Integrating the Healthcare Enterprise

IHE Radiation Oncology
Technical Framework Supplement

Treatment Delivery Record Content (TDRC)

Revision 1.1 – Trial Implementation

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Author: Radiation Oncology Technical Committee

Email: ro@ihe.net

Please verify you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.

Foreword

This is a supplement to the IHE Radiation Oncology Technical Framework. 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 July 1, 2019 for trial implementation and may be available for testing at subsequent IHE Connectathons. The supplement may be amended based on the results of testing. Following successful testing it will be incorporated into the Radiation Oncology Technical Framework. Comments are invited and can be submitted at http://www.ihe.net/Radiation_Oncology_Public_Comments.

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.

Information about the IHE Radiation Oncology domain can be found at 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 and http://ihe.net/Profiles

The current version of the IHE Radiation Oncology Technical Framework can be found at: http://ihe.net/Technical_Frameworks.

CONTENTS

Introduction to this Supplement

This profile defines the content of the treatment record being transferred from the Treatment Delivery Device, Treatment Management System or other RT Beams Treatment Record storage or producer to an interested consumer. This content can be available as soon as patient delivery is completed, and other computation and information gathering and formatting can be performed to support the creation of the RT Beams Treatment Record.

Open Issues and Questions

#	Introduced in	Owner	Description
6	0.9	Chris Pauer	Remove "Content" from actors. Add Referenced Treatment Record Sequence
7	0.11	Chris Pauer	Change future tense of profile introduction.
8	0.12	Chris Pauer	Further tense clean up. Other small areas were clarified during committee review.

Closed Issues

#	Introduced in	Owner	Description
1	0.5	Chris Pauer	Unilateral choice to follow example of Ion, exclude Pet from this initial version of TDRC.
2	0.5	Chris Pauer	Consensus of group is to leave this off.
3	0.6	Chris Pauer	Meeting of TC on Jun 18, 2018 indicated that Ion attendees felt that including Ion at this time was premature.
4	0.7	Chris Pauer	Updates were specific to Ion, so based on Jun 18 meeting, this issue is moot.
5	0.7	Chris Pauer	Note added in 0.8

History

Date	Rev.	Author	Change Summary
2018-11-15	1.0	IHE RO Technical Committee	Initial Public Comment release
2019-07-01	1.1	IHE RO Technical Committee	Initial Trial Implementation release

General Introduction and Shared Appendices

The IHE Technical Framework General Introduction and Shared Appendices are components shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to these documents where appropriate.

*Update the following appendices to the General Introduction as indicated below. Note that these are **not** appendices to Volume 1.*

Appendix A – Actor Summary Definitions

Add the following new actors to the IHE Technical Frameworks General Introduction Appendix A:

Actor	Definition
Treatment Delivery Record Producer	The actor exposing the finalized treatment record to the consumer representing a treatment delivery.
Treatment Delivery Record Consumer	A consumer of the finalized treatment record representing the treatment delivery.

Appendix B – Transaction Summary Definitions

Add the following new transactions to the IHE Technical Frameworks General Introduction Appendix B:

No new transactions

Appendix D – Glossary

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

No new Glossary terms.

Volume 1 – Profiles

Copyright Licenses

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

Not applicable.

Domain-specific additions

Not applicable.

Add new Section X

X Treatment Delivery Record Content (TDRC) Profile

The Treatment Delivery Record Content (TDRC) Profile specifies the content of the RT Beams Treatment Record being transferred from the Treatment Delivery Record Producer storage to the Treatment Record Consumer.

This profile ensures that the treatment record transferred from the Producer will contain all of the necessary information.

It will especially address the following:

1. This profile will make the therapists' workflow easier and faster, because it incorporates all information needed for treatment delivery record keeping.
2. This will enable therapists to concentrate more on finalizing the details of patient treatment rather dealing with technical issues.
3. Fewer uncertainties will also reduce the time physicists and therapists need to gather and review treatment delivery information.

TDRC contributes to patient safety, because it will standardize the content which is reviewed to assess if delivery of treatment was accurate to the plan. The profile will not specify how to validate the treatment delivery parameters, but will ensure that they are available, and well-formatted. The applications involved are Treatment Management Systems, Treatment Delivery Systems and Quality Assurance Devices.

This profile is a content-focused profile. For further information on the context, see Section X.6 TDRC Cross Profile Considerations.

X.1 TDRC 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 https://www.ihe.net/resources/technical_frameworks/#GenIntro.

Figure X.1-1 shows the actors directly involved in the TDRC Profile and the direction that the content is exchanged.

