**Integrating the Healthcare Enterprise**



**IHE Radiation Oncology**

**Technical Framework Supplement**

**Treatment Planning – Image Content**

**(TPIC)**

**Draft for Trial Implemenation**

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**Please verify you have the most recent version of this document.** See [here](http://ihe.net/Technical_Frameworks/) for Trial Implementation and Final Text versions and [here](http://ihe.net/Public_Comment/) for Public Comment versions.

**Foreword**

This is a supplement to the IHE Radiation Oncology Technical Framework V1.8. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on October 23, 2015 for Public Comment. Comments are invited and can be submitted at <http://www.ihe.net/Radiation_Oncology_Public_Comments/>. In order to be considered in development of the Trial Implementation version of the supplement, comments must be received by November 23, 2015.

This supplement describes changes to the existing technical framework documents.

“Boxed” instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend Section X.X by the following:

Where the amendment adds text, make the added text bold underline. Where the amendment removes text, make the removed text bold strikethrough. When entire new sections are added, introduce with editor’s instructions to “add new text” or similar, which for readability are not bolded or underlined.

General information about IHE can be found at: [www.ihe.net](http://www.ihe.net/).

Information about the IHE Radiation Oncology domain can be found at: [ihe.net/IHE\_Domains](file:///C:\Users\Mary%20Jungers\Google%20Drive\01_IHE\AppData\Roaming\Microsoft\Word\ihe.net\IHE_Domains\).

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at: [http://ihe.net/IHE\_Process](http://ihe.net/IHE_Process/) and [http://ihe.net/Profiles](http://ihe.net/Profiles/).

The current version of the IHE Radiation Oncology Technical Framework can be found at: [http://ihe.net/Technical\_Frameworks](http://ihe.net/Technical_Frameworks/).

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# Introduction to this Supplement

This profile defines the content of images to be used as reference images for positioning at a treatment session, usually being transferred from the Treatment Planning System to the Treatment Management System.

## History

|  |  |  |
| --- | --- | --- |
| Date | Rev. | Change Summary |
| 2015-10-23 | 1.0 | Initial publication for public comment |
| 2016-01-04 |  | (Note on numbering: While pre-PC versions have been numbered as 1.n already, Revision number re-start now with 1.0 etc. following PC Versioning)  Review comments by Martin von Siebenthal (Varian) addressed:   * Altered text in Appendix A: Actor Summary Definitions to clarify the content of the statement. * Changed Text in Appendix B: Transaction Summary Definitions * 7.3.3.1.1.2:.Patient position for DRRs should be treatment position, to use the same gantry angle as the ones at treatment time. It could be the CT Patient Position as well, but than the gantry angle will not be the once used at treatment time: A DRR from Gantry = 0 with HFS has Gantry = 180 when treated with HFP. Change and extended specification accordingly. * RO-TPIC-1: 3.Y2.4.1.2: Since the transaction should be in fact neutral to SOP Classes, the text is extended. Only RT Image requirements are specified currently. As needed, specific requirements for other modalities maybe added in future. |
| 2016-02-22 | 1.1 | Corrected definition of Fraction Number (lost comment from Martin von Siebenthal).  Since DICOM cp1502 is now Part of DICOM Edition 2016a the Issue 12 is now finalized and closed.  Draft for Trial Implementation. |



