

# **DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

## **INTERFACE SPECIFICATION**

**LED45020 / 000 / 20-Nov-06**

### **COPYRIGHT INFORMATION:**

THIS DOCUMENT MAY BE FREELY COPIED AND DISTRIBUTED AS LONG AS THIS COVER PAGE REMAINS INTACT.

**Copyright ©2006**  
IMPAC Medical Systems, Inc.  
100 West Evelyn Avenue  
Mountain View, CA USA 94041

## Table of Contents

<b>1. INTRODUCTION.....</b>	<b>1</b>
1.1 PURPOSE .....	1
1.2 SCOPE .....	1
1.3 REFERENCES .....	1
1.4 WHAT'S CHANGED?.....	1
1.5 DOCUMENTATION CONVENTIONS .....	1
1.6 DEFINITIONS, ACRONYMS AND ABBREVIATIONS .....	1
<b>2. GENERAL DESCRIPTION .....</b>	<b>2</b>
2.1 OVERVIEW .....	2
2.1.1 DICOM RT Plan.....	2
<b>3. DETAILED DESCRIPTION .....</b>	<b>6</b>
3.1 TRANSLATION PROCESS .....	6
3.2 RT PLAN TRANSLATION CONVENTIONS.....	7
3.2.1 General Assumptions.....	7
3.2.2 Specific Numeric Operations.....	7
3.2.3 Specific String Operations .....	7
3.3 RTPCONNECT RECORDS CREATED FROM TRANSLATED DICOM ATTRIBUTES.....	8
3.3.1 RTPConnect Record: PLAN_DEF .....	8
3.3.2 RTPConnect Record: RX_DEF .....	9
3.3.3 RTPConnect Record: SITE_SETUP_DEF .....	11
3.3.4 RTPConnect Record: FIELD_DEF .....	12
3.3.5 RTPConnect Record: CONTROL_PT_DEF .....	17
3.3.6 RTPConnect Record: DOSE_DEF .....	21
3.3.7 RTPConnect Record: DOSE_ACTION.....	22
3.4 RTPCONNECT COMMON ELEMENTS .....	23

# 1. INTRODUCTION

## 1.1 PURPOSE

This document describes the process of translating a DICOM RT Plan object into an RTP*Connect* Import file. The translation process is part of the operation of IMPAC's DICOM Communication Module (DCM) product.

This document is intended for use by software developers of DICOM interfaces, customers and system integrators who wish to send RT Plans to DCM.

## 1.2 SCOPE

This document is limited to the definition of the data items and rules used when extracting information from a DICOM RT Plan object to be embedded in an RTP*Connect* Import file. This document refers to the DICOM Standard and Appendix B of LED45016, the DICOM Conformance Statement for DCM, for a description of the RT Plan Storage Service Class, and LED17001, the RTP*Connect* Interface Specification, for a description of the RTP*Connect* Import File format.

## 1.3 REFERENCES

This document references the following documents:

TITLE
Digital Imaging and Communications in Medicine (DICOM), parts 1-14; published by NEMA
LED17001, RTP <i>Connect</i> Radiotherapy Treatment Planning Import/Export Interface Specification; published by IMPAC Medical Systems, Inc.
LED45019, DICOM Communication Module DICOM Conformance Statement; published by IMPAC Medical Systems, Inc.

## 1.4 WHAT'S CHANGED?

The following items are new or were changed for the release of DCM MOSAIQ 1.20:

- ◆ Added new section on SITE\_SETUP\_DEF.

## 1.5 DOCUMENTATION CONVENTIONS

The following conventions are used throughout this document:

- Courier font indicates a record name, field element or explicit RTP*Connect* Import File value.

## 1.6 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

<b>CRC</b>	Cyclical Redundancy Check
<b>DCM</b>	DICOM Communication Module
<b>DICOM</b>	Digital Imaging and Communications in Medicine. A standard developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) for electronic transfer of digital images and associated information.
<b>RT</b>	Radiotherapy
<b>RTP</b>	Radiotherapy Treatment Planning

## **2. GENERAL DESCRIPTION**

### **2.1 OVERVIEW**

The DICOM RT Plan object is used to transfer treatment plans generated by manual entry, a virtual simulation system or a treatment planning system before or during a course of treatment. It contains geometric and dosimetric data that specifies a course of external beam and/or brachytherapy treatment, for example beam angles, collimator openings, beam modifiers and brachytherapy specifications.

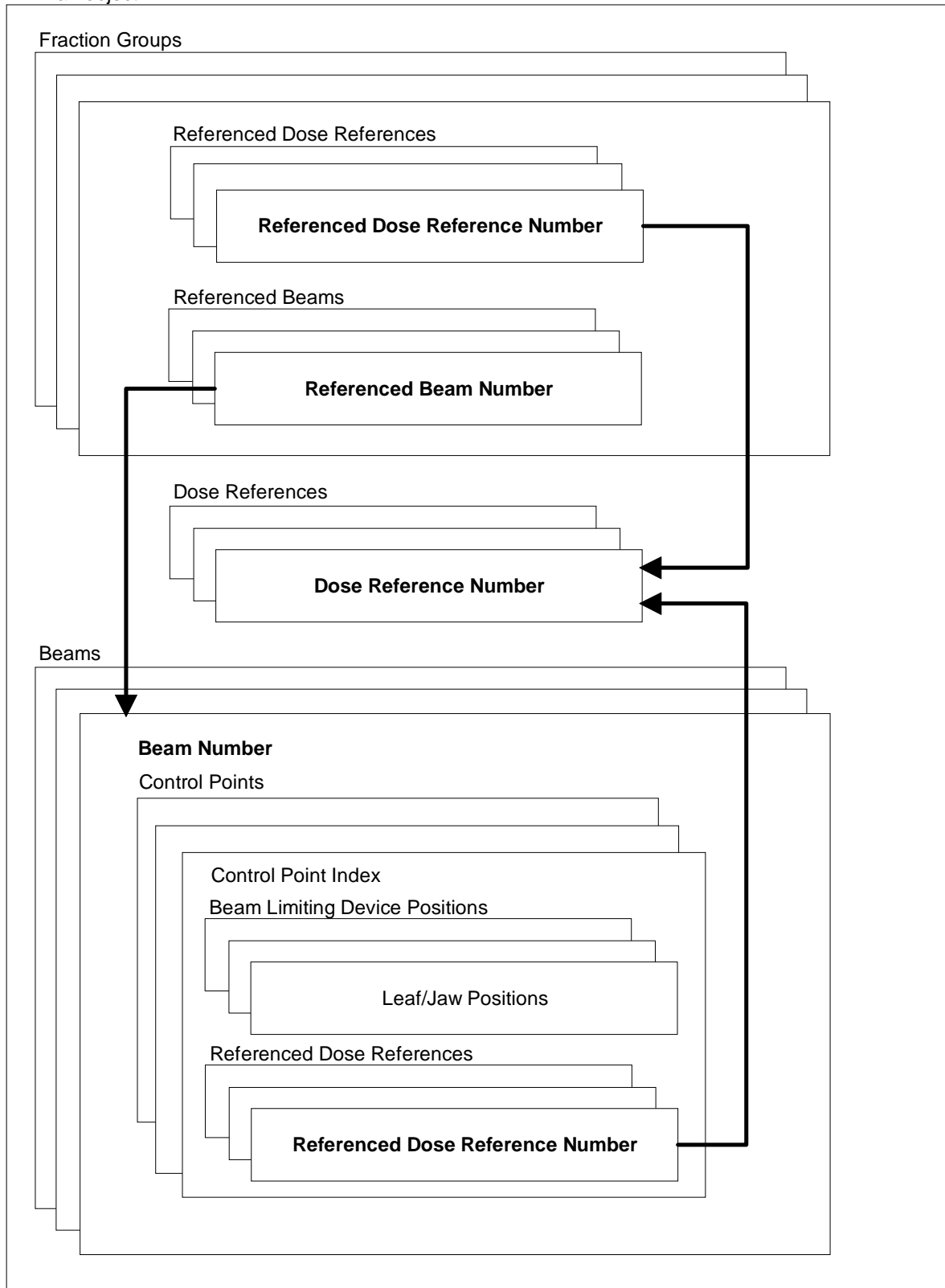
RT Plans received by DCM are translated into *RTPConnect* Import files intended for import by the Multi-ACCESS application. Multi-ACCESS performs the import process that extracts information from the *RTPConnect* Import file and stores the information in the Information Management System database. For a detailed description of the *RTPConnect* Import file format, refer to LED17001, the *RTPConnect* Interface Specification.

