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Digital Imaging and Communications in Medicine (DICOM)

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Supplement 176: Second Generation Radiotherapy – Additional RT Treatment Modalities

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DICOM Standards Committee, Working Group 7, Radiation Therapy

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Foreword

74 This Supplement specifies additional IODs necessary to support the new Second Generation Radiotherapy IODs and operations.

76 This document is an extension to the following parts of the published DICOM Standard:

	PS 3.2	Conformance
78	PS 3.3	Information Object Definitions
	PS 3.4	Service Class Specifications
80	PS 3.6	Data Dictionary
	PS 3.16	Content Mapping Resource

82

Scope and Field of Application

Introduction

84 The scope of this supplement is the introduction of new RT Radiation IODs for non-C-Arm treatment devices. The C-Arm treatment devices are covered in Supplement 175. This Supplement is based
86 on the real-world model and specifications defined Supplements 147 and 175. References, definitions etc. not present in this supplement can be found in Supplement 147 and 175.

88

Part 2 Addendum

90 **Add new SOP Classes to PS3.2 Table A.1-2 UID Values:**

UID Value	UID Name	Category
1.2.840.10008.5.1.4.1.1.481.XN.5.1	Tomotherapeutic Radiation Storage	Transfer
1.2.840.10008.5.1.4.1.1.481.XN.5.4	Multiple Fixed Source Radiation Storage	Transfer
1.2.840.10008.5.1.4.1.1.481.XN.5.5	Robotic Radiation Storage	Transfer

92

Part 3 Addendum

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2

**Add the following columns in PS3.3 Section A.1.4, Table A.1-1 COMPOSITE INFORMATION OBJECT MODULES OVERVIEW –
RADIOTHERAPY**

4

IODs Modules	Tomo Rad	Multi- Fixed Rad	Rob Rad
Patient	<u>M</u>	<u>M</u>	<u>M</u>
Clinical Trial Subject	<u>U</u>	<u>U</u>	<u>U</u>
General Study	<u>M</u>	<u>M</u>	<u>M</u>
Patient Study	<u>U</u>	<u>U</u>	<u>U</u>
Clinical Trial Study	<u>U</u>	<u>U</u>	<u>U</u>
General Series	<u>M</u>	<u>M</u>	<u>M</u>
Clinical Trial Series	<u>U</u>	<u>U</u>	<u>U</u>
Enhanced RT Series	<u>M</u>	<u>M</u>	<u>M</u>
General Equipment	<u>M</u>	<u>M</u>	<u>M</u>
Enhanced General Equipment	<u>M</u>	<u>M</u>	<u>M</u>
Frame Of Reference	<u>M</u>	<u>M</u>	<u>M</u>
...			
Radiotherapy Common Instance	<u>M</u>	<u>M</u>	<u>M</u>
RT Delivery Device Common	<u>M</u>	<u>M</u>	<u>M</u>
RT Radiation Common	<u>M</u>	<u>M</u>	<u>M</u>
<u>Tomotherapeutic Delivery Device</u>	<u>M</u>		
<u>Tomotherapeutic Beam</u>	<u>M</u>		
<u>Multiple Fixed Source Delivery Device</u>		<u>M</u>	
<u>Fixed Orientation Collimator Group</u>		<u>M</u>	
<u>Multiple Fixed Source Beams</u>		<u>M</u>	
<u>Robotic Delivery Device</u>			<u>M</u>
<u>Robotic Path</u>			<u>M</u>
...			
Common Instance Reference Module	<u>M</u>	<u>M</u>	<u>M</u>
SOP Common	<u>M</u>	<u>M</u>	<u>M</u>

A.VV.1.6 Tomotherapeutic Radiation Information Object Definition

2 **A.VV.1.6.1 Tomotherapeutic Radiation IOD Description**

4 The Tomotherapeutic Radiation IOD represents the information required to describe a radiotherapy treatment on a serial or helical tomotherapeutic delivery device.

The value of Modality (0008,0060) shall be RTRAD.

6 **A.VV.1.6.2 Tomotherapeutic Radiation IOD Entity-Relationship Model**

See Figure A.VV.1.1.1-1.

8 **A.VV.1.6.3 Tomotherapeutic Radiation IOD Module Table**

10 **Table A.VV.1.6-1
TOMOTHERAPEUTIC RADIATION IOD MODULES**

IE	Module	Reference	Usage
<i>Include 'RT Radiation IOD Modules Macro' Table A.VV.1.1.1-2</i>			
RT Radiation	Tomotherapeutic Delivery Device	C.AA.F1	M
	Tomotherapeutic Beam	C.AA.F2	M

12 **A.VV.1.6.3.1 RT Radiation Common Module in RT Radiation IOD Modules Macro**

14 For the Tomotherapeutic Radiation IOD, the Code Sequence Macro in the Radiotherapy Procedure
 14 Technique Code Sequence (30xx,0C99) in the RT Radiation Common Module shall use Defined CID
 16 SUP147013. The Code Sequence Macro in Treatment Machine Special Mode Sequence (30xx,0C97)
 16 shall use Defined CID SUP147017. The Code Sequence Macro in Radiation Type Code Sequence
 (30xx,51C4) shall use Defined CID SUP147052.