## Closed Issues

| # | Intr. in | | Resp. | Description |
| --- | --- | --- | --- | --- |
| 1 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  Make sure, that Series Date and Series Time is Required. This should be considered this for all new Profiles.  Should become part of upcoming General Content Profile  2015-01-09: U. Busch: Covered in TDPC; which contains the proposal for the general module definitions now. |
| 2 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  General Equipment Module: Manufacturer must be present. Model? Version?  Could be considered for all profiles.  Should become part of upcoming General Content Profile  2015-01-09: U. Busch: Covered in TDPC; which contains the proposal for the general module definitions now. |
| 3 | Prepub 1.0 | | Ulrich Busch | Shouldn't we make Pixel Intensity Relationship (0028,1040) required?  2015-01-09: U. Busch: We should – therefore proposed to be mandatory now. |
| 4 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  Image Type (0008,0008) = FLUENCE: Should be better defined.  2014-09-18 TC: Possibly FLUENCE could be supported (no decision yet). Type 4 should be used to further specify what fluence it is. Types 4 should be proposed next timer. Make this as an option to the profile.  TC: No need to say anything beyond DICOM (make a second check on that)  2015-04-10: Standard definition is sufficient. FLUENCE allowed along TC 2015-01-23. |
| 5 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  Reported Values Origin (3002,000A) – no additional requirements?  2015-01-12: U. Busch: No, we don't need to say something here. |
| 6 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  Referenced RT Plan Sequence (300C,0002):  Other than the proposal of IHE-TC 2014-02-27 (Item 21), have declared it as required, since there is no use case in the scope of that profiles where an image has no plan context. |
| 7 | Prepub 1.0 | | Ulrich Busch | Referenced Beam Number (300C,0006): 2015-01-12: U. Busch: Proposed to make is mandatory, since the current systems for conventional treatment always rely on it. For Protons it is optional.  2015-01-23: TC: Discussed and defined condition and wording. |
| 8 | Prepub 1.0 | | Ulrich Busch | (from IHE-TC 2014-02-27)  RT Beam Limiting Device Sequence – requirements TBD (further discussion tabled). Same topic exists for the presence of beam modifiers. For DRRs,, all of that is not needed – see also DICOM WG-07 Meeting Minutes of March 24 – March 28, 2014.  However, other images maybe re-issued without that information, when serving as reference images, since the information there may be confused with the actual plan data. In general, information about BLDs and Beam modifiers should come from the actual plan and not from the reference image to ensure, that they are actual (safety issue).  ACTION: TPS, TMS vendors to investigate the source of BLD and Diaphragm information in RT Image instances of type DRR and how/where it is used by April 8 (for discussion at next TC meeting).  2015-01-12: U. Busch: Proposed to allow it in case of Non-DRRs, but don't make it required in that case. For DRRs, it remains undefined (along WG-07 conclusion) |
| 9 | Prepub 1.1 | | Ulrich Busch | 2014-09-18: TC: Should we consider how to annotate structures in Structure Sets or Contours in the Curve Module to be used for positioning.  2015-01-23 TC: Will not mention it.  2015-04-10: v1.5: Done |
| 10 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: Bits Stored (0028,0101): Are there vendors, which do less than 16 bit – and therefore we should keep the standard definition.  2015-01-23 TC: Define 16 bit for DRRs, but keep it open for others.  2015-04-10: v1.5: Done |
| 11 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: Pixel Representation (0028,0103). Are there vendors, which use signed?  2015-01-23 TC: Define to use only unsigned.  2015-04-10: v1.5: Done |
| 12 | | Prepub 1.2 | Ulrich Busch | 2014-09-18: TC: WG-07 should propose a CP to add 'May be present otherwise' to allow Pixel Intensity Relationship Sign (0028,1041 be present without Pixel Intensity Relationship (0028,1040).  2015-01-12: U. Busch: Decouple the 2 attributes is an invasive change, which hardly will pass WG-06 and the validators review. Further on, at other places this pair is handled always as a pair as well. Rather than the proposal is to change the attribute definition of Pixel Intensity Relationship (0028,1040) to use C.8.19.6.4.1.1 Pixel Intensity Relationship. That is an existing definition for some modalities and therefore provides a better justification basis for such a change.  Go to WG.-06 to remove the necessity to have Pixel Intensity Relationship (0028,1040 present.  WG-07: Will be handled by CP1502.  When this CP gets approved, that Pixel Intensity Relationship Sequence stay Required, since there is no need any more to define LOG or LIN as type.  2016-02-22 U. Busch: CP 1502 is now part of DICOM Edition 2016a. Therefore the issue can be closed as along the TC decisions (see above): |
| 13 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: On which plane is the Image Position specified. Esp. because of non/normal images, it should be the Image Plan. However, the standard specifies the IEC Image Receptor System. This is esp. unfortunate, since the projection from the first pixel to that plane is not defined and e.g., would not work for a 90 Deg rotation. WG-07 should develop a CP to clarify the definition.  2015-01-09: U. Busch: Is now addressed by WG-07 with CP 1439. |
| 14 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: Add an explanation for non-normal images: Esp. explain the resolution (on image plane), the image position (following Issue 13 outcome), and alike.  2015-01-09: U. Busch: Is now addressed by WG-07 with CP 1439. |
| 15 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: We have to specify, where the images have to be referenced (in Beam or in Setup Sequence). This certainly should go into the profile for the TPS-TMS workflow, where the cross-IOD relations could be defined.  2015-04-10: Will be covered in workflow profiles, not here. |
| 16 | Prepub 1.2 | | Ulrich Busch | 2014-09-18: TC: We have to specify, that the RT Image angles do not have to match the angles of a referenced beam.  2015-01-12: U. Busch: Added a Note that generally the value of the RT Image may differ from the values in the Referenced Beam. |
| 18 | Prepub 1.4 | |  | 2015-01-23 TC: Cleanup Exposure Sequence: The condition, that it is not present when it is DRR is already part of the standard. Therefore remove all conditions referring to DRR. Only list attributes where there are elevated requirements (for non DRR case).  2015-04-10: Cleaned Exposure Sequence. |
| 17 | Prepub 1.2 | | Ulrich Busch  (ulrich.busch@varian.com) | Image Creation DateTime must be required.  2015-01-09: U. Busch: Covered in TDPC; which contains the proposal for the general module definitions now. |
| 19 | Prepub 1.4 | | Ulrich Busch  (ulrich.busch@varian.com) | Make Image Content Datetime required for all Images.  Make Image Acquisition Datetime required for non-DRR.  2015-04-10: Added Reference to TDPC, 7.4.1.8 General Image Module to (see Version TPIC v1.5). |