#### **2.1.1 DICOM RT Plan**

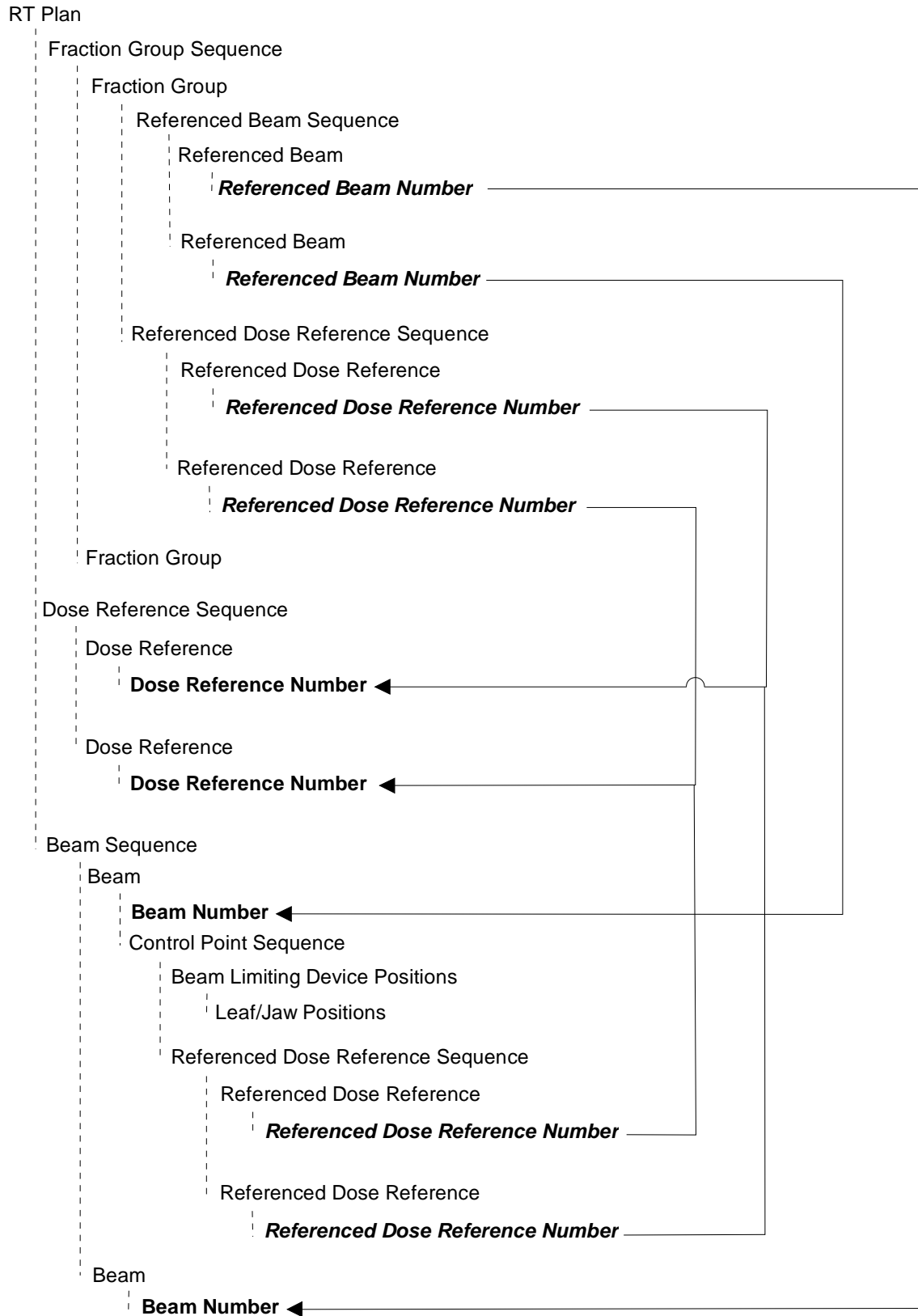
An RT Plan object may contain zero or more Fraction Groups, Beams and Dose References. Each Fraction Group contains references to Dose References and Beams. Each Beam contains Control Points and each Control Point contains Beam Limiting Device Positions and zero or more references to Dose References.

The following diagrams describe the RT Plan object. For a detailed description, refer to the DICOM Standard.