A product implementation using this profile must group actors from this profile with actors from a workflow or transport profile to be functional. The grouping of the content module described in this profile to specific actors is described in more detail in the "Required Actor Groupings" section below.

Figure X.1-1: TDRC Actor Diagram

Table X.1-1 lists the content module(s) defined in the TDRC Profile. To claim support with this profile, an actor shall support all required content modules (labeled "R") and may support optional content modules (labeled "O").

Table X.1-1: TDRC Profile – Actors and Content Modules

Actors	Content Modules	Optionality	Reference
Treatment Delivery Record Producer	RT Treatment Record IOD for Photon External Beam	R	RO TF-3: 7.3.6.1.1
	General Beam Treatment Record Modules	R	RO TF-3: 7.4.11.2
Treatment Delivery Record Consumer	RT Treatment Record IOD for Photon External Beam	R	RO TF-3: 7.3.6.1.1
	General Beam Treatment Record Modules	R	RO TF-3: 7.4.11.2

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 Delivery Record Producer is the actor exposing the content in the treatment workflow.

X.2 TDRC 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 Delivery Record Content – Actors and Options

Actor	Option Name	Reference
Treatment Delivery Record Producer	No options defined	--
Treatment Delivery Record Consumer	No options defined	--

X.3 TDRC Required Actor Groupings

An actor from this profile (Column 1) shall implement all of the required transactions and/or content modules in this profile ***in addition to all*** of the transactions required for the grouped actor (Column 2).

If this is a content profile, and actors from this profile are grouped with actors from a workflow or transport profile, the Reference column references any specifications for mapping data from the content module into data elements from the workflow or transport transactions.

In some cases, required groupings are defined as at least one of an enumerated set of possible actors; this is designated by merging column one into a single cell spanning multiple potential grouped actors. Notes are used to highlight this situation.

Section X.5 describes some optional groupings that may be of interest for security considerations and Section X.6 describes some optional groupings in other related profiles.

Table X.3-1: TDRC – Required Actor Groupings

TDRC Actor	Actor to be grouped with	Reference	Content Bindings Reference
Treatment Delivery Record Producer	None		
Treatment Delivery Record Consumer	None		--

X.4 TDRC Overview

X.4.1 Concepts

The Treatment Delivery Record Consumer retrieves the RT Beams Treatment Record from a Treatment Delivery Record Producer, which holds the treatment record or prepares it for transmission.

X.4.2 Use Cases

X.4.2.1 Use Case #1: Transfer of Treatment Record for Recording, Evaluation and Accounting

A patient, phantom or machine test configuration has been exposed to a radiation treatment on a RT Delivery System. The RT Beams Treatment Record describing the treatment information needs to be available for

- Continuing an interrupted partial treatment
- Treatment Tracking (including manual reconstruction)
- Adaptive Planning including Dose Reconstruction
- Trend Analysis
- Treatment Verification

X.4.2.1.1 Transfer of Treatment Record for Recording and Evaluation Use Case Description

The user wants to document a patient's treatment, or other machine operation procedures, hold treatment information for further analysis and to do quality assessment on the delivery. The treatment record that represents the radiation delivery shall contain the complete information regarding the delivery that was done. This includes the definition of all relevant beam parameters.

X.4.2.1.2 Transfer of Treatment Record for Recording and Evaluation Process Flow

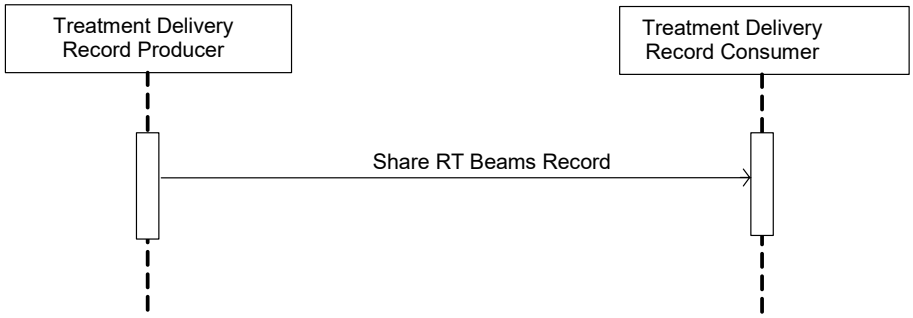

Figure X.4.2.1.2-1: Basic Process Flow in TDRC Profile

Pre-conditions:

The RT Beams Treatment Record is prepared at the Treatment Delivery Record Producer.

Main Flow:

The RT Beams Treatment Record is stored to the Treatment Delivery Record Consumer by the Treatment Delivery Record Producer.

