# Meeting Minutes

## DICOM WORKING GROUP SEVEN (RADIOTHERAPY)

Virtual Meeting (GoToMeeting)
March 9-13, 2020

Presiding Officers:　　　　　　　　Christof Schadt, Brainlab, Co-Chair
　　　　　　　　　　　　　　　　Jim Percy, Elekta, Co-Chair
DICOM Secretariat:　　　　　　　　Carolyn Hull, MITA/NEMA

| Member Company/Organization | Name | | Mon | Tue | Wed | Thur | Frid |
|---|---|---|---|---|---|---|---|
| Voting Members Present | | | | | | | |
| AAPM | Walter Bosch | Voting | X | X | X | X | X |
| AAPM | Yulong Yan | Voting | X | X | X | X | X |
| AAPM | Bruce Curran | Voting | X | X | X | X | X |
| Accuray | Bob Pekarek | Voting | X | X | X | X | X |
| Brainlab | Christof Schadt | Voting | X | X | X | X | X |
| Elekta | Jim Percy | Voting | X | X | X | X | X |
| IBA | David Wikler | Voting | | X | X | X | |
| Mevion | Bruce Rakes | Voting | X | X | X | X | X |
| RaySearch | Stefan Pall Boman | Voting | X | X | X | | X |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sun Nuclear | Chris Pauer | Voting | X | X | | | |
| Varian | Kari Jyrkkälä | Voting | X | X | X | X | X |
| Voting Members Not Present | | | | | | | |
| ACR | John Carrino | Voting | | | | | |
| Canon Medical Systems, USA | Kevin O'Donnell | Voting | | | | | |
| Hokkaido University Grad. School of Med. | Hiroki Shirato | Voting | | | | | |
| Optivus Proton Therapy, Inc. | Michael Baumann | Voting | | | | | |
| PixelMed Publishing | David Clunie | Voting | | | | | |
| Shanghai Proton and Heavy Ion Ctr | Michael Moyers | Voting | | | | | |
| Siemens Healthineers | Frank Heister | Voting | | | | | |
| Others Present (Alternate Voting Members, Observers, Guests) | | | | | | | |
| ICT | Harold Beunk | Observ. | X | X | X | X | |

| Varian | Thomas Schwere | Observ. | | | | X | |
|--------|---------------|---------|---|---|---|---|---|
| Varian | Ulrich Busch | Observ. | X | X | X | X | X |

# Actual Week Schedule

| | Monday<br><br>Mar 9 | Tuesday<br><br>Mar 10 | Wednesday<br><br>Mar 11 | Thursday<br><br>Mar 12 | Friday<br><br>Mar 13 |
|---|---|---|---|---|---|
| **Session 1**<br>**07:30-09:30** | Setup,<br>Administrative,<br>Opening,<br>Group Status | General<br>Topics | Supp 199 | Supp 160<br>Patient Setup | Supp 215 Ion |
| **Session 2**<br>**09:30-12:00** | CPs | Supp 199 | Supp 199 | Supp 160<br>Patient Setup | Supp 199<br><br>Review Meeting<br>Minutes (ftp)<br>Contacts list<br>Future Meetings<br><br>Supp 160<br><br>Wrap-up |
| | Lunch Break | | | | Adjournment |
| **Session 3**<br>**13:00-15:00** | CPs | Supp 199 | Supp 199 | Leo Cancer<br>Care<br><br>Supp 199 (final<br>review) | |
| **Session 4**<br>**15:00-16:30** | CPs | Supp 199 | Supp NN6<br>Remaining CPs<br>(146, 2006) | | |

Drawing Board:
https://jamboard.google.com/d/1ClV69aYx7hly5ODWBPi5zN7lcVrGVLtiN0lNXPLMqpg/viewer?f=1

# Opening

Carolyn Hull reminded the group of the anti-trust rules.

The meeting schedule was reviewed and revised to accommodate availability of participants. Meeting times for Tues-Fri meetings were shifted one hour earlier (7:30am - 4:30pm CDT).

# Subgroups

## Brachy

the subgroup met last week to update the definitions of the RT Structure Set. Additions to the DICOM Standard may be required for defining applicators (Defined Terms). Jim will follow-up with the subgroup about the details on the new terms. A comment was to promote codes instead/in parallel.

## Ion

The IHE-RO profile for the Ion Plan was sent out for Public Comment. Starting to update the Treatment Record profile to include Ions (in particular Pencil Beam). The discussion about additional reference points in the generic 2nd Gen definitions has to continue to advance the Ion Supplement. The vendors are looking into dynamic arc treatments which may be able to be defined using existing Gen 1 Control Points using DYNAMIC vs. STATIC Beam Type.  Per Uli, WG-07 needs to provide guidance for Gen 2.