RT Plan object



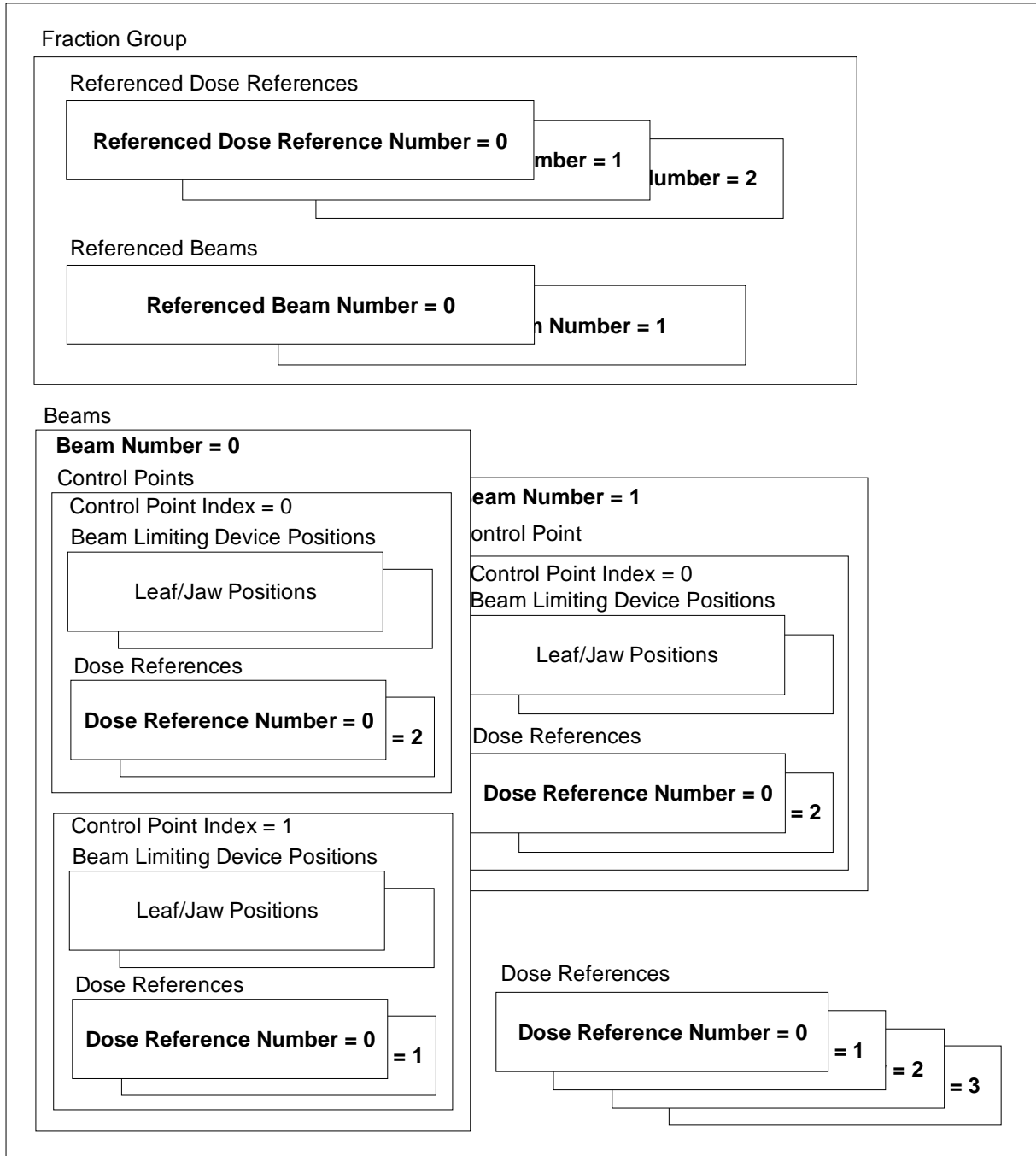
The following describes the RT Plan object in a hierarchical diagram:



2.1.1.1 Example of DICOM RT Plan

The following diagram is an example of an RT Plan object:

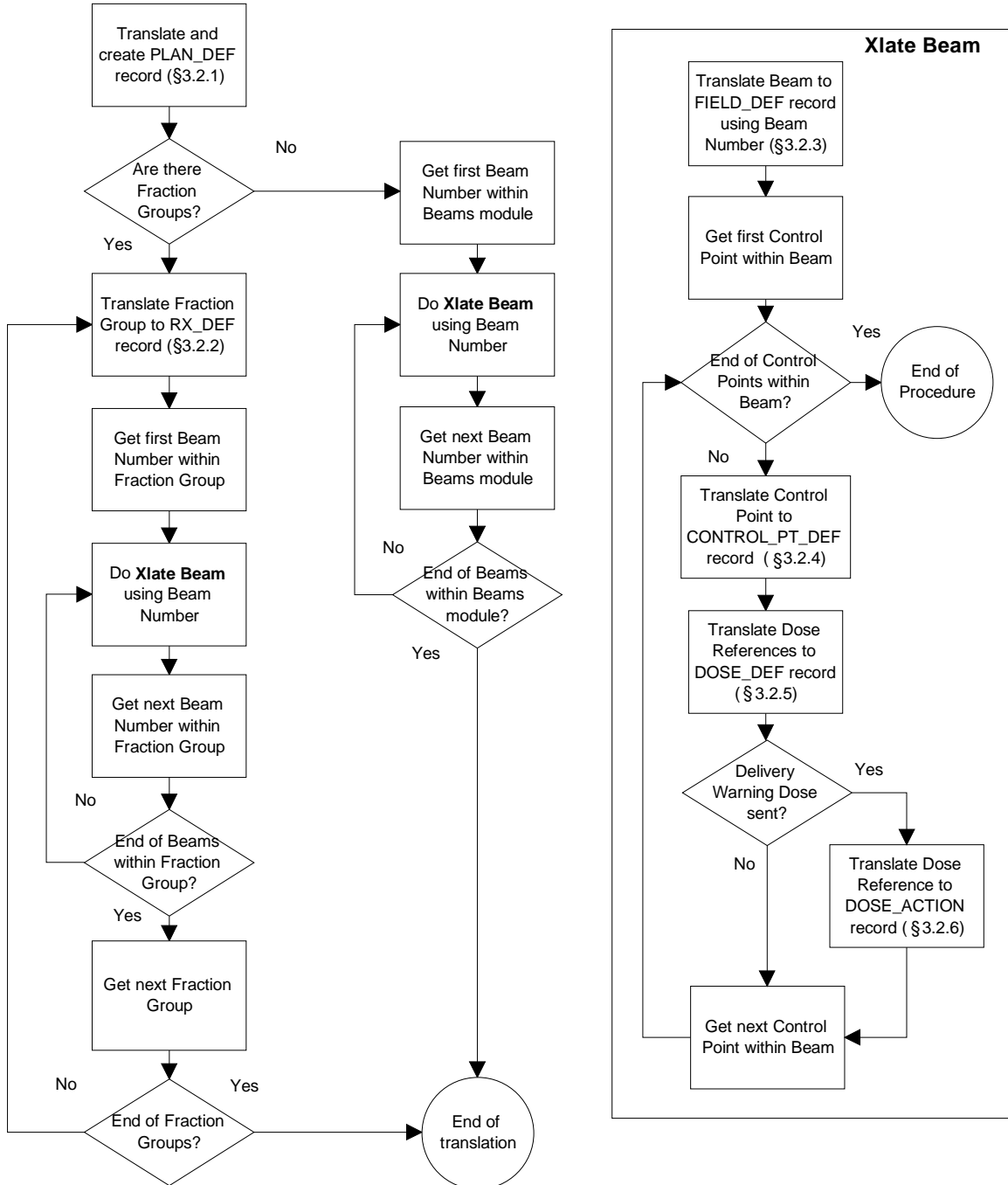
RT Plan object



### 3. DETAILED DESCRIPTION

#### 3.1 TRANSLATION PROCESS

The following flowchart describes the translation process:



## 3.2 RT PLAN TRANSLATION CONVENTIONS

### 3.2.1 General Assumptions

The translation process performs the following:

- ◆ Rounds/truncates numeric attributes to the nearest value before validating them.
- ◆ Retains leading spaces and ignores trailing spaces of string attributes.
- ◆ Truncates excess trailing characters from string attributes when the source is larger than the destination.
- ◆ Sets the destination to NULL (i.e. " ") when a source attribute contains invalid data.
- ◆ Sets the destination to NULL when a source attribute lacks data, the data is invalid or the data otherwise fails to meet process criteria.

### 3.2.2 Specific Numeric Operations

Round<sup>1</sup>

- ◆ Round to integer value. E.g. 1.3 becomes 1, 1.5 becomes 2, -1.3 becomes -1, -1.5 becomes -2.
- ◆ Round to 1 decimal place. E.g. 3.12 becomes 3.1, 3.15 becomes 3.2, -3.12 becomes -3.1, -3.15 becomes -3.2.
- ◆ Round to 2 decimal places. E.g. 3.122 becomes 3.12, 3.157 becomes 3.16, -3.122 becomes -3.12, -3.156 becomes -3.16.