# General Introduction

Appendix A - Actor Summary Definitions

Add the following actors to the IHE Technical Frameworks General Introduction list of Actors:

|  |  |
| --- | --- |
| Actor | Definition |
| Treatment Planning Reference Image Content Producer | A system producing reference images for the purpose to control / correct the position of the patient in a Radiotherapy treatment. |
| Treatment Planning Reference Image Content Consumer | A system receiving reference images for the purpose to control / correct the position of the patient in a Radiotherapy treatment.  This system is expected to store those images and keep them available for the time when the actual Radiotherapy Treatment is started. At this time another system may request those images during one or more Radiotherapy treatment session(s) to support control and/or correction of the position of the patient prior, during or after delivering the treatment. |

Appendix B - Transaction Summary Definitions

Add the following transactions to the IHE Technical Frameworks General Introduction list of Transactions:

|  |  |
| --- | --- |
| Transaction | Definition |
| Retrieve Reference Images from Planning [RO-TPIC-1] | The retrieval of Reference Images by a system managing Radiotherapy treatment sessions. This system will store those images to make them available to other systems performing patient positioning during a Radiotherapy treatment session once the Radiotherapy Treatment has started. |

Glossary

Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

None

Volume 1 – Profiles

## Copyright Licenses

Add the following to the IHE Technical Frameworks General Introduction Copyright section:

Section not applicable.

## Domain-specific additions

Section not applicable.

Add Section X

# X Treatment Planning Image Content (TPIC) Profile

The Treatment Planning Image Content (TPIC) Profile will make the workflow more reliable, since it ensures that all information needed for positioning is present.