Annual face-to-face which usually occurs in conjunction with PTCOG (in Taipei this year) has been postponed because of the virus.  Currently scheduled for September.

## Motion Management

A presentation for WG-06 is being prepared. T. Schwere is going to present a use case. The face-to-face meeting is set for Accuray HQ in Sunnyvale in August.

## AAMI RT3

The RT3 standard is being cleaned and should go out any time.

## IEC

Jim Percy presented the IEC update.

## IHE-RO

Mark Pepelea left the PC. Bjorn Hardemark is new PC industry co-chair.
XRTS (formerly HIS) Profile in development. Stefan Boman is editing DRRO Profile (combined content and workflow).

# General Topics

AAPM has been approached by MITA regarding interest in taking over secretariat of WG-07.  It has been estimated that this would involve ~300 hrs/year.  Comment made that this may be an overestimate as group members take care of editorial and oversight functions.

## Encryption of DICOM Connections

DICOM Part 15 provides Extended BCP 195 TLS Profile for encryption.  Options include support of cipher suites. WG-07 recommends that IHE-RO explore development of an Integration Profile to ensure interoperable exchange.

## Unicode Usage

It is recommended that IHE-RO develop a Profile to specify usage of Unicode in objects.  There is a need to specify that an application can handle (receive, encode, display)  unicode character sets.  This issue may be less urgent than encryption.

## Unattached (HD) Contours

C. Schadt presented results of an internal evaluation of ROIs with higher resolution. This approach preserves information in the higher resolution MR images used for segmentation. There was a small loss of volume information when the high-resolution MR contours were resampled into planes parallel to CT images.  Further discussion of this topic is expected in review of CP RT148.

## Referencing between 1st and 2nd Gen IODs

Based on the discussion started with CP 1617, the current CP RT 152 (see 4.1 "CPs new to WG-07"), a request/question by B. Pekarek how to relate alternative RT Plan/RT Radiation Set instances (see also CP RT 155 by C. Schadt) and the question by T. Schwere to introduce the Treatment Session UID in 1st Gen records, the group discussed again the overall approach of how to handle 1st and 2nd Generation RT Objects in parallel. The purpose of the discussion was to re-evaluate the current consensus whether this still stands to not weaken the implementation of 2nd Generation IODs, but support environments with heterogeneous applications (some supporting 1st Gen, some supporting 2nd Gen and some supporting both).

Linking SOP instances to each other is already supported in General Instance Reference Module.  Linking to constituents below the Instance level is not supported by this mechanism.

Concern expressed on the one hand that the cost of implementation of 2nd Gen is high and "hybrid" systems may ease the transition.  On the other hand, alternatives to consistent use of 2nd Gen objects may be unsafe and may reduce motivation to fully adopt 2nd Gen.

As an alternative to bi-directional references, the use of one-directional references from 1st-to-2nd Gen, vs. 2nd-to-1st Gen were discussed.  These can be implemented via private tags.

# Change Proposals

## CP RT148 Inner and Outer Contours

This CP proposes to update the section on how to encode inner and outer contours. This was part of CP 2006 Unattached Contours but was separated as this topic requires more discussion.

The current standard "allows" key-holing to represent excluded volumes.  However, many manufacturers use an "XOR" method.  The CP adds the statement that the XOR method may also be used to indicate excluded internal volumes.  CP to be forwarded to WG-06.

## CP RT150 Add RT Structure Set Attributes to Confidentiality Profiles

Attributes of the RT Structure Set IOD were identified to be missing from the Confidentiality Profiles in Part 15. Clean Descriptor option was added for several attributes.  CP to be forwarded to WG-06.

## CP RT151 Extend the geometric RT Image definition

Allow for pitch and roll of the X-ray Imager system.  Defines imaging geometry using a 9 DOF coordinate system in which the imaging beams need not pass through treatment isocenter.  The group reviewed a proposal to add source translation in IEC Gantry CS and Image Receptor Pitch and Roll.  This CP was rejected as the existing standard already provides this capability via RT Image Orientation and RT Image Position (bound to the Gantry Coordinate System).  It was proposed to draft informative material for Part 17 to explain interoperable interpretation of imager geometry.

## CP RT152 RT Physician Intent Reference from RT Plan

Add a reference to an RT Physician Intent Instance to the RT Plan. Concern expressed that allowing 1st Gen RT Plan to reference RT Physician Intent/Prescription IODs would undermine demand to implement 2nd Gen. C-Arm Radiations and Radiation Sets.  The group decided to set aside this addition for now and reconsider in a year.