Round<sup>2</sup>

- ◆ Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If the attribute MLCX or MLCY is found, round down to integer value, e.g. 1.3 becomes 1, 1.5 becomes 1, -1.3 becomes -2, -1.5 becomes -2; else round to integer value, e.g. 1.3 becomes 1, 1.5 becomes 2, -1.3 becomes -1, -1.5 becomes -2.

Round<sup>3</sup>

- ◆ Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If the attribute MLCX or MLCY is found, round up to integer value, e.g. 1.3 becomes 2, 1.5 becomes 2, -1.3 becomes -1, -1.5 becomes -1; else round to integer value, e.g. 1.3 becomes 1, 1.5 becomes 2, -1.3 becomes -1, -1.5 becomes -2.

First<sup>1</sup>

- ◆ First two consecutive digits. E.g. 123 and a123bcd become 12, ab1c23d becomes 1.

### 3.2.3 Specific String Operations

Name Parsing<sup>1</sup>

- ◆ In the DICOM Standard, the PN (Person Name) Value Representation (data type) is defined as a character string delimited by caret "^" characters (5EH). The character string before the first caret delimiter, or the whole character string if no caret delimiter is found, shall be used as the last name. The character string between the first caret delimiter and the next delimiter or space character (20H) shall be used as the first name. If a third caret delimiter is present, the character string between the second and third delimiter shall be the middle name; else the character string between the first space character after the first caret delimiter and the next space character shall be the middle name.

### 3.3 RTPCONNECT RECORDS CREATED FROM TRANSLATED DICOM ATTRIBUTES

#### 3.3.1 RTPConnect Record: PLAN\_DEF

Only one PLAN\_DEF record is created in an RTPConnect Import file. The following table maps the fields within the PLAN\_DEF record to the DICOM attributes.

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
Keyword	—	PLAN_DEF
Patient_ID	S(20)	Patient ID (0010,0020)
Patient_Last_Name	S(40)	Patient's Name (0010,0010). Follow Name Parsing <sup>1</sup> convention
Patient_First_Name	S(40)	Patient's Name (0010,0010). Follow Name Parsing <sup>1</sup> convention
Patient_MInitial	S(01)	Patient's Name (0010,0010). Follow Name Parsing <sup>1</sup> convention
Plan_ID	S(15)	RT Plan Label (300A,0002)
Plan_Date	YYYYMMDD	RT Plan Date (300A,0006)
Plan_Time	HHMMSS	RT Plan Time (300A,0007)
Course_ID	See §3.4	RTPConnect Common Element
Diagnosis	—	NULL
MD_Last_Name	—	NULL
MD_First_Name	—	NULL
MD_MInitial	—	NULL
MD_Approve_LName	S(20)	Reviewer Name (300E,0008). Follow Name Parsing <sup>1</sup> convention
MD_Approve_FName	S(20)	Reviewer Name (300E,0008). Follow Name Parsing <sup>1</sup> convention
MD_Approve_MInitial	S(01)	Reviewer Name (300E,0008). Follow Name Parsing <sup>1</sup> convention
Phy_Approve_LName	S(20)	NULL
Phy_Approve_FName	S(20)	NULL
Phy_Approve_MInitial	S(01)	NULL
Author_Last_Name	S(40)	Operator's Name (0008,1070). Follow Name Parsing <sup>1</sup> convention
Author_First_Name	S(40)	Operator's Name (0008,1070). Follow Name Parsing <sup>1</sup> convention
Author_MInitial	S(01)	Operator's Name (0008,1070). Follow Name Parsing <sup>1</sup> convention
RTP_Mfg	S(20)	Manufacturer (0008,0070)
RTP_Model	S(20)	Manufacturer's Model Name (0008,1090)
RTP_Version	S(10)	Software Version (0018,1020)
RTP_IF_Protocol	S(20)	IMPAC_DCM_SCP

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
RTP_IF_Version	S(10)	1.20xx
CRC	—	Calculated CRC

**3.3.2 RTPConnect Record: RX\_DEF**

If there are no Fraction Groups, a single RX\_DEF record is created with a Course\_ID of "Site 01".

For each existing Fraction Group, determine the Primary Site by looping through all the Reference Beams in the Referenced Beam Sequence (300C,0004). Match the Referenced Beam Number (300C,0006) with a Beam Sequence >Beam Number (300A,00C0). If the Beam Sequence >Treatment Delivery Type (300A,00CE) is TREATMENT, loop through all the Referenced Dose References in Beam Sequence >Control Point Sequence >Referenced Dose Reference Sequence (300C,0050) and match the Referenced Dose Reference Number (300C,0051) with a Dose Reference Sequence >Dose Reference Number (300A,0012). The Primary Site is the first Dose Reference with the Dose Reference Type (300A,0020) of TARGET. If no Dose Reference with a Dose Reference Type of TARGET is found, the first Referenced Dose Reference will be the Primary Site.

Creating RX\_DEF records based on fraction groups and the derived Primary Site:

```

FOR each fraction group in a Fraction Group Sequence (300A,0070)
  FOR each reference beam in the Referenced Beam Sequence (300C,0004)
    READ the Referenced Beam Number (300C,0006)
    IF the Referenced Beam Number matches the Beam Sequence >Beam Number (300A,00C0)
      IF the Beam Sequence >Treatment Delivery Type (300A,00CE) is TREATMENT (or attribute doesn't exist)
        FOR each referenced dose in Beam Seq >Control Point Seq >Referenced Dose Reference Seq (300C,0050)
          READ the Referenced Dose Reference Number (300C,0051)
          IF the Referenced Dose Ref Number matches the Dose Reference Seq >Dose Ref Number (300A,0012)
            IF the Dose Reference Type (300A,0020) is TARGET
              SET Primary Site (RX_DEF will be created with this Primary Site)
            END search for Primary Site for this fraction group
          ELSE keep looping through referenced doses
        ELSE keep looping through referenced doses
      ENDFOR (referenced doses)
      IF Primary Site not found/set
        SET Primary Site to the first ref dose in Beam Seq >Control Point Seq >Referenced Dose Reference Seq
          (RX_DEF will be created with this Primary Site)
        END search for Primary Site for this fraction group
      ELSE keep looping through referenced beams
    ELSE keep looping through referenced beams
  ELSE keep looping through referenced beams
ENDFOR (referenced beams)
IF Primary Site not found/set
  SET Primary Site to NULL (default RX_DEF will be created for this fraction group)
ELSE keep looping through fraction groups
ENDFOR (fraction group)

```

## DCM MOSAIQ 1.20 RT PLAN TRANSLATION

Each Fraction Group within the Fraction Group Sequence (300A,0070) is translated to one RX\_DEF record. For each Fraction Group, all Referenced Dose References except the Dose Reference identified as the Primary Site become Secondary Sites.

The following table maps the fields within the RX\_DEF record to the DICOM attributes.