18 **A.VV.1.9 Multiple Fixed Source Radiation Information Object Definition**

A.VV.1.9.1 Multiple Fixed Source Radiation IOD Description

20 The Multiple Fixed Source Radiation IOD represents the information required to describe a
 20 radiotherapy treatment on a multiple fixed source photon delivery device.

22 The value of Modality (0008,0060) shall be RTRAD.

A.VV.1.9.2 Multiple Fixed Source Radiation IOD Entity-Relationship Model

24 See Figure A.VV.1.1.1-1.

A.VV.1.9.3 Multiple Fixed Source Radiation IOD Module Table

26 **Table A.VV.1.9-1
MULTIPLE FIXED SOURCE RADIATION IOD MODULES**

IE	Module	Reference	Usage
<i>Include 'RT Radiation IOD Modules Macro' Table A.VV.1.1.1-2</i>			
RT Radiation	Multiple Fixed Source Delivery Device	C.AA.H1	M
	Fixed Orientation Collimator Group	C.AA.H2	U
	Multiple Fixed Source Beams	C.AA.H3	M

A.VV.1.9.3.1 RT Radiation Common Module in RT Radiation IOD Modules Macro

2 For the Multiple Fixed Source Radiation IOD, the Code Sequence Macro in the Radiotherapy
 Procedure Technique Code Sequence (30xx,0C99) in the RT Radiation Common Module shall use
 4 Defined CID SUP147045. The Code Sequence Macro in Radiation Type Code Sequence
 (30xx,51C4) shall use Defined CID SUP147052. The Equipment Frame of Reference UID
 6 (30xx,51A0) shall be 1.2.840.10008.1.4.RRR.4.

A.VV.1.10 Robotic Radiation Information Object Definition

8 A.VV.1.10.1 Robotic Radiation IOD Description

The Robotic Radiation IOD represents the information required to describe a radiotherapy treatment
 10 on a robotic delivery device, such as paths, nodes, and collimation type.

The value of Modality (0008,0060) shall be RTRAD.

12 A.VV.1.10.2 Robotic Radiation IOD Entity-Relationship Model

See Figure A.VV.1.1.1-1.

14 A.VV.1.10.3 Robotic Radiation IOD Module Table

**Table A.VV.1.10-1
 ROBOTIC RADIATION IOD MODULES**

IE	Module	Reference	Usage
<i>Include 'RT Radiation IOD Modules Macro' Table A.VV.1.1.1-2</i>			
RT Radiation	Robotic Delivery Device	C.AA.J1	M
	Robotic Path	C.AA.J2	M

18 A.VV.1.10.3.1 RT Radiation Common Module in RT Radiation IOD Modules Macro

20 For the Robotic Radiation IOD, the Code Sequence Macro in the Radiotherapy Procedure Technique
 Code Sequence (30xx,0C99) in the RT Radiation Common Module shall use Defined CID
 SUP147046. The Code Sequence Macro in Treatment Machine Special Mode Sequence (30xx,0C97)
 22 shall use Defined CID SUP147017. The Code Sequence Macro in Radiation Type Code Sequence
 (30xx,51C4) shall use Defined CID SUP147052. The Equipment Frame of Reference UID
 24 (30xx,51A0) shall be 1.2.840.10008.1.4.RRR.3.

2 **Add the following to PS3.3 Annex C:**

C.AA.2 Second Generation Radiotherapy General-Purpose Macros

4 **C.AA.2.18 Decaying Radiation Source Definition Macro**

6 The Decaying Radiation Source Macro describes instances of decaying sources used for therapeutic radiation treatments. It includes information about the isotope, manufacturer and source strength.