1. The profile will eliminate the need to further enhance / complete the images at the treatment management system prior to their use at the treatment session.
2. The profile will eliminate uncertainties at the Treatment Management System, where deficiencies in received images may be detected, but resolved with some guesswork, leading to error and incorrect positioning for treatment.
3. Fewer uncertainties will also reduce the time physicists, therapists, and physicians need to visit the treatment room to assist therapists in technical issues, where such issues are not caught up front by the Treatment Management System, but only detected later at treatment time.

The profile will substantially contribute to patient safety, because it will explicitly specify what content is needed to safely determine the patient position correction in all dimensions. The applications involved are Treatment Planning Systems and Treatment Management Systems.

This profile is a content-focused profile. For further information on the context, see section TPIC Cross Profile Considerations.

## X.1 TPIC Actors, Transactions, and Content Modules

This section defines the actors, transactions, and/or content modules in this profile. General definitions of actors are given in the Technical Frameworks General Introduction Appendix A at <http://www.ihe.net/Technical_Framework/index.cfm>.

Figure X.1-1 shows the actors directly involved in the TPIC Profile and the relevant transactions between them. If needed for context, other actors that may be indirectly involved due to their participation in other related profiles are shown in dotted lines. Actors which have a mandatory grouping are shown in conjoined boxes.



Figure X.1-1: TPIC Actor Diagram

Table X.1-1 lists the transactions for each actor directly involved in the TPIC Profile. To claim compliance with this Profile, an actor shall support all required transactions (labeled “R”) and may support the optional transactions (labeled “O”).

Table X.1-1: TPIC Profile - Actors and Transactions

| Actors | Transactions | Optionality | Reference |
| --- | --- | --- | --- |
| Treatment Planning Reference Image Content Producer | Retrieve Reference Images from Planning [RO-TPIC-1] | R | RO TF-2: 3.Y2 |
| Treatment Planning Reference Image Content Consumer | Retrieve Reference Images from Planning [RO-TPIC-1] | R | RO TF-2: 3.Y2 |

### X.1.1 Actor Descriptions and Actor Profile Requirements

Most requirements are documented in Transactions (Volume 2) and Content Modules (Volume 3). This section documents any additional requirements on profile’s actors.

The Treatment Planning Image Content Producer Actor is the actor exposing the content in the treatment workflow. The content of what the Treatment Planning Image Content Producer exposes is received and managed by the Treatment Management System.

## X.2 TPIC Actor Options

Options that may be selected for each actor in this profile, if any, are listed in the Table X.2-1. Dependencies between options when applicable are specified in notes.

Table X.2-1: Treatment Planning Image Content - Actors and Options

| Actor | Option Name | Reference |
| --- | --- | --- |
| Treatment Planning Reference Image Content Producer | No options defined | -- |
| Treatment Planning Image Reference Content Consumer | No options defined |  |

## X.3 TPIC Required Actor Groupings

None

## X.4 TPIC Overview

### X.4.1 Concepts

The Treatment Planning Reference Image Content Consumer retrieves the image objects for treatment from a Treatment Planning Reference Image Content Producer.

### X.4.2 Use Cases

#### X.4.2.1 Use Case #1: Transfer of Reference Images to Delivery System

To support positioning of the patient prior to treatment, reference images are prepared in a Treatment Planning system and transferred to a Treatment Management Systems to be available at Treatment Sessions.

##### X.4.2.1.1 Transfer of Reference Images to Delivery System Use Case Description

The user is planning for the radiotherapy treatment of a patient. A treatment plan is developed to be used for treatment containing complete information about the delivery device needs. Additionally, reference images need to be created / defined and eventually annotated / segmented to be used at the treatment session to position the patient correctly. Those images are transferred from the planning system to a treatment management system to be made available for the delivery system at the time of treatment.

##### X.4.2.1.2 Transfer of Reference Images to Delivery System Process Flow



Figure X.4.2.1.2-1: Basic Process Flow in TPIC Profile

Pre-conditions:

The objects are prepared in a Treatment Planning Image Content Producer.