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>								
Keyword	—	RX_DEF								
Course_ID	See §3.4	RTPConnect Common Element								
Rx_Site_Name	See §3.4	RTPConnect Common Element								
Technique	S(20)	Treatment Protocols (300A,0009)								
Modality	S(10)	Within the <b>first</b> beam of the Referenced Beam Sequence (300C,0004) of the <b>current</b> Fraction Group Sequence (300A,0070), match the Referenced Beam Number (300C,0006) with a Beam Sequence >Beam Number (300A,00C0); get the Beam Sequence >Radiation Type (300A,00C6):  <table style="width: 100%; border: none;"> <tr> <td style="border: none;"><u>Radiation Type</u></td> <td style="border: none;"><u>Modality</u></td> </tr> <tr> <td style="border: none;">PHOTON</td> <td style="border: none;">Xrays</td> </tr> <tr> <td style="border: none;">ELECTRON</td> <td style="border: none;">Elect</td> </tr> <tr> <td style="border: none;"><i>Otherwise</i></td> <td style="border: none;">NULL</td> </tr> </table>	<u>Radiation Type</u>	<u>Modality</u>	PHOTON	Xrays	ELECTRON	Elect	<i>Otherwise</i>	NULL
<u>Radiation Type</u>	<u>Modality</u>									
PHOTON	Xrays									
ELECTRON	Elect									
<i>Otherwise</i>	NULL									
Dose_Spec	—	NULL								
Rx_Depth	—	NULL								
Dose_TTL	1-32767 cGy	Within the primary site's Dose Reference (for the current fraction group), use Target Prescription Dose (300A,0026), format: float (Gy). Multiply float by 100 and truncate to integer.								
Dose_Tx	1-9999 cGy	Multiply TPD (float) by 100, divide by Number of Fractions Planned (integer) and truncate to integer: TPD: within the primary site's Dose Reference Sequence, get Target Prescription Dose (300A,0026); NFP: within the Fraction Group Sequence (300A,0070), get Number of Fractions Planned (300A,0078).								
Pattern	—	NULL								
Rx_Note	S(60)	Prescription Description (300A,000E)								
Number_of_Fields	1-999	Within the <b>current</b> Fraction Group Sequence, use Number of Beams (300A,0080).								
CRC	—	Calculated CRC								

**3.3.3 RTPConnect Record: SITE\_SETUP\_DEF**

For each RX\_DEF record created for the Fraction Group, determine the Isocenter Position by looping through all the Reference Beams in the Referenced Beam Sequence (300C,0004). Match the Referenced Beam Number (300C,0006) with a Beam Sequence >Beam Number (300A,00C0), and retrieve the 3 values in the Isocenter Position (300A,0111) attribute in the Beam Sequence >Control Point Sequence. If these 3 values are present and stay the same in all the Beams, then Isocenter\_Position\_X, Isocenter\_Position\_Y, and Isocenter\_Position\_Z are set to these 3 values; otherwise they are set to “?”.

The following table maps the fields within the SITE\_SETUP\_DEF record to the DICOM attributes.

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Keyword	—	SITE_SETUP_DEF
Rx_Site_Name	See §3.4	RTPConnect Common Element.
Isocenter_Position_X	-999.99 – 999.99	Use the first value of the Beam Sequence >Control Point Sequence >>Isocenter Position (300A,012C), format: float (mm). Divide by 10 and round <sup>1</sup> float to 2 decimal places. Note: see special condition above.
Isocenter_Position_Y	-999.99 – 999.99	Use the second value of the Beam Sequence >Control Point Sequence >>Isocenter Position (300A,012C), format: float (mm). Divide by 10 and round <sup>1</sup> float to 2 decimal places. Note: see special condition above.
Isocenter_Position_Z	S(20)	Use the third value of the Beam Sequence >Control Point Sequence >>Isocenter Position (300A,012C), format: float (mm). Divide by 10 and round <sup>1</sup> float to 2 decimal places. Note: see special condition above.
Structure_Set_UID	S(64)	Within the Referenced Structure Set Sequence (300C,0060), use the first occurrence of Referenced SOP Instance UID (0008,1155).
Frame_Of_Reference_UID	S(64)	Within the Referenced Structure Set Sequence (300C,0060), if the first occurrence of Referenced SOP Instance UID (0008,1155) is found and not blank, use Frame Of Reference UID (0020,0052)
CRC	—	Calculated CRC

**3.3.4 RTPConnect Record: FIELD\_DEF**

Each Beam within the Beam Sequence (300A,00B0) that has the Treatment Delivery Type (300A,00CE) TREATMENT is translated to one FIELD\_DEF record. Beams that lack the Treatment Delivery Type attribute are assumed to be TREATMENT beams. The Beam is retrieved from the Beam Sequence (300A,00B0) using the Beam Number.

The following table maps the fields within the FIELD\_DEF record to the DICOM attributes.

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Keyword	—	FIELD_DEF
Rx_Site_Name	See §3.4	RTPConnect Common Element
Field_Name	S(20)	Within the current Beam Sequence, use Beam Description (300A,00C3).
Field_ID	See §3.4	RTPConnect Common Element
Field_Note	S(60)	NULL
Field_Dose	0.01-9999.99 cGy	Within the current Fraction Group Sequence, within the Referenced Beam Sequence, find the Referenced Beam that has matching Beam Number (300C,0006). Use Beam Dose (300A,0084) of the Referenced Beam; format: float (Gy). Multiply float by 100 and truncate to 2 decimal places
Field_Monitor_Units	0.01-9999.99 MU	If Beam Sequence >Primary Dosimeter Unit (300A,00B3) is MU, then use Beam Sequence >Beam Number (300A,00C0) as the derived beam. Identify the Fraction Group Sequence >Referenced Beam Sequence (300C,0004) from the current Fraction Group Sequence, where Fraction Group Sequence >Referenced Beam Sequence >>Referenced Beam Number (300C,0006) is equal to the derived beam. Use the Fraction Group Sequence >Referenced Beam Sequence >>Beam Meterset (300A,0086) attribute from the Referenced Beam Sequence identified above. Truncate float to 2 decimal places.
Wedge_Monitor_Units	0-9999.99 MU	Within the Beam Sequence: If Primary Dosimeter Unit (300A,00B3) is MU and Wedge Type (300A,00D3) is MOTORIZED, determine the Cumulative Meterset Weight (300A,0134) from the last Control Point where Wedge Position (300A,0118) is IN. Divide Cumulative Meterset Weight by Final Cumulative Weight (300A,010E), multiply by Beam Meterset (300A,0086) for current beam, and truncate float to 2 decimal places.
Treatment_Machine	S(20)	Within the current Beam Sequence, use Treatment Machine Name (300A,00B2). NOTE: This element is used to match with an existing machine in the database so that conversion of treatment geometry attributes from IEC-based coordinate system to machine-based native coordinate system can be performed.