8 **Table C.AA.2.18-1
DECAYING RADIATION SOURCE DEFINITION ATTRIBUTES**

Attribute Name	Tag	Type	Description
Number of Decaying Radiation Sources	(30xx,51D0)	1	Number of decaying radiation sources.
Decaying Radiation Source Sequence	(30xx,51D1)	1	Sequence of decaying radiation source. The number of Items included in this sequence Sequence shall equal the value of Number of Decaying Radiation Sources (30xx, 51D0).
>Device Index	(30xx,0112)	1	Index of the Device. The value shall start at 1 and increase monotonically by 1.
>Include 'Device Model Macro' Table C.AA.2.11-1			
>Include 'Device Identification Macro' Table C.AA.2.14-1			Defined CID SUP SUP147074
>Decaying Source Isotope Code Sequence	(30xx,51D2)	1	Name of Isotope used as a decaying source. Only a single Item shall be included in this Sequence.
>>Include 'Code Sequence Macro' Table 8.8-1.			Defined CID SUP147069
>Decaying Source Strength Quantity	(30xx,51D4)	1	Measurement quantity of source strength. Enumerated Values: AIR_KERMA_RATE DOSE_RATE_WATER
>Decaying Source Strength Reference Datetime	(30xx,51D3)	1	Reference date for Reference Air Kerma Rate (300A,022A) or Source Strength (300A,022B) of Isotope.
>Decaying Source Reference Air Kerma Rate	(30xx,51D5)	1C	Air Kerma Rate in µGy/h at 1 m in air of Isotope specified at Source Strength Reference Datetime (30xx, 51D3). Required if Decaying Source Strength Quantity (30xx,51D4) equals AIR_KERMA_RATE.

Attribute Name	Tag	Type	Description
>Decaying Source Strength	(30xx,51D6)	1C	Source Strength of Isotope in Gy/sec at Decaying Source Strength Reference Datetime (30xx,51D3). Required if Source Strength Quantity (30xx,51D4) equals DOSE_RATE_WATER.

2 **C.AA.F1 Tomotherapeutic Delivery Device Module**

4 The Tomotherapeutic Delivery Device Module contains tomotherapy-specific information pertaining to the physical device used to deliver the treatment, including geometrical parameters of the collimation system. This information is constant for all possible beam deliveries with this equipment.

6 **Table C.AA.F1-1
TOMOTHERAPEUTIC DELIVERY DEVICE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Description
Source-Axis Distance	(300A,00B4)	1	Radiation source to gantry rotation axis distance of the equipment that is to be used for beam delivery (mm).
<i>Include 'Radiation Generation Mode Macro' Table C.AA.2.19-1</i>			
<i>Include 'RT Beam Limiting Device Definition Macro' Table C.AA.2.20-1</i>		<i>Defined CID for included 'RT Accessory Device Identification Macro' is CID SUP147010.</i>	

8

C.AA.F1.1 Tomotherapeutic Delivery Device Attribute Description

10 **C.AA.F1.1.1 Leaf Slot Definition**

12 A leaf slot is a channel perpendicular to the binary collimator long axis that can be occluded by a leaf or leaves during treatment. A leaf slot may be occluded by a single leaf (for example, in the case of opposing banks of interleaved leaves), or by two leaves (in the case of opposed leaf pairs). The exact nature of these leaves is not described in this module: for the purpose of beam characterization it is sufficient to model the leaf slot dimensions only.

16 **C.AA.F2 Tomotherapeutic Beam Module**

18 The Tomotherapeutic Beam Module specifies how a tomotherapeutic treatment beam is to be delivered.

20 **Table C.8A.F2-1
TOMOTHERAPEUTIC BEAM MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Description
Tomotherapeutic Nominal Couch Speed	(30xx,1007)	1	Nominal couch speed for beam in mm/sec.

Attribute Name	Tag	Type	Description
Tomotherapeutic Nominal Gantry Period	(30xx,1008)	1C	Nominal gantry period for beam in seconds. Required if code value in Radiotherapy Procedure Technique Code Sequence (30xx,0C99) is (S147240, 99SUP147, "Helical Beam"). May be present otherwise.
Spiral Pitch Factor	(0018,9311)	1C	Pitch factor describing the treatment position motion relative to the maximum collimator opening. Required if code value in Radiotherapy Procedure Technique Code Sequence (30xx,0C99) is (S147240, 99SUP147, "Helical Beam"). May be present otherwise.
Tomotherapeutic Control Point Sequence	(30xx,1010)	1	Control Points used to model the beam delivery. Two or more Items shall be included in this Sequence.
<i>>Include 'External Beam Control Point General Attributes Macro' Table C.AA.2.17-1</i>			
<i>>Include 'RT Beam Limiting Device Positions Macro' Table C.AA.2.21-1</i>			
>Referenced Radiation Generation Mode Index	(30xx,0124)	1	Radiation Generation Mode Index (30xx,0113) in the Radiation Generation Mode Sequence (30xx,51C0) in this IOD.
>Source Roll Continuous Angle	(30xx,51B5)	1C	Continuous gantry roll angle of the radiation source at the Control Point (degrees) with respect to the Equipment Frame of Reference. Required if the RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any RT Control Point. See C.AA.2.16.1, C.AA.G2.1.2, C.AA.1.8 and C.AA.E1.1.3.