## CP RT153 RT Rad Correct Content Detail Flag

Correction of the RT Radiation Physical and Geometric Content Detail Flag attribute description. Removed "...and dosimetric information is present."  CP to be forwarded to WG-06.

During review of Supplement 199 it was decided to cancel this CP as this issue will be addressed while refactoring the RT Radiation Common and the RT Radiation Record Modules.

## CP RT154 Enhanced Beam Limiting Device Offset Specification

Clarification and correction of RT Beam Limiting Device Offset attribute description.


## Discussion of Potential CP

In the 2$^{nd}$ Gen device macros the "Number of …" attributes always have to be present, even in case the conditions in section C.36.2.2.5.1.1 are not met. As an example, if there is no need to provide the actual RT Beam Limiting Device Opening Sequence as the field does not change, still the number of openings has to be provided. Was this an oversight? Do we want to change this?

The group considered possible changes to attribute description and informative examples. Ultimately, it was decided that no change is needed.


## CP RT155 Constituent Mapping for RT Plan

The group discussed the work started with CP 1617 and introduction of constituent mapping for RT Plan/Beam and RT Radiation.  The proposed changes can be accommodated using a Standard Extended SOP Class.  No further changes were proposed at this time. The CP will be reviewed again in about one year to re-evaluate the overall situation.


[Meeting adjourned for the day on 3/9/20 at 5:30pm CDT.]


# Additional CPs


## CP RT146 - Extension of Segmentation Type

The CP proposes to add an ISOSURFACE value to the Segmentation Type (0062,0001) ENUMERATED VALUE.  The location of the surface is computed using an Isosurface Threshold Value ().  It is not clear if there is sufficient motivation to modify an existing ENUMERATED VALUE.  CP was canceled.

# CP RT145 - Unattached Contours

Proposal to extend RT Structure Set to allow repeatable conversion of high-resolution contours to a pixel-based representation.   The revised proposal adds three Attriubutes (all Type 1, inside a Type 3 Sequence) to define spacing, orientation, and reference position of a pixel grid for conversion of contours to a pixel-based representation:

      Recommended Pixel Spacing
      Recommended Pixel Orientation
      Recommended Pixel Grid Alignment

Conversion to pixel-based segmentation works only for CLOSED_PLANAR contours. (See (7FEO,0001)  in Section C.7.6.3 for another example of a Type 3 attribute that is only allowed to be present under certain conditions.)

[Adjourned for the day 3/11/20 @ 4:30pm CDT]

# Supplements

## Supp 160

Christof is preparing a presentation for Supp 160 - Patient Setup.  The Scope and Field of Application Section was reviewed and revised.

Line-by-line review of Module Attributes:
- RT Patient Treatment Setup IOD describes the setup of the patient using any fixation and shielding devices, as well as patient preparation and setup procedures.
- VR of Patient Setup Technique Description was changed to LT (10k).
- Scope of a Patient Setup: RT Positioning Scope Macro defines applicability of positioning parameters to RT Radiation Set(s), RT Radiation(s), or Treatment Position Groups.
- How is the Patient Setup UID defined? Uniquely identifies setup and whatever modifies the dose distribution.  Does this include Bolus? No, this is part of the Radiation. The Setup UID links Radiations (Radiation Sets) to Setups. This is a "sticky" UID.  Setup may be revised.  Some aspects of patient setup are stable, others may be adjusted over the course of therapy.  What other semantics?  It is not clear.  This topic was tabled.
- Consolidated Patient Setup Device specifications into a single sequence with coded roles.
- Patient Setup Procedure Sequence may reference Patient Setup Devices
- Patient to Equipment Relationship Macro (includes 4x4 matrix)
- Treatment Position Displacement Sequence contains relative displacement (delta) from initial reference, e.g., laser position.  Need to specify reference position.

- Added Displacement Reference Location () to indicate whether the Treatment Position Sequence, External Reference (laser alignment), or Internal Reference (mark or bony anatomy) is used.
    - Displacement Reference Label (VR=LO)
- Patient Support Displacement Sequence invokes Patient Support Position Macro
    - Define new TID for Patient Support *Displacement* Parameters and provide corresponding codes.
- Patient Positioning Instruction (references UPS) - discussion re whether this is needed here - It was decided to remove the reference.
- Omitted Radiation Sequence,
- Patient Setup Device Sequence - consolidates setup devices
    - Created three CIDs for Fixation, Shielding, and Alignment Devices
    - Yulong to edit list of shielding device code meanings and definitions.
    - Patient Alignment Devices CID was reviewed - physicists to edit.
    - Motion management Devices: Coaching Device / Patient Distraction Device
- Patient Setup Device Role (FIXATION, SHIELDING, ALIGNMENT) - is this really needed? May reconsider.