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Treatment_Type	See §3.3.4.1	
Modality	S(05)	Within the current Beam Sequence, get Radiation Type (300A,00C6): <u>Radiation Type</u> <u>Modality</u> PHOTON                  Xrays ELECTRON                Elect Otherwise                NULL
Energy	See §3.4	RTPConnect Common Element
Time	—	NULL
Doserate	See §3.4	RTPConnect Common Element
SAD	30.0-999.9 cm	Within the current Beam Sequence, use Source to Axis Distance (300A,00B4), format: float (mm). Divide float by 10 and Round <sup>1</sup> to 1 decimal place
SSD	See §3.4	RTPConnect Common Element
Gantry_Angle	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Collimator_Angle	-360.0-360.0 degrees	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence, use Beam Limiting Device Angle (300A,0120), format: float (deg). Round <sup>1</sup> float to 1 decimal place
Field_X_Mode	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Field_X	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Collimator_X1	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Collimator_X2	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Field_Y_Mode	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Field_Y	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Collimator_Y1	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Collimator_Y2	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Couch_Vertical	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Couch_Lateral	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Couch_Longitudinal	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Couch_Angle	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Couch_Pedestal	See §3.4	Within the current Beam Sequence, within the <b>first</b> Control Point Sequence: RTPConnect Common Element
Tolerance_Table	1-9	Identify the Tolerance Table from the Tolerance Table Sequence (300A,0040) where Tolerance Table Sequence >Tolerance Table Number (300A,0042) is equal to Referenced Tolerance Table Number (300C,00A0), use Tolerance Table Label (300A,0043).
Arc_Direction	S(03)	If FIELD_DEF:Treatment_Type is determined to be ARC, then continue; otherwise NULL. Within the <b>first</b> Control Point Sequence, get Gantry Rotation Direction (300A,011F): <u>Gantry Rotation Direction</u> <u>Arc_Direction</u> CW                                    CW CC                                    CCW <i>Otherwise</i> NULL
Arc_Start_Angle	-360.0-360.0 degrees	If FIELD_DEF:Treatment_Type is determined to be ARC, then continue; otherwise NULL. Within the <b>first</b> Control Point Sequence, use Gantry Angle (300A,011E), format: float (deg). Round <sup>1</sup> float to 1 decimal place.
Arc_Stop_Angle	-360.0-360.0 degrees	If FIELD_DEF:Treatment_Type is determined to be ARC, then continue; otherwise NULL. Within the <b>last</b> Control Point Sequence, use Gantry Angle (300A,011E), format: float (deg). Round <sup>1</sup> float to 1 decimal place.

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Arc_MU_Degree	0.0-99.99 MU/degree	<p>If FIELD_DEF:Treatment_Type is determined to be ARC, then continue; otherwise NULL.</p> <p>Use the Fraction Group Sequence &gt;Referenced Beam Sequence &gt;&gt;Beam Meterset (300A,0086) attribute where Fraction Group Sequence &gt;Referenced Beam Sequence &gt;&gt;Referenced Beam Number (300C,0006) is equal to the Beam Number of the current Beam Sequence. Divide Beam Meterset by the difference between the Gantry Angles (300A,011E) in the <b>first</b> Control Point Sequence and the <b>last</b> Control Point Sequence. Round<sup>1</sup> float to 2 decimal places.</p> <p><b>Note:</b> The difference between the Gantry Angles in the first Control Point Sequence and the last Control Point Sequence is calculated based on the Gantry Rotation Direction (300A,011F):</p> <p><u>Gantry Rotation Direction</u>    <u>Difference in Gantry Angles</u></p> <p>CW              If Arc_Start_Angle &gt; Arc_Stop_Angle                  Difference = Arc_Stop_Angle + 360 - Arc_Start_Angle              Else                  Difference = Arc_Stop_Angle - Arc_Start_Angle              End</p> <p>CC              If Arc_Stop_Angle &gt; Arc_Start_Angle                  Difference = Arc_Start_Angle + 360 - Arc_Stop_Angle              Else                  Difference = Arc_Start_Angle - Arc_Stop_Angle              End</p>
Wedge	S(10)	Within the current Beam Sequence, get Number of Wedges (300A,00D0): if it is 1, within Wedge Sequence, use Wedge ID (300A,00D4).
Dynamic_Wedge	S(10)	NULL
Block	S(10)	Within the Block Sequence (300A,00F4), use Block Tray ID (300A,00F5).
Compensator	S(10)	Within the current Beam Sequence, get Radiation Type (300A,00C6): if it is PHOTON, within the <b>first</b> Compensator Sequence (300A,00E3), use Compensator ID (300A,00E5).
e_Applicator	S(10)	Within the current Beam Sequence, get Radiation Type (300A,00C6): if it is ELECTRON, within the Applicator Sequence (300A,0107), use Applicator ID (300A,0108).
e_Field_Def_Aperture	S(10)	Within the current Beam Sequence, get Radiation Type (300A,00C6): if it is ELECTRON, within the <b>first</b> Compensator Sequence (300A,00E3), use Compensator ID (300A,00E5).
Bolus	—	NULL
Portfilm_MU_Open	—	NULL
Portfilm_Coeff_Open	—	NULL
Portfilm_Delta_Open	—	NULL

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
Portfilm_MU_Treat	—	NULL
Portfilm_Coeff_Treat	—	NULL
CRC	—	Calculated CRC

### 3.3.4.1 RTPConnect Record: FIELD\_DEF:Treatment\_Type

#### Within the current Beam Sequence,

Set Treatment\_Type to FIXED

IF one or more geometric parameters changes during beam on within Control Points

Set Treatment\_Type to DYNAMIC

ELSE

IF Number of Control Points (300A,0110) is 2

IF Gantry Angle (300A,011E) changes within Control Points

Set Treatment\_Type to ARC

ENDIF

ELSEIF Number of Control Points (300A,0110) is 4

IF Wedge Position (300A,0118) and Gantry Angle (300A,011E) change within Control Points

Set Treatment\_Type to ARC

ENDIF

ENDIF

ENDIF

## 3.3.5 RTPConnect Record: CONTROL\_PT\_DEF

If FIELD\_DEF:Treatment\_Type is determined (§3.3.4.1) to be FIXED or ARC, and no geometric parameters change with the Control Points; then only the **first** Control Point is translated to a single CONTROL\_PT\_DEF record and the following fields are set to NULL: Energy, Doserate, SSD, Gantry\_Angle, Gantry\_Dir, Collimator\_Angle, Collimator\_Dir, Field\_X\_Mode, Field\_X, Collimator\_X1, Collimator\_X2, Field\_Y\_Mode, Field\_Y, Collimator\_Y1, Collimator\_Y2. Otherwise, each Control Point is translated to one CONTROL\_PT\_DEF record.

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
Keyword		CONTROL_PT_DEF
Field_ID	See §3.4	RTPConnect Common Element
MLC_Type	See §3.3.5.1	
MLC_Leaves	0, 20-100	Within the current Beam Sequence, within Beam Limiting Device Sequence, if RT Beam Limiting Device Type (300A,00B8) is MLCX or MLCY, use Number of Leaf Jaw Pairs (300A,00BC).
Total_Control_Points	1-999	If FIELD_DEF:Treatment_Type is determined to be not DYNAMIC $\Rightarrow$ 1; otherwise within the current Beam Sequence, use Number of Control Points (300A,0110).
Control_Pt_Number	0-998	Within the Beam Sequence, within the current Control Point Sequence, use Control Point Index (300A,0112).
MU_Convention	1-2	1. (1 means fractional MU, 2 means Absolute MU).
Monitor_Units	0-1.000000 MU	Divide float by float (CMW / fCMW) and truncate float to 6 decimal places: CMW: within the Beam Sequence, within the current Control Point Sequence, use Cumulative Meterset Weight (300A,0134); fCMW: within the Beam Sequence, within the current Control Point Sequence, use Final Cumulative Meterset Weight (300A,010E).
Wedge_Position	IN, OUT	Within the Beam Sequence, within the current Control Point Sequence, within the first Wedge Position Sequence, use Wedge Position (300A,0118).
Energy	See §3.4	RTPConnect Common Element
Doserate	See §3.4	RTPConnect Common Element
SSD	See §3.4	RTPConnect Common Element
Scale_Convention	1-2	2. (1 means Native, 2 means IEC 1217 Convention).
Gantry_Angle	See §3.4	RTPConnect Common Element