Post-conditions:

The RT Beams Treatment Record is completely received and available at the Treatment Delivery Record Consumer.

X.5 TDRC Security Considerations

X.6 TDRC Cross Profile Considerations

X.6.1 Workflow Aspects

It is likely that the TDRC Profile content will be transferred using a DICOM C-STORE DIMSE Service. This operation may be configured on the adhering Producer device to be attempted after every radiation delivery.

Alternatively, the C-STORE can be embedded in the DICOM Query-Retrieve Service, following a C-MOVE request by the Treatment Delivery Record Consumer based on a timeframe query. This communication is anticipated to follow the workflow specification in the following profiles:

Table X.6-1: TDRC – Cross Profile Actor Mappings

TDRC Actor	Workflow Profile	Adhering Actor in Workflow Profile
Treatment Delivery Record Producer	Treatment Delivery Workflow II (TDW II)	Treatment Delivery Device
	Integrated Positioning and Delivery Workflow (IPDW)	Positioning and Delivery System
	Discrete Positioning and Delivery Workflow (DPDW)	Treatment Delivery Device
	Basic Quality Assurance Workflow	Treatment Data Supplier
Treatment Delivery Record Consumer	Treatment Delivery Workflow II (TDW II)	Object Storage
	Integrated Positioning and Delivery Workflow (IPDW)	Object Storage
	Discrete Positioning and Delivery Workflow (DPDW)	Object Storage
	Basic Quality Assurance Workflow	Delivery Analysis Performer

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Appendices

Not applicable.

Volume 2 – Transactions

Not applicable.

Appendices

No appendices.

Volume 2 Namespace Additions

The Radiation Oncology domain registry of OIDs is located at:

The RO domain does not have a namespace registry for OIDs, etc. They have not had to define any specifically for the domain. Any UIDs, OIDs, etc., come from DICOM®[1] so far.

Additions to the Radiation Oncology OID Registry are:

NA

[1] DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

Volume 3 – Content Modules

5 IHE Namespaces, Concept Domains and Vocabularies

Add to Section 5 IHE Namespaces, Concept Domains and Vocabularies

NA

5.1 IHE Namespaces

The Radiation Oncology registry of OIDs is located at NA.

The Radiation Oncology domain does not have a namespace registry for OIDs, etc. They have not had to define any specifically for the domain. Any UIDs, OIDs, etc. come from DICOM so far.

Additions to the Radiation Oncology OID Registry are:

codeSystem	codeSystemName	Description
NA	NA	NA

5.2 IHE Concept Domains

For a listing of the Radiation Oncology Concept Domains see:

NA

conceptDomain	conceptDomainName	Description
NA	NA	NA

5.3 IHE Format Codes and Vocabularies

5.3.1 IHE Format Codes

*List in the table below any **new** format codes to be added to the IHE Format Codes wiki page at http://wiki.ihe.net/index.php/IHE_Format_Codes. For public comment, the additions must be listed in the table below. The domain technical committee must ensure any new codes are also added to the wiki page prior to publication for trial implementation.*

Profile	Format Code	Media Type	Template ID
NA	NA	NA	NA

5.3.2 IHEActCode Vocabulary

*List in the table below, any **new** additions to the IHEActCode Vocabulary wiki page at http://wiki.ihe.net/index.php/IHEActCode_Vocabulary. For public comment, the additions must be listed in the table below. The domain technical committee must ensure any new codes are also added to the wiki page prior to publication for trial implementation.*

Code	Description
NA	NA

5.3.3 IHERoleCode Vocabulary

*List in the table below any **new** additions to the IHERoleCode Vocabulary wiki page at http://wiki.ihe.net/index.php/IHERoleCode_Vocabulary. For public comment, the additions must be listed in the table below. The domain technical committee must ensure any new codes are also added to the wiki page prior to publication for trial implementation.*

Code	Description
NA	NA

6 Content Modules

No Content Modules defined.

7 DICOM Content Definition

DICOM Content Definitions constrain the use of instances of specific DICOM IODs (also referred to as DICOM objects). This typically means placing requirements on the creators of those instances, although requirements may also be placed on the receivers and users.

The most common such requirements are to:

- Make a module that is optional (U) in a DICOM IOD be required or conditional,
- Make an attribute that is optional (Type 3) in a DICOM Module be required or conditional,
- Require that an attribute that is optional (Type 3) in a DICOM Module be absent
- Constrain the content of an attribute to be empty
- Constrain the content of an attribute to be populated in a certain way, such as:
  - Constraining the value to be taken from a specific table
  - Constraining the value to be copied from a specific source
  - Constraining the value to encode certain information
- Require that an attribute be displayed/accessible to the operator

Reiterating DICOM requirements is kept to a minimum sufficient to provide context for the IHE requirements. Implementers are still required to be familiar with, and conform to, the underlying DICOM specification.

