 305 mm x 6 mm thick steel or 10 mm aluminum)	Centered on the ceiling at virtual isocenter 2 ft 3.5 in (700 mm) from the machine isocenter.
Apollo Gantry Rear	Wall behind the gantry	18 in x 12 in x 1/4 in thick steel or 3/8 in aluminum (457 mm x 305 mm x 6 mm thick steel or 10 mm aluminum)	Vertical, centered at isocenter height 3 ft 8.25 in (1124 mm) above the finished floor.
Dorado Overhead	Ceiling	42 in x 16 in x 1/4 in thick steel or 3/8 in aluminum (1067 mm x 406 mm x 6 mm)	Centered on the ceiling, 5 ft (1524 mm) in front of the machine isocenter.
Dorado Vertical Side (2)	Each wall to the left and right side of the gantry	42 in x 16 in x 1/4 in thick steel or 3/8 in aluminum (1067 mm x 406 mm x 6 mm thick steel or 10 mm aluminum)	Vertical, centered at virtual isocenter 2 ft 3.5 in (700 mm) from the machine isocenter. Install so that the center of the plate is 3 ft 8.25 in (1124 mm.) above the finished floor.
Dorado Horizontal Side (2)	Each wall to the left and right side of the gantry	42 in x 16 in x 1/4 in thick steel or 3/8 in aluminum (1067 mm x 406 mm x 6 mm thick steel or 10 mm aluminum)	Horizontal, centered at virtual isocenter 2 ft 3.5 in (700 mm) from the machine isocenter. Install so that the center of the plate is 12 in (305 mm) minimum below the ceiling.

5.1.6 Recessed-Opening-Mounted Lasers

If the facility plans to install the lasers in recessed openings, follow the guidelines listed in the table below to determine the size of the openings.

The finished wall must not overlap the mounting plate. The plate must remain independent of the furred out wall.

Table 21 Treatment Room laser opening dimensions

Laser	Vault Location	Clear Opening Size	Clear Recess Depth
Apollo Overhead	Ceiling	18 in x 12 in (457 mm x 305 mm)	At least 10 in (254 mm.) from the steel mounting plate to the ceiling plane.
Apollo Gantry Rear	Wall behind the gantry	18 in x 12 in (457 mm x 305 mm)	At least 8 in (2032 mm) from the mounting plate to the recess opening on the wall plane or laser-box door.
Dorado Overhead	Ceiling	42 in x 16 in (1067 mm x 406 mm)	At least 10 in (254 mm) from the mounting plate to the dropped ceiling plane.
Dorado Vertical Side (2)	Each wall to the left and right side of the gantry	42 in x 16 in (1067 mm x 406 mm)	At least 8 inches (2032 mm) from the mounting plate to the recessed opening on the wall plane.
Dorado Horizontal Side (2)	Each wall to the left and right side of the gantry	42 in x 16 in (1067 mm x 406 mm)	At least 8 inches (2032 mm) from the mounting plate to the recessed opening on the wall plane.

5.2 TomoTherapy System Shipping and Rigging Considerations

The following table lists typical crate measurements for any rigging or storage purposes.

NOTE: These measurements and weights may vary or change over time.

Table 22 Crate Sizes and Weights for Shipments

Crate Size for Shipments	Crate Weight for Shipments
115 x 57 x 93 inches 292 x 145 x 238 cm	9562 lb 4338 kg
117 x 30 x 37 inches 297 x 76 x 94 cm	1380 lb 626 kg
32 x 27 x 75 inches 82 x 69 x 191 cm	1090 lb 495 kg
38 x 24 x 62 inches 97 x 62 x 159 cm	336 lb 152 kg
20 x 74 x 78 inches 51 x 188 x 198 cm	656 lb 298 kg
92 x 45 x 87 inches 234 x 114 x 221 cm	610 lb 277 kg
92 x 58 x 61 inches 234 x 147 x 155 cm	600 lb 272 kg
59 x 55 x 45 inches 150 x 140 x 114 cm	430 lb 195 kg