Main Flow:

The Reference Images are retrieved by the Treatment Planning Image Content Consumer from the Treatment Delivery Plan Content Producer.

Post-conditions:

The objects are completely received and available at the Treatment Planning Image Content Consumer.

## X.5 TPIC Security Considerations

There are no specific security considerations.

## X.6 TPIC Cross Profile Considerations

### X.6.1 Workflow Aspects

The transaction messages of the TPIC Profile use the DICOM C-STORE DIMSE Service only. Workflow-oriented aspects are not handled in that profile.

Typically, the C-STORE DIMSE Service is embedded in the DICOM Query-Retrieve Service, following a C-MOVE request by the Treatment Delivery Device. This communication is typically following the workflow specification in the following profiles:

Appendices

Volume 2 – Transactions

Add Section 3.Y 2

## 3.Y2 Retrieve Reference Images from Planning [RO-TPIC-1]

### 3.Y2.1 Scope

In the Retrieve Reference Images from Planning transaction, a Treatment Planning Image Content Consumer receives the Reference Images to be used for patient positioning from the Treatment Planning Reference Image Content Producer.

### 3.Y2.2 Actor Roles



Figure 3.Y2.2-1: Use Case Diagram

Table 3.Y2.2-1: Actor Roles

|  |  |
| --- | --- |
| Actor: | Treatment Planning Image Content Producer |
| Role: | Provides the reference images prepared for patient positioning |
| Actor: | Treatment Planning Image Content Consumer |
| Role: | Receives the reference images prepared for patient positioning |

### 3.Y2.3 Referenced Standards

DICOM 2014c Edition PS 3.3

### 3.Y2.4 Interaction Diagram



#### 3.Y2.4.1 Reference Image Storage

In the Retrieve Reference Images from Planning transaction, a Treatment Planning Reference Image Content Consumer receives from the Treatment Planning Reference Image Content Producer required for performing patient positioning.

##### 3.Y2.4.1.1 Trigger Events

The profile is agnostic in respect to workflow events triggering the transfer. Any valid DICOM C-STORE operation can be used to transfer the DICOM objects between Producer and Consumer actor.

##### 3.Y2.4.1.2 Message Semantics

The reference images contain all parameters needed to perform patient positioning.

The content of reference images of SOP Class RT Image (1.2.840.10008.5.1.4.1.1.481.1) is defined in Section 7.3.3.1.1.

There are no specific requirements for the content of Reference Images of other SOP Classes.

##### 3.Y2.4.1.3 Expected Actions

The Treatment Planning Image Content Consumer is expected to preserve the content of the reference image for subsequent transfers to systems performing / monitoring patient positioning during upcoming treatment sessions.

### 3.Y2.5 Security Considerations

There are no specific security considerations.

Appendices

Not applicable.

Volume 3 – Content Modules

# 5 Namespaces and Vocabularies

Not applicable.

# 6 Content Modules

Not applicable.

# 7 DICOM Content Definition

## 7.1 Conventions

See Treatment Delivery Plan Content (TDPC) Profile.

## 7.2 General Definitions

See Treatment Delivery Plan Content (TDPC) Profile.

## 7.3 IOD Definitions

This section defines each DICOM IOD used in the IHE Radiation Oncology domain in detail, specifying the standards used and the information defined.

### 7.3.1 Prescription IODs

### 7.3.2 Plan IODs

### 7.3.3 Image IODs

#### 7.3.3.1 RT Image

##### 7.3.3.1.1 RT Image IOD in Planning State

This section defines the content of an RT Image produced by an application to be used to serve as a reference image for positioning the patient for treatment.