Attribute Name	Tag	Type	Description
>Tomotherapeutic Leaf Initial Closed Fractions	(30xx,1031)	1C	Fraction of time between the current Control Point and the next Control Point during which leaves are closed before opening, starting at the current Control Point for the current leaf bank. Value multiplicity is equal to Number of Parallel RT Beam Delimiters (30xx,5048). Required if one or more leaf open times are not symmetrical about the projection center and if the RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any Control Point. May be present otherwise. See C.AA.2.16.1
>Tomotherapeutic Leaf Open Fractions	(30xx,1030)	1C	Fraction of time between the current Control Point and the next Control Point during which leaves are open for the current leaf bank. Value multiplicity is equal to Number of Parallel RT Beam Delimiters (30xx,5048). Required if the RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any Control Point. See C.AA.2.16.1

2 **C.AA.H1 Multiple Fixed Source Delivery Device Module**

4 The Multiple Fixed Source Delivery Device Module contains multiple fixed source device-specific
 4 information pertaining to the physical device used to deliver the treatment, including geometrical
 6 parameters of the collimation system. This information is constant for all possible beam deliveries
 6 with this equipment.

8 **Table C.AA.H1-1
 MULTIPLE FIXED SOURCE DELIVERY DEVICE MODULE**

Attribute Name	Tag	Type	Description
Fixed Orientation Collimator Sequence	(30xx,5130)	1	The fixed orientation collimators of the device that are used in this Radiation. One or more Items shall be included in this Sequence.
>Fixed Orientation Collimator Index	(30xx,5135)	1	The Index of the fixed orientation collimator.
>Include 'RT Beam Limiting Device Definition Macro' Table C.AA.2.20-1			Defined CID SUP147027

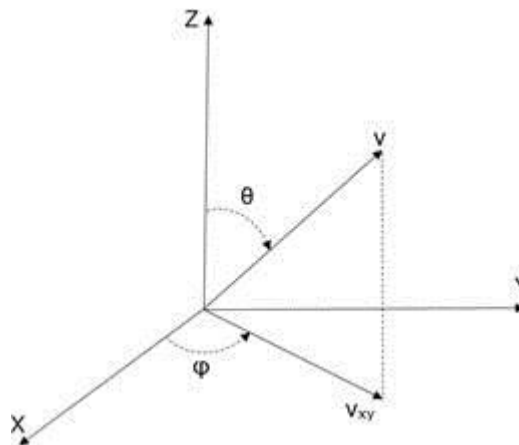
Attribute Name	Tag	Type	Description
>Fixed Orientation Collimator Theta Angle	(30xx,5133)	1	The theta angle in degrees from the isocenter to the radiation source. See C.AA.H1.1.1.
>Fixed Orientation Collimator Phi Angle	(30xx,5134)	1	The phi angle in degrees from the isocenter to the radiation source. See C.AA.H1.1.1.
>Radiation Source Isocenter Distance	(30xx,5132)	1	Source to isocenter distance in mm.
>Referenced Device Index	(30xx,0142)	1	The value of the Device Index (30xx,0112) in the Decaying Radiation Source Sequence (30xx,yyy1) identifying the source to be used by this fixed orientation collimator.
<i>Include 'Radiation Decaying Source Definition Macro' Table C.AA.2.37</i>			

2 **C.AA.H1.1 Equipment Frame of Reference**

4 The Equipment Frame of Reference UID (30xx,51A0) 1.2.840.10008.1.4.RRR.4 defines a coordinate system as follows:

6 The equipment coordinate system axes are oriented as follows: When viewed from the patient support device towards the front of the equipment, the x-Axis points to the viewers Right, the y-Axis points towards the device and the z-Axis points up.

8 Fixed Orientation Collimator Theta Angle (30xx,5133) is the angle from the Z-axis of the equipment coordinate system to the vector from the isocenter to the source (v). Fixed Orientation Collimator Phi Angle (30xx,5134) is the angle from the X-axis of the device coordinate system to the projection of the vector from the isocenter to the source on the XY plane of the device coordinate system (v_{xy}).



**Figure C.AA.H1.1.1-1
Fixed Orientation Collimator Angles**

2

C.AA.H2 Fixed Orientation Collimator Group Module

4

The fixed orientation collimators grouped within this Module represent fixed orientation collimators that are concurrently used as they are managed together by the delivery device and that can be used for verification prior to radiation treatment. During planning, the groups may be used to manually optimize the dose distribution.