Content Definitions may be referenced from a Profile independent of transactions to constrain content without specifying the transport. Content Definitions may also be referenced from within a Transaction specification to constrain the content without duplicating the same constraint text across multiple related transactions.

For attributes that are optional, the creator is permitted but not required to include them, and the receiver is permitted but not required to ignore them.

7.1 Conventions

DICOM Conventions are defined in Appendix E to the *IHE Technical Frameworks General Introduction*.

Table 7.1-1: Usage of DICOM Modules in IHE

M / C / U	As defined in DICOM PS 3.3
R	The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present.

RC	The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present when the specified conditions apply.

Table 7.1-2: Usage of DICOM Attributes in IHE

O	The attribute or its value is optional, i.e., in DICOM it is Type 2 or 3.
O+*	The attribute is optional, but additional constraints have been added. Note: The specification approach does not force a Type 2 or Type 3 value to become a Type 1 by stating O+.
R	The attribute is required, and is not an IHE extension of the DICOM requirements; i.e., it is already Type 1 in DICOM, but additional constraints are placed by IHE, for example on the value set that may be used for the attribute.
R+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present, i.e., is Type 1, whereas the DICOM requirement may be Type 2 or 3.
RC+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present when the condition is satisfied, i.e., is Type 1C, whereas the DICOM requirement may be Type 2 or 3. If the condition is not fulfilled, the DICOM definitions apply. Note, that this means that the attribute may be present / have a value also in case the condition does not apply.
D	The requirements of DICOM apply unchanged, but the attribute needs to be displayed.
-	No IHE extension of the DICOM requirements is defined. The attribute is listed for better readability or similar purpose.
X+	The attribute information is required to be absent. DICOM Type 2 attributes shall be present with no value. DICOM Type 3 attributes shall be absent.

7.1.1 DICOM Structured Report

Conventions for constraining instances of DICOM Structured Reports as IHE Content Definitions are not yet worked out. In many cases, requiring the use of a specific DICOM SR Template may be sufficient.

7.1.2 Display Requirements

If a requirement lists *, then that attribute is not required to be displayed.

7.2 General Definitions

No change to framework.

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

7.3.4 RT Structure Set IODs

7.3.5 RT Dose IODs

7.3.6 Treatment Record IODs

7.3.6.1 Technique Specific RT Treatment Record

7.3.6.1.1 RT Treatment Record IOD for Photon External Beam

7.3.6.1.1.1 Referenced Standards

DICOM 2018c Edition PS 3.3

7.3.6.1.1.2 IOD Definition

Table 7.3.6.1.1.2-1: IOD Definition

IE	Module	Reference	Usage	IHE-RO Usage
Patient	Patient	C.7.1.1	M	M See Section 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See Section 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See Section 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Equipment	General Equipment	C.7.5.1	M	M See Section 7.4.1.5.1

IE	Module	Reference	Usage	IHE-RO Usage
Treatment Record	RT General Treatment Record	C.8.8.17	M	M See Section 7.4.11.2.1
	RT Patient Setup	C.8.8.12	U	-
	RT Treatment Machine Record	C.8.8,18	M	-
	Measured Dose Reference Record	C.8.8.19	U	-
	Calculated Dose Reference Record	C.8.8.20	U	R See Section 7.4.11.5.1 Calculated Dose Reference Record Module for Consistent Dose
	RT Beams Session Record	C.8.8.21	M	M See Section 7.4.11.2.2
	RT Treatment Summary Record	C.8.8.23	U	-
	SOP Common	C.12.1	M	M See Section 7.4.1.6.1
	Common Instance Reference	C.12.2	U	-