###### 7.3.3.1.1.1 Referenced Standards

DICOM 2014 PS 3.3

###### 7.3.3.1.1.2 IOD Definition

| IE | Module | Reference | Usage | IHE-RO Usage |
| --- | --- | --- | --- | --- |
| Patient | Patient | [C.7.1.1](#sect_C_7_1_1) | M | M  See 7.4.1.1.1 |
| Clinical Trial Subject | [C.7.1.3](#sect_C_7_1_3) | U | U |
| Study | General Study | [C.7.2.1](#sect_C_7_2_1) | M | M  See 7.4.1.2.1 |
| Patient Study | [C.7.2.2](#sect_C_7_2_2) | U | U |
| Clinical Trial Study | [C.7.2.3](#sect_C_7_2_3) | U | U |
| Series | RT Series | [C.8.8.1](#sect_C_8_8_1) | M | M  See 7.4.1.4.1 |
| Clinical Trial Series | [C.7.3.2](#sect_C_7_3_2) | U |  |
| Frame of Reference | Frame of Reference | [C.7.4.1](#sect_C_7_4_1) | U | R  See 7.4.1.7.1 |
| Equipment | General Equipment | [C.7.5.1](#sect_C_7_5_1) | M | M  See 7.4.1.5.1 |
| Image | General Image | [C.7.6.1](#sect_C_7_6_1) | M | M  See 7.4.1.8.1 |
| Image Pixel | [C.7.6.3](#sect_C_7_6_3) | M | M |
| Contrast/Bolus | [C.7.6.4](#sect_C_7_6_4) | C - Required if contrast media was used in this image | C |
| Cine | [C.7.6.5](#sect_C_7_6_5) | C - Required if multi-frame image is a cine image. | C |
| Multi-frame | [C.7.6.6](#sect_C_7_6_6) | C - Required if pixel data is multi-frame data. | C |
| Device | [C.7.6.12](#sect_C_7_6_12) | U | U |
| RT Image | [C.8.8.2](#sect_C_8_8_2) | M | M  See 7.4.6.1.1 |
| Modality LUT | [C.11.1](#sect_C_11_1) | U | U |
| VOI LUT | [C.11.2](#sect_C_11_2) | U | U |
| Approval | [C.8.8.16](#sect_C_8_8_16) | U | U |
| SOP Common | [C.12.1](#sect_C_12_1) | M | M  See 7.4.1.6.1 |
| Common Instance Reference | [C.12.2](#sect_C_12_2) | U | R |
| Frame Extraction | [C.12.3](#sect_C_12_3) | C - Required if the SOP Instance was created in response to a Frame-Level retrieve request | C |

Frame of Reference, Isocenter and Patient Position

If the image type is DRR (image is re-constructed from a CT Image), the following shall apply:

* the Frame of Reference UID shall be the Frame of Reference UID of the CT image
* the Isocenter Position (300A,012C) shall be the coordinates used to reconstruct the image
* the Patient Position (0018,5100) shall be the position of the patient during treatment.

The definitions above assume, that the device parameters in the RT Images have the values as defined for the treatment position as well. Example: A DRR constructed with Gantry Angle = 0 Deg in HFS position has a to have the Gantry Angle of 180 Deg when the patient is treated in HFP position (even if the CT was acquired at Patient Position = HFS). Theoretically the DRR could also be written with Patient Position = HFS, but then the Gantry Angle must have the value 0 and the Patient Positioning Correction Application must take into account, that the Patient Position of the RT Image and the treatment position are different. Current systems are not expected to take care of this, and therefore the RT Image should be written with device parameters applicable to the treatment position.

Otherwise

* the Frame of Reference UID shall be the Frame of Reference UID generated for the acquired images. This Frame of Reference may be the one administered at the time of acquisition or a Frame of Reference administered after acquisition.
* the Isocenter Position (300A,012C) shall be the coordinates in respect to the origin as administered at the image acquisition.
* the Patient Position (0018,5100) shall be the position of the patient during acquisition.

Burned-in information in RT Images

Images shall not contain burned in annotations. That requirement is equivalent with the attribute Burned In Annotation (0028,0301) in the General Image Module having the value NO, but shall also apply when this attribute is not present.