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Gantry_Dir	S(03)	Within the current Beam Sequence, within the current Control Point Sequence, get Gantry Rotation Direction (300A,011F): <u>Gantry Rotation Direction</u> <u>Gantry_Dir</u> CW                                      CW CC                                        CCW <i>Otherwise</i> NULL
Collimator_Angle	-360.0-360.0 degrees	Within the current Beam Sequence, within the <b>current</b> Control Point Sequence, use Beam Limiting Device Angle (300A,0120), format: float (deg). Round <sup>1</sup> float to 1 decimal place.
Collimator_Dir	S(03)	Within the current Beam Sequence, within the current Control Point Sequence, get Beam Limiting Device Rotation Direction (300A,0121): <u>Beam Limiting Device Rotation Direction</u> <u>Collimator_Dir</u> CW    CW CC    CCW <i>Otherwise</i> NULL
Field_X_Mode	See §3.4	RTPConnect Common Element
Field_X	See §3.4	RTPConnect Common Element
Collimator_X1	See §3.4	RTPConnect Common Element
Collimator_X2	See §3.4	RTPConnect Common Element
Field_Y_Mode	See §3.4	RTPConnect Common Element
Field_Y	See §3.4	RTPConnect Common Element
Collimator_Y1	See §3.4	RTPConnect Common Element
Collimator_Y2	See §3.4	RTPConnect Common Element
Couch_Vertical	See §3.4	RTPConnect Common Element
Couch_Lateral	See §3.4	RTPConnect Common Element
Couch_Longitudinal	See §3.4	RTPConnect Common Element
Couch_Angle	See §3.4	RTPConnect Common Element
Couch_Dir	See §3.4	RTPConnect Common Element
Couch_Pedestal	See §3.4	RTPConnect Common Element
Couch_Ped_Dir	See §3.4	RTPConnect Common Element

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
MLC_LP <sub>1-100</sub>	-25.00-25.00 cm	Within the current Beam Sequence, within Beam Limiting Device Sequence, if RT Beam Limiting Device Type (300A,00B8) is MLCX or MLCY, use the <b>first</b> <i>n</i> values of Leaf Jaw Positions (300A,011C), where <i>n</i> is determined from within the current Beam Sequence, within Beam Limiting Device Sequence, Number of Leaf Jaw Pairs (300A,00BC). If <i>n</i> < 100, the remaining MLC_LP <sub>n+1</sub> to MLC_LP <sub>100</sub> fields are set to NULL. For Leaf Jaw Positions (300A,011C), format: float (mm); Round <sup>1</sup> float to 1 decimal place and divide by 10.
MLC_LP <sub>101-200</sub>	-25.00-25.00 cm	Within the current Beam Sequence, within Beam Limiting Device Sequence, if RT Beam Limiting Device Type (300A,00B8) is MLCX or MLCY, use the <b>next</b> <i>n</i> values of Leaf Jaw Positions (300A,011C), where <i>n</i> is determined from within the current Beam Sequence, within Beam Limiting Device Sequence, Number of Leaf Jaw Pairs (300A,00BC). If <i>n</i> < 100, the remaining MLC_LP <sub>n+1</sub> to MLC_LP <sub>200</sub> fields are set to NULL. For Leaf Jaw Positions (300A,011C), format: float (mm); Round <sup>1</sup> float to 1 decimal place and divide by 10.
CRC		Calculated CRC

**3.3.5.1 RTPConnect Record: CONTROL\_PT\_DEF:MLC\_Type**

**Within the current Beam Sequence,**

```

Set MLC_Type to NULL
Get the RT Beam Limiting Device Type (300A,00B8) from the first Control Point
IF RT Beam Limiting Device Type is "MLCX" or "MLCY"
    Set MLC_Type to 11
    IF Manufacturer (0008,0070) is "GE"
        Set MLC_Type to 1
    ELSE IF Manufacturer is "PHILIPS" or "ELEKTA"
        Set MLC_Type to 2
    ELSE IF Manufacturer is "SCANDATRONICS"
        Set MLC_Type to 3
    ELSE IF Manufacturer is "SIEMENS"
        Set MLC_Type to 4
    ELSE IF Manufacturer is "VARIAN"
        Set MLC_Type to 5
    ELSE IF Manufacturer is "BRAINLAB"
        Set MLC_Type to 6
    ELSE IF Manufacturer is "RADIONICS"
        Set MLC_Type to 7
    ELSE IF Manufacturer is "LIEBINGER-FISHER"
        Set MLC_Type to 8
    
```

```
ELSE IF Manufacturer is "WELLHOFER"  
  Set MLC_Type to 9  
ELSE IF Manufacturer is "MITSUBISHI"  
  Set MLC_Type to 10  
ELSE IF Manufacturer is "MRC"  
  Set MLC_Type to 12  
ENDIF  
ENDIF
```

**3.3.6 RTPConnect Record: DOSE\_DEF**

Each Dose Reference within the Dose Reference Sequence (300A,0010) that has been referenced in any Fraction Group is translated to a DOSE\_DEF record. Using the Dose Reference Number (300A,0012) within the Dose Reference Sequence, find all Beams in the Beam Sequence that have a matching Referenced Dose Reference Number (300C,0051) within the Referenced Dose Reference Sequence (300C,0050) of the Control Point Sequence (300A,0111) of that Beam. A maximum of 10 Beams per Dose Reference can be described in one DOSE\_DEF record. More than one DOSE\_DEF record for the same Dose Reference (i.e. the same Region\_Name) can be used when more than 10 Beams contribute to one Dose Reference.

The following table maps the fields within the DOSE\_DEF record to the DICOM attributes.

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
Keyword	—	DOSE_DEF
Region_Name	See §3.4	RTPConnect Common Element
Region_Prior_Dose	0-32767 cGy	Within the Dose Reference Sequence, use Nominal Prior Dose (300A,001A), format: float (Gy). Multiply float by 100 and Round <sup>1</sup> to integer
Field_ID & Reg_Coeff Pairs	—	Ten Field_ID and Reg_Coeff pairs occur in each record, where <i>n</i> is 1-10
Field_ID <sub>n</sub>	S(05)	Identify a Beam Sequence, where Beam Sequence >Control Point Sequence >>Referenced Dose Reference Sequence >>>Referenced Dose Reference Number (300C,0051) matches Dose Reference Sequence >Dose Reference Number (300A,0012). Use the Beam Sequence >Beam Name (300A,00C2) attribute from the Beam Sequence identified above: <ul style="list-style-type: none"> <li>• If the attribute isn't NULL, convert to upper case characters.</li> <li>• If the attribute is NULL, then use Beam Sequence &gt;Beam Number (300A,00C0).</li> </ul>
Reg_Coeff <sub>n</sub>	0-9.99999	Use Cumulative Dose Reference Coefficient (300A,010C); which is found within the Beam Sequence, within the Control Point Sequence, within Referenced Dose Reference Sequence with the matching Referenced Dose Reference Number (300C,0051). Round <sup>1</sup> float to 5 decimal places.
Actual_Dose	—	NULL
Actual_Fractions	—	NULL
CRC	—	Calculated CRC

**3.3.7 RTPConnect Record: DOSE\_ACTION**

Each Dose Reference within the Dose Reference Sequence (300A,0010) that has been referenced in any Fraction Group and has a Delivery Warning Dose (300A,0022) attribute that is not NULL, is translated to a DOSE\_ACTION record.