6

8

**Table C.AA.H2-1
FIXED ORIENTATION COLLIMATOR GROUP MODULE**

Attribute Name	Tag	Type	Description
Fixed Orientation Collimator Group Sequence	(30xx,5131)	1	Groups of fixed orientation collimators. Each Fixed Orientation Collimator Index (30xx,5135) shall appear only once in this Sequence. One or more Items shall be included in this Sequence.
>Fixed Orientation Collimator Group Index	(30xx,5139)	1	Index of the fixed orientation collimator group. The value shall start at 1 and increase monotonically by 1.
>Fixed Orientation Collimator Group Label	(30xx,513D)	1	Identification label for the group. Each label shall be unique within the Sequence.
>Fixed Orientation Collimator References Sequence	(30xx,513F)	1	Fixed orientation collimators used for the pattern. One or more Items shall be included in this Sequence.
>>Referenced Fixed Orientation Collimator Index	(30xx,513A)	1	The value of Fixed Orientation Collimator Index (30xx,5135) from the Fixed Orientation Collimator Sequence (30xx,5130) within this IOD.

10

C.AA.H3 Multiple Fixed Source Beams Module

12

The Multiple Fixed Source Beams Module specifies how multiple fixed source treatment beams are to be delivered. A pattern is a collection of fixed orientation collimators that are simultaneously used for radiation delivery. A treatment may be specified by a sequence of one or more patterns.

14

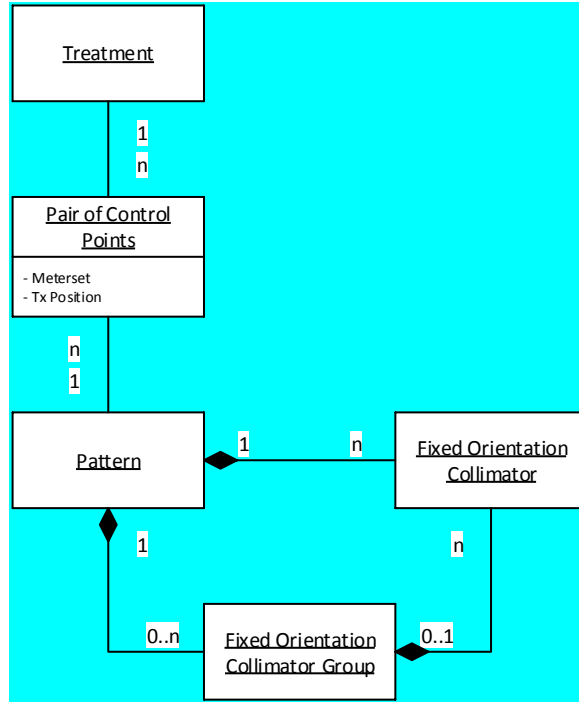
**Table C.8A.H3-1
MULTIPLE FIXED SOURCE BEAMS MODULE ATTRIBUTES**

16

Attribute Name	Tag	Type	Description
Fixed Orientation Collimator Pattern Sequence	(30xx,513C)	1	Fixed orientation collimator patterns. One or more Items shall be included in this Sequence.

Attribute Name	Tag	Type	Description
>Fixed Orientation Collimator Pattern Index	(30xx,5136)	1	Index of the fixed orientation collimator Pattern. The value shall start at 1 and increase monotonically by 1.
>Fixed Orientation Collimator Pattern Label	(30xx,513D)	1	Identification label for the fixed orientation collimator pattern. The label shall be unique within this Sequence.
>Fixed Orientation Collimator References Sequence	(30xx,513F)	1	Fixed orientation collimators used for the pattern. One or more Items shall be included in this Sequence.
>>Referenced Fixed Orientation Collimator Index	(30xx,513A)	1	The value of Fixed Orientation Collimator Index (30xx,5135) from the Fixed Orientation Collimator Sequence (30xx,5130) within this IOD.
>Fixed Orientation Collimator Group References Sequence	(30xx,5138)	1C	The fixed orientation collimator groups used in this fixed orientation collimator pattern. Required if the Fixed Orientation Collimator Group Sequence (30xx,5131) is present. One or more Items shall be included in this Sequence.
>>Referenced Fixed Orientation Collimator Group Index	(30xx,5140)	1	The value of Fixed Orientation Collimator Group Index (30xx, 5139) from the Fixed Orientation Collimator Group Sequence (30xx,5131) within this IOD.
Fixed Source Control Point Sequence	(30xx,5137)	1	Control Points used to model the radiation delivery. The Sequence shall contain an even number of Items, where each pair marks the start and end of a radiation. See C.AA.H3.1 Two or more Items shall be included in this Sequence.
<i>> Include 'RT Control Point General Attributes Macro' Table C.AA.1.16-1</i>			
>Referenced Fixed Orientation Collimator Pattern Index	(30xx,513E)	1C	The value of Fixed Orientation Collimator Pattern Index (30xx,5136) from the Fixed Orientation Collimator Pattern Sequence (30xx,513C).Required if the RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any Control Point.

2 C.AA.H3.1 Multiple Fixed Source Beams Module Attribute Description



2

Figure C.AA.H3.1.1-1
Concepts used in Multiple Fixed Source Beams treatment

4

In this context, a Pair of Control Points is sometimes referred to as a “shot”.