## 7.4 Module Definitions

### 7.4.1 General Modules

### 7.4.2 Workflow-related Modules

### 7.4.3 General Plan-related Modules

### 7.4.4 Plan-Related Modules in Planning

### 7.4.5 Plan-Related Modules in Delivery

### 7.4.6 Image-Related Modules in Planning

### 7.4.6.1 RT Image Module

#### 7.4.6.1.1 RT Image Module in Planning State

##### 7.4.6.1.1.1 Referenced Standards

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##### 7.4.6.1.1.2 Module Definitions

| Attribute Name | Tag | Presence | Attribute Note |
| --- | --- | --- | --- |
| Bits Allocated | (0028,0100) | R+\* | Shall have Enumerated Value 16 if Value 3 of Image Type (0008,0008) is DRR. |
| Bits Stored | (0028,0101) | R+\* | Shall have Enumerated Value 16 if Value 3 of Image Type (0008,0008) is DRR. |
| Pixel Representation | (0028,0103) | R+\* | Enumerated Values shall be 0000H (unsigned integer) |
| Pixel Intensity Relationship | (0028,1040) | R+\* | Shall be present and have a value.  Presence is required to enable the Pixel Intensity Relationship Sign (0028,1041) attribute to be present, which contains the useful part of the information.  The value of this attribute is not critical (it likely may have the value 'OTHER'). |
| Pixel Intensity Relationship Sign | (0028,1041) | R+\* |  |
| RT Image Label | (3002,0002) | R | User-defined label for RT Image. |
| RT Image Description | (3002,0004) | O | User-defined description of RT Image. |
| Image Type | (0008,0008) | R+\* | The producer may produce any of the following types.  The consumer must be able to consume all of the following types.  Image identification characteristics (see Section C.7.6.1.1.2). RT Images shall use one of the following Defined Terms for Value:  Digitally reconstructed radiographs = DERIVED\SECONDARY\DRR  Simulator Images = ORIGINAL\PRIMARY\SIMULATOR  Portal Images = ORIGINAL\PRIMARY\PORTAL  Radiographic Images = ORIGINAL\PRIMARY\RADIOGRAPH  Fluence Images = DERIVED\SECONDARY\FLUENCE  The Image Type shall solely characterize the type of the image as it was created. Any other use, e.g., to mark as digitally reconstructed RT Image (DRR) as PORTAL to specify an intended imaging procedure at the treatment session or alike is prohibited. That kind of information has to be conveyed either in imaging instructions as part of a DICOM Worklist interface, or in the Planned Verification Image Sequence (300A,00CA) where DICOM Worklist is not yet in place.  Therefore the values ORIGINAL\PRIMARY\PORTAL and ORIGINAL\PRIMARY\RADIOGRAPH shall only be used for RT Images being Reference Images, if an image was effectively acquired at a treatment machine. |
| X-Ray Image Receptor Translation | (3002,000D) | O | If absent, shall be interpreted as (0,0,0).  If present must not be ignored. |
| X-Ray Image Receptor Angle | (3002,000E) | O | If absent, shall be interpreted as 0.0.  If present, must have a value and must not be ignored. |
| RT Image Orientation | (3002,0010) | RC+ | Required if RT Image Plane (3002,000C) is NON\_NORMAL.  If present, must have a value and must not be ignored. |
| Image Plane Pixel Spacing | (3002,0011) | R+ | Shall have a value. |
| RT Image Position | (3002,0012) | R+ | Shall have a value. |
| Radiation Machine SAD | (3002,0022) | R+ | Shall have a value. |
| RT Image SID | (3002,0026) | R+ | Shall have a value. |
| Source to Reference Object Distance | (3002,0028) | R+ | Shall not be present. |
| Referenced RT Plan Sequence | (300C,0002) | R+ | Shall be present. |
| >Include ‘SOP Instance Reference Macro' Table 10-11 | | | |
| Referenced Beam Number | (300C,0006) | RC+\* | Shall be present if the beam reference is known. |
| Referenced Fraction Group Number | (300C,0022) | O |  |