92 x 55 x 61 inches 234 x 140 x 155 cm	600 lb 272 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	462 lb 210 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	444 lb 202 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	494 lb 224 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	426 lb 193 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	520 lb 236 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	400 lb 181 kg
40 x 48 x 36 inches 102 x 122 x 92 cm	878 lb 398 kg
50 x 50 x 88 inches 127 x 127 x 224 cm	
36 x 54 x 81 inches 92 x 137 x 221 cm	1434 lb 650 kg
	Total Weight = 21,917 lb Total Weight = 9942 kg

These measurements and weights may vary or change over time

5.2.1 Shipping and Rigging

The TomoTherapy System is shipped to arrive at the site, at approximately 7:00 am. Installations typically start on a Tuesday or Wednesday but can be scheduled according to the customer's needs based on Accuray personnel availability.

Accuray will schedule and pay for the shipment of the crated system to the customer location, unless specified otherwise in the sales contract.

Unless otherwise specified in the Customer's contract Accuray is responsible for rigging. The Accuray Project Manager can answer any questions regarding contractual rigging terms.

Accuray allows a total of $8,000 (US dollars) for standard rigging cost, unless otherwise noted. The customer will be responsible for any additional cost incurred where applicable. This occasionally occurs if a crane or other special equipment is required. In the event that the customer is responsible for rigging the Accuray Project Manager can refer rigging resources to the customer if requested.

5.2.2 Rig-In Manpower and Equipment Requirements

1. Clearance

- Treatment vault minimum Clearances: 4 ft (1200 mm) wide x 6 ft -10 in (2083 mm) tall for rigging on wheels (standard option), at least 7 ft (2130 mm) tall for rigging on skates (depends on the skates' design)
- iDMS™ System room: 3 ft wide x 7 ft high (900 mm x 2000 mm) for rigging the equipment into the, door clearances for the rig path need to be the United States standard measurement of 82 in (2083 mm)

2. Manpower

- One experienced rigger, two or three additional movers.
- Our installers will be present to help answer questions and assist where required.

3. Equipment

- One 15,000 lb (6800 kg) forklift with 8 ft (2.4 m) fork blades.
- One electric two-ton pallet jack.
- One, hand-operated genie lift (>300 lbs (136 kg) capacity
- One J-bar.
- Eight (8) four-wheel dollies.
- Two metal plates for crossing doorways.
- Floor protection for the length of the route (Masonite or Lexan sheets 4 ft x 8 ft) (1.2 m x 2.4 m). The Gantry, at 8,500 lbs (3,856 kg), is the heaviest piece to move.
- Basic tools for uncrating the equipment.
- Tarps to cover or “stage” the equipment if the weather is an issue.
- Straps

NOTE: Because the rig-in typically starts at 7:00 am, it is preferred that the rigging equipment be delivered the day before the system delivery. If this is not feasible, the equipment must be on site before 7:00 am on the delivery date.

5.3 Storage

The facility must establish a locked storage area where the Accuray Installation Technicians can store tools and testing equipment for approximately one month during installation. Choose a location that is near the installation site and that is accessible 24 hours per day. Also, supply a clean 12 ft x 12 ft (3650 mm x 3650 mm) low-traffic, indoor storage area where the Accuray Installation Technicians can place the gantry enclosures during installation. The enclosures are delivered in sections, so you may establish multiple storage areas if one area cannot accommodate all of the enclosures.

5.4 Information Technology Needs

Please refer to Accuray’s *Network Systems Requirements* document. The Accuray Project Managers will provide this document to you.

NOTE: The IT setup work must be completed prior to the system delivery.