C.AA.J1 Robotic Delivery Device Module

6

The Robotic Delivery Device Module contains robot-specific information pertaining to the physical device used to deliver the treatment, including geometrical parameters of the collimation system.

8

This information is constant for all possible beam deliveries with this equipment.

10

Table C.AA.J1-1
ROBOTIC DELIVERY DEVICE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Description
Robotic Base Position Geometry	(30xx,0F03)	1	Geometry of the Robotic Base Position. Defined Terms: FLOOR_LEFT – Looking from the foot of the table towards the robot, the robot is floor-mounted to the viewer's left FLOOR_RIGHT – Looking from the foot of the table towards the robot, the robot is floor-mounted to the viewer's right FLOOR_CENTER - Looking from the foot of the table towards the robot, the robot is floor-mounted straight ahead

Attribute Name	Tag	Type	Description
<i>Include 'Radiation Generation Mode Macro' Table C.AA.2.19-1</i>			
<i>Include 'RT Beam Limiting Device Definition Macro' Table C.AA.2.20-1</i>			
<i>Include 'Accessory Holder Definition Macro' Table C.AA.2.26-1</i>			

2 **C.AA.J1.1 Equipment Frame of Reference UID**

4 The Equipment Frame of Reference UID (30xx,51A0) 1.2.840.10008.1.4.RRR.3 defines a coordinate system as follows:

6 The equipment coordinate system axes are oriented as follows: When viewed from the patient support device towards the front of the equipment, the x-Axis points to the viewers Right, the y-Axis points to the device and the z-Axis points up.

8 The x and y coordinate of the beam limiting device system coincide with the equipment coordinate system under the following conditions:

- 10 • Robot Head Yaw Angle (30xx,0F46) is zero
- 12 • Beam is parallel to the negative z-axis equipment coordinate system (x and y coordinates of source and target are equal)

14 **C.AA.J2 Robotic Path Module**

16 The Robotic Path Module specifies how a robotic path is to be delivered. Each SOP Instance corresponds to a single robotic path. Multiple paths are encoded as separate RT Radiation instances defined by reference in the RT Radiation Set IOD.

18 **Table C.AA.J2-1
ROBOTIC PATH MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Description
Robotic Path Identifier Code Sequence	(30xx,0F15)	1	Identifier of the template path from which the nodes referenced in the Robotic Path Control Point Sequence (30xx,0F50) were selected. Only a single Item shall be included in this Sequence.
<i>>Include 'Code Sequence Macro' Table 8.8-1.</i>			<i>Defined CID SUP147011.</i>
Robotic Path Control Point Sequence	(30xx,0F50)	1	Control Points used to model the beam delivery. Two or more Items shall be included in this Sequence.
<i>>Include 'External Beam Control Point General Attributes Macro' Table C.AA.2.17-1</i>			
>Referenced Radiation Generation Mode Index	(30xx,0124)	1	Beam Radiation Generation Index (30xx,0113) in the Radiation Generation Mode Sequence (30xx,51C0) in this IOD.
>Robotic Node Number	(30xx,0F33)	1	A unique number that identifies an individual node within the path. See Note 1.

Attribute Name	Tag	Type	Description
>RT Treatment Source Coordinate	(30xx,0F40)	1	Coordinates (x,y,z) in mm of the source of the beam with respect to the Equipment Frame of Reference.
>RT Treatment Target Coordinate	(30xx,0F44)	1C	Cartesian values (x,y,z) in mm of the target of the beam along the central axis of the beam with respect to the Equipment Frame of Reference. Required if RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any Control Point. See C.AA.2.16.1.1.
>Robot Head Yaw Angle	(30xx,0F46)	1C	Robot Head Yaw Angle in degrees, i.e. the rotation of the beam-limiting device coordinate system about the beam axis with respect to the Equipment Frame of Reference. Required if RT Control Point Index (30xx,0111) equals 1 or attribute value changes at any Control Point. See C.AA.2.16.1.1.
<i>>Include 'RT Beam Limiting Device Positions Macro' Table C.AA.2.21-1</i>			

- 2 Note 1: The values of Robotic Node Number (30xx,0F33) within the Robotic Path Control Point Sequence
 4 (30xx,0F50) may reference node positions being pre-defined in the device configuration. This
 6 attribute is distinct from the RT Control Point Index (30xx,0111), which simply indexes items within
 the Robotic Path Control Point Sequence (30xx,0F50).

