ClearCalc

User Manual

V2.2.0, Rev 9

RAD formation

335 Madison Ave, 4th floor
New York, New York 10017
USA
844-723-3675
support@radformation.com

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1. Introduction

1.1. What is ClearCalc?

ClearCalc calculation evaluation assesses the accuracy of a Radiation Oncology Treatment Planning System's (TPS) treatment plan calculation. ClearCalc has three components:

- One is a standalone Windows Operating System executable application that is used for administrative operations to set specified beam configuration(s), default settings, and user settings.
- The other ClearCalc application is a calculation evaluation application that utilizes incoming DICOM or ESAPI plan file information to perform a dose and/or monitor unit (MU) calculation on the incoming or entered treatment plan parameters.
- ClearCalc also contains a Monte Carlo dose calculation engine (RadMonteCarlo) that uses treatment planning parameters to calculate expected doses.

1.2. How does it benefit the users?

ClearCalc calculates patient-specific MU and, if applicable, reference point dose(s) independently using autonomous algorithms for detection of errant MU and dose values. ClearCalc also calculates a diode estimated dose to the depth of maximum dose for photon and electron fields for comparison to in-vivo dosimetry measurements.

1.3. Key sections of the software

- Photon
  - ➢ Independently calculate patient-specific MU and, if applicable, reference point dose(s) for a photon plan to assist the user in determining if the treatment plan is dosimetrically accurate. ClearCalc independently calculates the depth for each field using the CT data and includes any heterogeneity effects when determining the equivalent depth. Values are compared to a photon calculation tolerance specified by the user. If MU and, if applicable, reference point dose secondary calculation is outside of the user-specified tolerance, the constraint will display in red and have a red "X". If MU and, if applicable, reference point dose secondary calculation is within the user-specified tolerance, the constraint will display in green and have a green "✓". The user also has an option to "Verify" failing results at their discretion.
  - ➢ Optionally, independently calculate patient-specific dose(s) for a photon plan using RadMonteCarlo, a novel Monte Carlo algorithm, to calculate expected doses.

- Electron
  - ➢ Independently calculate patient-specific MU and, if applicable, reference point dose(s) for an electron plan to assist the user in determining if the treatment plan is dosimetrically accurate. Values are compared to an electron calculation tolerance specified by the user. As with photons, results can Pass or Fail and the user may also Verify a failing result.

- ➢ Optionally, independently calculate patient-specific dose(s) for a photon plan using RadMonteCarlo, a novel Monte Carlo algorithm, to calculate expected doses.

- Brachytherapy Second Check
  - ➢ Independently calculate patient-specific reference point dose(s) for a HDR or LDR brachytherapy plan to assist the user in determining if the treatment plan is dosimetrically accurate. Values are compared to a brachytherapy calculation tolerance specified by the user. As with photons, results can Pass or Fail and the user may also Verify a failing result.
- Proton Second Check
  - ➢ Independently calculate patient-specific dose(s) for a proton plan using RadMonteCarlo, a novel Monte Carlo algorithm, to calculate expected doses to assist the user in determining if the treatment plan is dosimetrically accurate. Values are compared to a proton tolerance specified by the user. Results will be displayed to the user to verify.
- Diode Calculation
  - ➢ Independently calculate the dose to the depth of maximum dose for the machine/energy combination utilized for an in-vivo field measurement comparison. Results can Pass or Fail and the user may also Verify a failing result.
- Log File Analysis
  - ➢ Utilizing machine treatment log files, independently recalculate the delivered treatment doses
- Create Users and Edit User Rights
  - ➢ Administrators can create new users and set user rights for other users. Users may have:
    - ■ Administrator Rights
      - ✓ Edit users
      - ✓ Edit settings
      - ✓ Input license key and synchronize software
    - ■ Data Configuration Rights
      - ✓ Edit machine settings and certain data for photon calculations
      - ✓ Create and edit beam data utilized for electron calculations
      - ✓ Create and edit beam data utilized for brachytherapy calculations
      - ✓ Create and edit diodes utilized for photon and electron in-vivo dosimetry comparison
    - ■ Standalone Rights
      - ✓ Utilize the Standalone application for analysis of DICOM files
      - ✓ Photon Hand Calculation module
      - ✓ Electron Hand Calculation module
- Create and edit machine or radioactive source specific data for use:
  - ➢ User can synchronize supported beam data for photon and electron machines
  - ➢ User can configure photon, electron, and brachytherapy machine settings
  - ➢ User can generate new electron machines and brachytherapy sources
  - ➢ User may edit electron and brachytherapy data
  - ➢ User can configure diodes for photons and electrons for available machines
  - ➢ User may select defaults for main application settings and directory locations
- System Settings
  - ➢ Administrators can:
    - ■ Set the system display units in centigray [cGy] or gray [Gy]