The following table maps the fields within the DOSE\_ACTION record to the DICOM attributes.

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Keyword	—	DOSE_ACTION
Region_Name	See §3.4	RTPConnect Common Element
Action_Dose	1-32767 cGy	Within the Dose Reference Sequence, use Delivery Warning Dose (300A,0022), format: float (Gy). Multiply float by 100 and truncate to integer
Action_Note	S(20)	Undefined
CRC	—	Calculated CRC

3.4 RTPCONNECT COMMON ELEMENTS

The following elements appear in more than one RTPConnect record; they are consolidated here in order to avoid redundancy.

RTPConnect Element	Format	Value / RT Plan Attribute / Translation Description
Collimator_X1	-25.0-25.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is ASYMX, then use the first value of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Round <sup>2</sup> float to integer and divide by 10.
Collimator_X2	-25.0-25.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is ASYMX, then use the second value of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Round <sup>3</sup> float to integer and divide by 10.
Collimator_Y1	-25.0-25.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is ASYMY, then use the first value of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Round <sup>2</sup> float to integer and divide by 10.
Collimator_Y2	-25.0-25.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is ASYMY, then use the second value of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Round <sup>3</sup> float to integer and divide by 10.
Course_ID	1-99	RT Plan Label (300A,0002), format: S(16). First <sup>1</sup> two consecutive digits found in string
Doserate	10-9999 MU/min	Within the current Beam Sequence, within the first Control Point Sequence, use Dose Rate Set (300A,0115), format: float (MU/min). Round <sup>1</sup> float to integer
Energy	1-99 MeV	Within the current Beam Sequence, within the first Control Point Sequence, use Nominal Beam Energy (300A,0114), format: float (MeV). Truncate float to integer
Field_ID	S(05)	Use the Beam Sequence >Beam Name (300A,00C2) attribute from the current Beam Sequence: <ul style="list-style-type: none"> <li>• If the attribute isn't NULL, convert to upper case characters.</li> <li>• If the attribute is NULL, then use Beam Sequence &gt;Beam Number (300A,00C0).</li> </ul>
Field_X	0.0-50.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is X, then use the first 2 values of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Subtract the first value from the second value, Round <sup>3</sup> float to integer and divide by 10.

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>
Field_X_Mode	S(03)	Get the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Beam Limiting Device Type (300A,00B8): <u>Beam Limiting Device Type</u> <u>Field_X_Mode</u> X    SYM ASYMX                                        ASY <i>Otherwise</i> NULL
Field_Y	0.0-50.0 cm	Identify the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>RT Beam Limiting Device Type (300A,00B8). If this attribute is Y, then use the first 2 values of Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Leaf/Jaw Positions (300A,011C), format: float (mm). Subtract the first value from the second value, Round <sup>3</sup> float to integer and divide by 10.
Field_Y_Mode	S(03)	Get the Beam Sequence >Control Point Sequence >>Beam Limiting Device Position Sequence >>>Beam Limiting Device Type (300A,00B8): <u>Beam Limiting Device Type</u> <u>Field_Y_Mode</u> Y    SYM ASYMY                                        ASY <i>Otherwise</i> NULL
Gantry_Angle	-360.0-360.0 degrees	Within the current Beam Sequence, within the first Control Point Sequence, use Gantry Angle (300A,011E), format: float (deg). Round <sup>1</sup> float to 1 decimal place
Couch_Vertical	-999.9 – 999.9 cm	Within the current Beam Sequence, within the first Control Point Sequence, use Table Top Vertical Position (300A,0128) , format: float (mm). Round <sup>1</sup> float to integer and divide by 10.
Couch_Lateral	-999.9 – 999.9 cm	Within the current Beam Sequence, within the first Control Point Sequence, use Table Top Lateral Position (300A,012A) , format: float (mm). Round <sup>1</sup> float to integer and divide by 10.
Couch_Longitudinal	-999.9 – 999.9 cm	Within the current Beam Sequence, within the first Control Point Sequence, use Table Top Longitudinal Position (300A,0129) , format: float (mm). Round <sup>1</sup> float to integer and divide by 10.
Couch_Angle	-20.0-380.0 degrees	Within the current Beam Sequence, within the first Control Point Sequence, use Patient Support Angle (300A,0122), format: float (deg). Round <sup>1</sup> float to 1 decimal place
Couch_Dir	S(03)	Within the current Beam Sequence, within the current Control Point Sequence, get Patient Support Rotation Direction (300A,0123): <u>Patient Support Rotation Direction</u> <u>Couch_Dir</u> CW    CW CC    CCW <i>Otherwise</i> NULL
Couch_Pedestal	-20.0-380.0 degrees	Within the current Beam Sequence, within the first Control Point Sequence, use Table Top Eccentric Angle (300A,0125), format: float (deg). Round <sup>1</sup> float to 1 decimal place

**DCM MOSAIQ 1.20 RT PLAN TRANSLATION**

<b>RTPConnect Element</b>	<b>Format</b>	<b>Value / RT Plan Attribute / Translation Description</b>								
Couch_Ped_Dir	S(03)	<p>Within the current Beam Sequence, within the current Control Point Sequence, get Table Top Eccentric Rotation Direction (300A,0126):</p> <table border="0"> <tr> <td><u>Table Top Eccentric Rotation Direction</u></td> <td><u>Couch_Ped_Dir</u></td> </tr> <tr> <td>CW</td> <td>CW</td> </tr> <tr> <td>CC</td> <td>CCW</td> </tr> <tr> <td><i>Otherwise</i></td> <td>NULL</td> </tr> </table>	<u>Table Top Eccentric Rotation Direction</u>	<u>Couch_Ped_Dir</u>	CW	CW	CC	CCW	<i>Otherwise</i>	NULL
<u>Table Top Eccentric Rotation Direction</u>	<u>Couch_Ped_Dir</u>									
CW	CW									
CC	CCW									
<i>Otherwise</i>	NULL									
Region_Name	S(20)	Use the Dose Reference Sequence >Dose Reference Description (300A,0016), unless the attribute is NULL. If the attribute is NULL, then use Site $\alpha$ , where $\alpha$ is the Dose Reference Sequence >Dose Reference Number (300A,0012).								
Rx_Site_Name	S(20)	<p>Within the Primary Site's Dose Reference Sequence (300A,0010), use the Dose Reference Sequence &gt;Dose Reference Description (300A,0016); unless the attribute is NULL.</p> <ul style="list-style-type: none"> <li>• If Dose Reference Description is NULL, then use Site <math>\alpha</math>, where <math>\alpha</math> is the Dose Reference Sequence &gt;Dose Reference Number (300A,0012).</li> <li>• If Dose Reference Sequence does not exist, then use Site 01.</li> </ul>								
SSD	10.0-999.9 cm	Within the current Beam Sequence, within the first Control Point Sequence, use Source to Surface Distance (300A,0130), format: float (mm). Divide float by 10 and Round <sup>1</sup> to 1 decimal place								