Part 4 Addendum

2 Add the following to PS3.4, Appendix B.5, Table B.5-1

SOP Class Name	SOP Class UID	IOD Spec (defined in PS 3.3)
<u>Tomotherapeutic Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.1</u>	<u>Tomotherapeutic Radiation IOD</u>
<u>Multiple Fixed Source Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.4</u>	<u>Multiple Fixed Source Radiation IOD</u>
<u>Robotic Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.5</u>	<u>Robotic Radiation IOD</u>

Add the following to PS3.4, Table I.4-1

2

Table I.4-1 Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification
<u>Tomotherapeutic Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.1</u>	<u>Tomotherapeutic Radiation IOD</u>
<u>Multiple Fixed Source Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.4</u>	<u>Multiple Fixed Source Radiation IOD</u>
<u>Robotic Radiation Storage</u>	<u>1.2.840.10008.5.1.4.1.1.481.XN.5.5</u>	<u>Robotic Radiation IOD</u>

4

Part 6 Addendum

2 Add the following data elements to PS3.6:

6 REGISTRY OF DICOM DATA ELEMENTS

(30xx,0F03)	Robotic Base Position Geometry	RoboticBasePositionGeometry	CS	1
(30xx,0F15)	Robotic Path Identifier Code Sequence	RoboticPathIdentifierCodeSequence	SQ	1
(30xx,0F33)	Robotic Node Number	RoboticNodeSequenceNumber	UL	1
(30xx,0F40)	RT Treatment Source Coordinates	RTTreatmentSourceCoordinates	FL	3
(30xx,0F42)	Robotic Beam Sub-Control Point Sequence	RoboticBeamSubControlPointSequence	SQ	1
(30xx,0F44)	RT Treatment Target Coordinates	RTTreatmentTargetCoordinates	FL	3
(30xx,0F46)	Robot Head Yaw Angle	RobotHeadYawAngle	FL	1
(30xx,0F50)	Robotic Path Control Point Sequence	RoboticPathControlPointSequence	SQ	1
(30xx,1000)	Tomotherapeutic Leaf Bank Definition Sequence	TomotherapeuticLeafBankDefinitionSequence	SQ	1
(30xx,1001)	Leaf Bank Offset	LeafBankOffset	FD	1
(30xx,1002)	Number of Leaf Slots	NumberOfLeafSlots	US	1
(30xx,1003)	Binary MLC Leaf Slot Boundaries	BinaryMLCLeafSlotBoundaries	FD	2-n
(30xx,1007)	Tomotherapeutic Nominal Couch Speed	TomotherapeuticNominalCouchSpeed	FD	1
(30xx,1008)	Tomotherapeutic Nominal Gantry Period	TomotherapeuticNominalGantryPeriod	FD	1
(30xx,1010)	Tomotherapeutic Control Point Sequence	TomotherapeuticControlPointSequence	SQ	1
(30xx,1030)	Tomotherapeutic Leaf Open Fractions	TomotherapeuticLeafOpenFractions	FL	1-n
(30xx,1031)	Tomotherapeutic Leaf Initial Closed Fractions	TomotherapeuticLeafInitialClosedFractions	FL	1-n
(30xx,5110)	Radiation Particle	RadiationParticle	CS	1
(30xx,5130)	Fixed Orientation Collimator Sequence	FixedOrientationCollimatorSequence	SQ	1
(30xx,5131)	Fixed Orientation Collimator Group Sequence	FixedOrientationCollimatorGroupSequence	SQ	1

(30xx,5132)	Radiation Source Isocenter Distance	RadiationSourceIsocenterDistance		1
(30xx,5133)	Fixed Orientation Collimator Theta Angle	FixedOrientationCollimatorThetaAngle	FD	1
(30xx,5134)	Fixed Orientation Collimator Phi Angle	FixedOrientationCollimatorPhiAngle	FD	1
(30xx,5135)	Fixed Orientation Collimator Index	FixedOrientationCollimatorIndex	US	1
(30xx,5136)	Fixed Orientation Collimator Pattern Index	FixedOrientationCollimatorPatternIndex	US	1
(30xx,5137)	Fixed Source Control Point Sequence	FixedSourceControlPointSequence	SQ	1
(30xx,5138)	Fixed Orientation Collimator Group References Sequence	FixedOrientationCollimatorGroupReferen cesSequence	SQ	1
(30xx,5139)	Fixed Orientation Collimator Group Index	FixedOrientationCollimatorGroupIndex	US	1
(30xx,513A)	Referenced Fixed Orientation Collimator Index	ReferencedFixedOrientationCollimatorIn dex	US	1
(30xx,513C)	Fixed Orientation Collimator Pattern Sequence	FixedOrientationCollimatorPatternSeque nce	SQ	1
(30xx,513D)	Fixed Orientation Collimator Group Label Label	FixedOrientationCollimatorGroupLabel	LO	1
(30xx,513E)	Referenced Fixed Orientation Collimator Pattern Index	ReferencedFixedOrientationCollimator PatternIndex	US	1
(30xx,513F)	Fixed Orientation Collimator References Sequence	FixedOrientationCollimatorReferencesS equence	SQ	1
(30xx,5140)	Referenced Fixed Orientation Collimator Group Index	ReferencedFixedOrientationCollimatorG roupIndex	US	1
(30xx,51D0)	Number of Decaying Radiation Sources	NumberOfDecayingRadiationSources	US	1
(30xx,51D1)	Decaying Radiation Source Sequence	DecayingRadiationSourceSequence	SQ	1
(30xx,51D2)	Decaying Source Isotope Code Sequence	SourceIsotopeCodeSequence	SQ	1
(30xx,51D3)	Decaying Source Strength Reference Datetime	SourceStrengthReferenceDatetime	DT	1
(30xx,51D4)	Decaying Source Strength Quantity	Decaying Source Strength Quantity	FD	1
(30xx,51D5)	Decaying Source Reference Air Kerma Rate	Decaying Source Reference Air Kerma Rate	FD	1