7.4 Module Definitions

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

7.4.1 General Modules

7.4.1.1 Patient Module

7.4.1.1.1 Patient Module Base Content

7.4.1.2 Study Module

7.4.1.2.1 Study Module Base Content

7.4.1.3 General Series Module

7.4.1.4 RT Series Module

7.4.1.4.1 RT Series Module Base Content

7.4.1.5 Equipment Module

7.4.1.5.1 Equipment Module Base Content

7.4.1.6 SOP Common Module

7.4.1.6.1 SOP Common Module Base Content

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

7.4.7 Image-related Modules from Delivery

7.4.8 Segment Modules in Planning

7.4.9 Segment Modules in Delivery

7.4.10 Registration Modules in Planning

7.4.11 Treatment Record Modules

7.4.11.1 Specific RT Beam Type Specifications

7.4.11.2 General Beam Attribute Specifications

7.4.11.2.1 RT General Treatment Record Module

7.4.11.2.1.1 Referenced Standards

DICOM 2018c Edition PS 3.3

7.4.11.2.1.2 Module Definition

Table 7.4.11.2.1.2-1: Module Definition

Attribute	Tag	Type	Attribute Note
Instance Number	(0020,0013)	-	
Treatment Date	(3008,0250)	R+	Value shall be present
Treatment Time	(3008,0251)	R+	Value shall be present
Referenced RT Plan Sequence	(300C,0002)	R+	Sequence shall be present and shall contain 1 item (see Note)
>Referenced SOP Class UID	(0008,1150)	-	
>Referenced SOP Instance UID	(0008,1155)	-	
Referenced Treatment Record Sequence	(3008,0030)	RC+	Required if the referenced treatment record(s) participated in the generation of this treatment.
>Referenced SOP Class UID	(0008,1150)	-	
>Referenced SOP Instance UID	(0008,1155)	-	

Note: RT Plan and RT Treatment Record display parameters and requirements should be fully detailed in the workflow profiles that make use of this content

7.4.11.2.2 RT Beams Session Record Module

7.4.11.2.2.1 Referenced Standards

DICOM 2018c Edition PS 3.3

7.4.11.2.2.2 Module Definition

Table 7.4.11.2.2.2-1: Module Definition

Attribute	Tag	Type	Attribute Note
Referenced Fraction Group Number	(300C,0022)	-	
Number of Fractions Planned	(300A,0078)	R+	Value shall be present
Primary Dosimeter Unit	(300A,00B3)	-	

Attribute	Tag	Type	Attribute Note
Treatment Session Beam Sequence	(3008,0020)	R+*	Shall have one item included in this sequence for each beam delivered
>Referenced Beam Number	(300C,0006)	R+*	Value shall be present.
>Beam Name	(300A,00C2)	RC+	Value shall be present and equal to matching beam in plan, if Beam Name is defined.
>Primary Fluence Mode Sequence	(3002,0050)	R+*	Sequence shall be present
>Referenced Verification Image Sequence	(300C,0040)	RC+*	Sequence shall be present if images were acquired during treatment.
>Current Fraction Number	(3008,0022)	R+	Value shall be present
>Treatment Delivery Type	(300A,00CE)	R+	Value shall be present
>Referenced Measured Dose Reference Sequence	(3008,0080)	RC+*	Sequence shall be present if measured dose information is available. (See Note.)
>Referenced Calculated Dose Reference Sequence	(3008,0090)	RC+*	Sequence shall be present if calculated dose information is available. (See Note.)
>Beam Type	(300A,00C4)	-	
>Radiation Type	(300A,00C6)	-	
>Treatment Delivery Type	(300A,00CE)	R+	
>Source-Axis Distance	(300A,00B4)	R+*	
> Referenced Patient Setup Number	(300C,006A)	-	
>Specified Primary Meterset	(3008,0032)	R+	
>Delivered Primary Meterset	(3008,0036)	R+	
>Control Point Delivery Sequence	(3008,0040)	-	Since the treatment delivery may not completely align with the plan directives, it is expected that this sequence will report on the delivery only, and that the control points reported may not agree with the plan.
>>Table Top Vertical Position	(300A,0128)	R+*	Value shall be present in Control Point 0 of Control Point Delivery Sequence (3008,0040) and for further control points if value changes during beam administration.
>>Table Top Longitudinal Position	(300A,0129)	R+*	Value shall be present in Control Point 0 of Control Point Delivery Sequence (3008,0040) and for further control points if value changes during beam administration.
>>Table Top Lateral Position	(300A,012A)	R+*	Value shall be present in Control Point 0 of Control Point Delivery Sequence (3008,0040) and for further control points if value changes during beam administration.
>>Override Sequence	(3008,0060)	RC+*	Value shall be present if override parameters were used.

455 Note: Treatment Records with 0 Gy delivered are expected and are assumed that they represent that no dose was delivered to the patient.

7.4.11.3 Beam Option Specifications

7.4.11.4 Measured Dose Reference Record

7.4.11.5 Calculated Dose Reference Record

7.4.11.5.1 Calculated Dose Reference Record Module for Consistent Dose

Appendices

Not applicable.

Volume 4 – National Extensions

4 National Extensions

Not applicable.