[Meeting adjourned 11:55am CDT 3/13/20]

# Supp 177

Work on this Supplement was referred to a future meeting.

# Supp 199

This Supplement was in Public Comment. The period ended March 2, 2020. U. Busch volunteered to review the comments and update the document accordingly.

The group decided to not have the Frame of Reference Module within the RT Radiation Record Set, as no coordinates are present in the IOD.

Regarding the Person Identification Macro, it shall be clarified with WG-06 how the codes are administered and whether the Identified Person or Device Macro could be utilized instead. Decision to use C.17-3b Person or Device Macro (with Observer Type = PSN) as it was used already in RT Common Instance Module.

The RT Radiation Record Common Module content is largely a superset of the RT Radiation Common Module.  Proposal to extract the common content as an RT Radiation Common Base Macro and invoke it in both Modules.

Treatment Tolerance Status appears to combine several concepts:  (IN/OUT Tolerance, Machine/Clinical Tolerance, Override/Not).   Replaced Treatment Tolerance Status with

Treatment Tolerance Sequence (Type 2) containing a Tolerance Type (Mach/Clinical), Attribute Selector, and Description.

Creator-Version UID indicates format version for Additional Parameter Recording.

Alternate Value Sequence (gggg,753E) is Type 2. This is acceptable.

In the Referenced Radiation Record Sequence in RT Radiation Record Set, all referenced SOP Instances shall all be recorded by the same treatment device. Proposal to require they all share the same Frame of Reference (or have no Frame of Reference for Manual Radiation Record SOP Class). This was found to be unnecessary. If coordinates are needed at the RT Radiation Record Set level, one would have to reference the RT Radiation Record in which they are defined.

Treatment Termination Status (3008,002A) has VR of Defined Term elsewhere. Decision to create a new Attribute, RT Treatment Termination Status (gggg,xxx1) for VR of Enumerated Value.

Manual Treatment Record - Proposal to retain the RT Control Point Sequence format of the other Treatment Record IODs in the Manual Treatment Record IOD. Manual recording for a delivery with Treatment Delivery Type (300A,00CE) CONTINUATION was discussed. Ideally, the starting and ending (cumulative) meterset values would be recorded. If the cumulative starting meterset value is unknown, this fact should be indicated in the Manual Treatment Record: e.g., using Starting Meterset Value Known Flag (Type 1).

[Adjourned for the day 3/10/20 @ 4:30pm CDT]

The description of Meterset-to-Dose Mapping was moved. Bob Pekarek to review and revise further ???
Recorded Parameters for Manual Recording discussed further. It was decided to allow adding any of the RT Control Point attributes of the corresponding RT Radiation Instance to the Manual RT Radiation Record.

Code meanings for interlock overrides were reviewed/revised.

Added Recorded RT Control Point DateTime () and Reference Radiation RT Control Point Index () in the RT Control Point General Macro if RT Record Flag () is YES.
Treatment Position Sequence and Referenced Treatment Position Index conditions were updated.

Added Starting Meterset Value Known Flag (gggg,7523) in the RT Control Point General Macro. This attribute has the value YES=the cumulative Meterset at the first recorded control point has the actual value at which the treatment was started or resumed.

Revised requirement wording for Cumulative Meterset in first control point of CONTINUATION session treatment records in section C.36.2.2.5.1.4.

Treatment Tolerance Violation Sequence attributes were reviewed and revised.
Uli to consider combining Override and Tolerance Violation Sequences.

The RT Radiation Record Set Instance Span was not clearly defined. The Enumerated Values were redefined and the description was updated accordingly.

Uli reviewed a combined Treatment Tolerance Violation and Override Sequence with the group. Contents of this Sequence include DateTime, Violation Category, Violation Type, Violation Cause, Attribute/Identification, Description; Override Sequence.

IOD for manual recording was renamed as Radiation Salvage Record IOD.

[Adjourned for the day 3/12/20 @ 4:30pm CDT]

It was considered to remove the top-level Additional Recorded Parameter Sequence in the RT Radiation Salvage Record Module.  This would place the recorded attributes in this IOD at the same level as they are in their original RT Radiation * IODs.  Also, Control Point attributes would be placed directly in the RT Radiation Salvage Record Control Point Sequence.  The enclosing Sequences for both top-level attributes and Control Point attributes were removed.  Examples to be updated.

Uli will complete cleanup of Supp 199 in preparation for reading with WG-06 the week of Mar 30th.