5.5 Seismic Regulations

If the facility is required to meet local or regional seismic regulations, provide the Accuray Project Manager with the specifics of those regulations in writing. Add time to the site-preparation schedule so an Accuray Installation Technician can visit the site prior to system delivery to install anchors for the Gantry, Patient Table, PDU, Computer rack and Frequency Convertor Unit. Anchors must be specified by a facility-contracted structural engineer. Accuray will supply and install the specified anchors. If local or regional seismic regulations require support angles for the PDU and iDMS™ System Server Rack, Accuray will supply a Seismic Mounting Kit. The PDU is shipped with seismic brackets.

Successful regulatory inspections of anchors must occur before the system is installed. It is the facility’s responsibility to contact the regulatory agencies and arrange for any required inspections prior to system installation.

5.6 Power Conditioners (60Hz Sites Only)

5.6.1 Equipment Needed

1. Power Conditioning

The equipment is sensitive to line voltage variations and source impedance. A complete survey of the electrical power monitoring should be conducted prior to the equipment installation and a copy of this survey should be sent to the Accuray Project Manager and the customer's Electrical Engineer for record. The customer's Electrical Engineer will evaluate the power monitoring results and the decision related to the purchase of a power conditioner/ Uninterrupted Power Source (UPS) if the input voltage cannot be regulated to within +/- 5% phase to phase. Double conversion power conditioning must be used if facility power conditioning is needed. The customer is responsible for the installation and maintenance of that equipment.

5.6.2 Common Supplier

Eaton Powerware – www.eaton.com (Model # 9390-40 30kVA)

OnLine Power- www.onlinepower.com (Model OLP075MRT-US 75kVA)

5.7 Frequency Converter (50 Hz Sites Only)

For sites that require it, Accuray supplies a frequency converter (as an option) that converts the input power to the Power Distribution Unit (PDU) from 50 to 60 Hz and acts also as a power conditioner. The Frequency Converter is based on dual conversion technology and provides improved output power to the PDU. Install the frequency converter no closer than 6 inches (152 mm) to any adjacent wall surface.

Table 23 Frequency converter location requirements

	Minimum Distance
Clearance above the unit for heat dissipation	3 ft (1 m)
Clearance in front of the unit to open the access panel	3 ft (1 m)
Distance from any wall	6 in (152 mm)

NOTE: The frequency converter is capable of continuous normal operation when the environmental requirements listed are maintained.

Table 24 Frequency converter environmental requirement

	Environmental Requirements
Heat output	12000 BTU/h (3.52 kW)
Temperature range	0 to 40°C (32 to 104°F). For optimal performance and reliability, maintain the room temperature below 25°C (77° F)
Relative humidity	Below 60%, non-condensing

NOTE: These numbers only represent the sensible heat load, and additional margins must be accommodated in the calculations to satisfy additional latent heat loads that are largely dependent on HVAC system losses and the ambient humidity for that geographic location.

Site planning considerations: Typically, the Frequency Converter is located in a Mechanical Room outside of the Treatment Room. Ensure that the room provides adequate ventilation and cooling according to the manufacturer's documentation. Do not use in a flammable gas environment. Installation of the Frequency Converter in the Treatment Room is not recommended, as this will result in increased heat load. During installation, Accuray will drill and anchor the FCU to the floor in seismic locations. Ensure that the room that contains the FCU meets all local fire and safety codes.

5.8 Closed Circuit TV (CCTV)

The facility may supply and install a video system. Accuray recommends these closed-circuit television camera locations:

- One stationary camera 5 ft (1524 mm) above the finished floor behind the gantry on the isocenter.
- One pan, tilt, and zoom camera on the wall or ceiling at the foot of the patient table.

Please see the site specific drawings for specific camera locations.

5.9 Common Supplier

- General Electric – www.gesecurity.com
- Panasonic – www.panasonic/business/security.com
- Samsung – www.samsungsecurity.com
- Nuvico – www.nuvico.com

NOTE: The camera system must be installed prior to the Radixact™ System installation as it is used during system testing and calibration.

5.10 Quality Assurance and Commissioning Tools and Equipment

Please consult with your Accuray Project Manager for specific requirements. All of the required tools must be on site before the Radixact™ System installation.

NOTES