| Fraction Number | (3002,0029) | RC+ | Shall be present if the image is created in the context of a particular treatment fraction using 3D image data acquired during that fraction. |
| Exposure Sequence | (3002,0030) | - |  |
| >Primary Fluence Mode Sequence | (3002,0050) | RC+\* | Shall be preserved, if received from the original source application. |
| >Meterset Exposure | (3002,0032) | RC+ | Shall be preserved, if received from the original source application. |
| >Diaphragm Position | (3002,0034) | RC+ | Shall not be present, if Value 3 of Image Type (0008,0008) is not SIMULATOR. |
| >Gantry Angle | (300A,011E) | RC+ | Shall be preserved, if received from the original source |
| >Gantry Pitch Angle | (300A,014A) | RC+ | Shall be preserved, if received from the original source |
| >Beam Limiting Device Angle | (300A,0120) | RC+ | Shall be preserved, if received from the original source |
| >Patient Support Angle | (300A,0122) | RC+ | Shall be preserved, if received from the original source |
| >Table Top Pitch Angle | (300A,0140) | RC+ | Shall be preserved, if received from the original source |
| >Table Top Roll Angle | (300A,0144) | RC+ | Shall be preserved, if received from the original source |
| >Table Top Vertical Position | (300A,0128) | RC+ | Shall be preserved, if received from the original source |
| >Table Top Longitudinal Position | (300A,0129) | RC+ | Shall be preserved, if received from the original source |
| >Table Top Lateral Position | (300A,012A) | RC+ | Shall be preserved, if received from the original source |
| >Number of Blocks | (300A,00F0) | - |  |
| >Block Sequence | (300A,00F4) | - | Shall not be present, if Value 3 of Image Type (0008,0008) is DRR. |
| >>Block Number of Points | (300A,0104) | R+ | Shall have a value. |
| >>Block Data | (300A,0106) | R+ | Shall have a value. |
| Gantry Angle | (300A,011E) | R+ | Shall contain the angle of the imaging source, along the coordinate system as specified in DICOM for that attribute. |
| Gantry Pitch Angle | (300A,014A) | R+ | Shall contain the angle of the imaging source, along the coordinate system as specified in DICOM for that attribute. |
| Patient Support Angle | (300A,0122) | R+ | Shall have a value. |
| Table Top Eccentric Axis Distance | (300A,0124) | R+ | Shall not be present. |
| Table Top Eccentric Angle | (300A,0125) | R+ | Shall not be present. |
| Table Top Pitch Angle | (300A,0140) | R+ | Shall have a value. |
| Table Top Roll Angle | (300A,0144) | R+ | Shall have a value. |
| Table Top Vertical Position | (300A,0128) | RC+ | Shall not be present, if Value 3 of Image Type (0008,0008) is DRR. Shall be preserved, if received from the original source |
| Table Top Longitudinal Position | (300A,0129) | RC+ | Shall not be present, if Value 3 of Image Type (0008,0008) is DRR. Shall be preserved, if received from the original source |
| Table Top Lateral Position | (300A,012A) | RC+ | Shall not be present, if Value 3 of Image Type (0008,0008) is DRR. Shall be preserved, if received from the original source |
| Isocenter Position | (300A,012C) | R+ | Shall have a value. |
| Patient Position | (0018,5100) | R+ | Shall have a value. |

Note that any values in the RT Image Module shall specify the actual values at the time the RT Image was acquired or generated. These values may differ from the values of the beam referenced in the Referenced Beam Number (300C,0006) if present. For example, the Gantry Angle (300A,011E) of the RT Image may differ from the Gantry Angle of the referenced beam if the acquired RT Image was taken at a different angle or the reconstructed DRR was generated using a different Gantry Angle.

Appendices

Not applicable.

Volume 3 Namespace Additions

Not applicable.

Volume 4 – National Extensions

Add appropriate Country section

4 National Extensions

Not applicable.