## Supp NN6 - RT Motion Management Objects

The group reviewed and revised Supplement NN6 slide presentation for WG-06.

## Supp 215

Jim Percy reviewed sup215_07_RTIonRadiationObjects.doc with the group.  Changes include addition of one or more reference locations.  A diagram (proton_nozzle.png) from Michael Moyer illustrates the layout of a proton nozzle.
- There are multiple accessory device reference locations.
- The snout can move in the direction of the beam.
- Want to define MLC projections at their physical position.
- Use distal end of accessory device holder as reference position

Incorporation of multiple reference locations was discussed.  Changes to existing standard were backed out and reworked:
- RT Delivery Device Common - **to contain a single reference location**.

- RT Accessory Device Identification Macro - added RT Device Distance Reference Location Code and RT Beam Modifier Definition Distance attributes. These attributes are type 1C, conditioned on the device having a distance reference location that differs from the reference location defined in the SOP instance.
- RT Accessory Device Holder Positions

Proposal to introduce these changes to the current standard via CP. This may be problematic outside the context of the Supplement.

The Ion subgroup will continue work on the Supplement.

Background information provided by Kari Jyrkkälä:

When supplement 175 was developed, it was known that using the radiation source as the reference location where distances are defined from is not optimal for ion plans thus using the treatment isocenter as the reference location for Ions plans was already envisioned. Also, the accessories (e.g. block, compensator, MLC, accessory holder) defined in the supplement 175 were planned to be re-used in the supplement 215. However, it was overlooked that in the ion plans the proton nozzle (snout) can move in the direction of the beam also during the delivery. This means the slot distances within the proton nozzle should be relative to the nozzle itself and not to the isocenter. In addition, we don't want that the movement of nozzle affects the planned MLC leaf positions, thus the leaf positions should be defined at their physical location and not projected to the isocenter. This simplifies the leaf position handing on the treatment delivery system side.

In Washington and Melbourne meetings the proposed solution was to allow multiple items in RT Device Distance Reference Location Code Sequence (300A,0659) in the RT Delivery Device Common Module. Individual accessories would then reference the location that they would be using. In the Dallas TCON meeting this proposal was further developed as follows:

- RT Delivery Device Common Module remains as it is in the standard, RT Device Distance Reference Location Code Sequence (300A,0659) contains only a single item
- RT Accessory Device Identification Macro is extended with RT Device Distance Reference Location Code Sequence (300A,0659) and RT Beam Modifier Definition Distance (300A,0688). This means that the Nozzle and accessories in general can have a different Distance Reference Location and Definition Distance from the treatment unit itself
- A new RT Accessory Device Holder Positions Macro is introduced that contains the control point specific parameters to control the Nozzle (accessory holder) position from the isocenter

Below is example how this could work:

Nozzle is an accessory holder that is fixed to the gantry head, it is not mounted to a slot. Distance Reference Location is 'distal end' and the Definition Distance 0.0. The nozzle has a

single slot 'M' for the MLC, the RT Accessory Holder Slot Distance for this slot is 20.0. Thus the 'slot' is 2.0 cm towards the source from the most distal point of the nozzle.

MLC is an accessory that is mounted to the slot 'M' of the Nozzle. Distance Reference Location is 'physical level' and the Definition Distance 0.0. This indicates that the MLC leaf positions are defined at the physical location of the device and they are independent of the actual position of the nozzle.

Actual position of the nozzle from the isocenter is defined in the control points using the RT Accessory Device Holder Positions Macro. If the nozzle position is 500.0 then the MLC is 52 cm from the isocenter.

## LEO Cancer Care

Mark and Dan of LEO Cancer Care presented the fixed-beam, upright/seated treatment delivery system and discussed issues related to the use of DICOM information objects for their data. Patient positioning accessories are indexed - angles and positions are adjusted to optimize patient posture for treatment.
An integrated CT scanner is used to acquire patient images. Image planes are/can be perpendicular to the table top.  The table top can be angled with respect to the beam.


# Other Topics


## Future Meetings

In view of the productivity of this meeting, plans for future WG-07 meetings were discussed.
- More frequent, shorter meetings may be good for focused effort on Supplements.
- Shorter meeting days (4 half-days) are better in view of timezone differences.
- It is important to disconnect from regular duties
- Consecutive days are important to maintain productivity

Uli indicated that he is willing to continue to contribute editorial assistance.


## Documents

Minutes to be posted to FTP server

Use Google Docs for transient document exchange
- Meeting notes
- WG member contact list

Meeting minutes from Nov 2019 WG-07 meeting in Melbourne, FL were reviewed and approved by the group without objection.
Reviewed by counsel:  CRS, April 23, 2020.