(30xx,51D6)	Decaying Source Strength	Decaying Source Strength	FD	1
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Add the following to PS3.6 Annex A:

2

ANNEX A REGISTRY OF DICOM UNIQUE IDENTIFIERS (UID) (NORMATIVE)

4

**Table A-1
UID VALUES**

6

UID Value	UID NAME	UID TYPE	Part
<u>1.2.840.10008.5.1.4.1.1.481.XN.5.1</u>	<u>Tomotherapeutic Radiation Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.1.1.481.XN.5.4</u>	<u>Multiple Fixed Source Radiation Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.1.1.481.XN.5.5</u>	<u>Robotic Radiation Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>

8

Add the following Well-known Frames of References to PS3.6, Annex A:

UID Value	UID Name	Normative Reference
<u>1.2.840.10008.1.4.RRR.3</u>	<u>Robotic System</u>	<u>See C.AA.J1.1</u>
<u>1.2.840.10008.1.4.RRR.4</u>	<u>Multiple Fixed Source System</u>	<u>See C.AA.H1.1</u>

10

Add the following data elements to PS3.6, Annex A:

12

**Table A-3
CONTEXT GROUP UID VALUES**

Context UID	Context Identifier	Context Group Name
<u>1.2.840.10008.6.1.FFF.11</u>	<u>SUP147011</u>	<u>Radiotherapy Robotic Paths</u>
<u>1.2.840.10008.6.1.FFF.69</u>	<u>SUP147069</u>	<u>Isotopes for Radiotherapy</u>
<u>1.2.840.10008.6.1.FFF.74</u>	<u>SUP147074</u>	<u>Decaying Radiation Source</u>

2

Part 16 Addendum

Add the following new CIDs to PS3.16, Annex B:

4

CID SUP147011 RADIOTHERAPY ROBOTIC PATHS

6

Context ID SUP147011

Radiotherapy Robotic Paths

Type: Extensible

Version: yyyyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147200	One Path Head
99SUP147	S147201	One Path Body
99SUP147	S147202	Even Paths Head
99SUP147	S147203	Even Paths Body
99SUP147	S147204	Short Paths Head
99SUP147	S147205	Short Path Body
99SUP147	S147206	Prostate
99SUP147	S147207	Prostate Short
99SUP147	S147208	Trigeminal

8

CID SUP147069 ISOTOPES FOR RADIOTHERAPY

10

Context ID SUP147070

Isotopes for Radiotherapy

12

Type: Extensible

Version: yyyyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
<i>Include CID SUP147057 Brachytherapy Isotope</i>		

14

CID SUP147074 DECAYING RADIATION SOURCE

16

Context ID SUP147074

Decaying Radiation Source

Type: NoExtensible

Version: yyyyymmdd

2

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147960	General Radiotherapeutic Decaying Source
99SUP147	S147961	Brachytherapy Decaying Source

4

2

Add the following to the table in PS3.16, Annex D:

4

ANNEX D DICOM CONTROLLED TERMINOLOGY DEFINITIONS (NORMATIVE)

6

Code Value	Code Meaning	Definition	Notes
S147200	One Path Head	The robotic path one path head	
S147201	One Path Body	The robotic path one path body	
S147202	Even Paths Head	The robotic path even paths head	
S147203	Even Paths Body	The robotic path one path body	
S147204	Short Paths Head	The robotic path short paths head	
S147205	Short Path Body	The robotic path short path body	
S147206	Prostate	The robotic path prostate	
S147207	Prostate Short	The robotic path prostate short	
S147208	Trigeminal	The robotic path trigeminal	
S147960	General Radiotherapeutic Decaying Source	A general decaying source used for radiotherapeutic treatments	
S147961	Brachytherapy Decaying Source	A decaying source used for brachytherapy treatments	

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