- Change system pass/condition/fail colors
- Adjust the display options for the photon point selection window
- Edit the PDF save location for ClearCalc reports
- Edit the DICOM Standalone default folder for DICOM files
- Enable the CyberKnife advanced heterogeneity corrections

1.4. Brief description about files required for ClearCalc

ClearCalc interfaces via the integrated API of the Eclipse™ Treatment Planning System though ClearCheck. The Eclipse™ (by Varian Medical Systems, Inc., Palo Alto, CA) TPS is a software device used by trained medical professionals to design and simulate radiation therapy treatments for malignant or benign diseases. Eclipse™ TPS is capable of planning treatments for external beam irradiation with photon, electron, and proton beams, as well as for internal irradiation (brachytherapy) treatments. The Eclipse™ user interfaces with a CT scan of a patient and plans which direction the radiation treatment will come from and the amount of radiation that can be used for the treatment. Eclipse™ calculates the dose that will be delivered by the user's plan and displays four directions of radiation dose to the user: the sagittal, coronal, and two transverse slices for the structures. ClearCalc, via ClearCheck, can use the Eclipse™ Scripting Application Programming Interface (ESAPI) to extract patient information from Eclipse™. The treatment plan data - including the RTImage, the RTPlan, RTStruct, and the RTDose files - are read into ClearCalc through the Eclipse™ scripting .DLL files. No direct DICOM export of the plan files is necessary for this integrated platform. Once the treatment plan data is read into ClearCalc, the plan accuracy evaluation automatically begins and the results are displayed to the user upon calculation completion.

Alternatively, ClearCalc can use DICOM files exported from a supported Treatment Planning System (TPS) for compatible photon, electron, and brachytherapy treatment plans. Then, the ClearCalc standalone application takes the incoming treatment plan DICOM files - including, but not limited to, the RTImage, the RTPlan, RTStruct, and the RTDose files - and processes the secondary calculation with the sent treatment plan files. After the plan files are selected by the user, the independent calculation begins and the results are displayed to the user upon calculation completion. For more detailed information on files required for specific machine configurations, refer to the ClearCalc Algorithms and Calculations section of the User Manual.

1.5. Intended Purpose

Device will be used for quality assurance of radiation therapy treatment plans and treatments.

1.6. Intended Use/Indications for use

ClearCalc is intended to assist radiation treatment planners in determining if their treatment planning calculations are accurate using an independent Monitor Unit (MU) and dose calculation algorithm.

1.7. Intended Users

ClearCalc is to be used only by trained clinically-qualified radiation oncology personnel.

1.8. Developer's Information

Manual Name: Radformation ClearCalc Software

ClearCalc ™

ClearCalc Version 2.2.0
Developed by Radformation, Inc.
335 Madison Avenue, 4th Floor
New York, NY 10017
USA

1.9. Package Includes

- User Manual
- ClearCalc Administration Application
- ClearCalc User Interface Applications
- All software and manuals are downloaded via https://www.radformation.com/

1.10. Symbols

Symbol	Description
	MANUFACTURER Manufacturer's name and address
	Operation Instructions
	Warnings
	Prescription Only Device

1.11. Software Recommendations

- Operating Systems Supported: Windows 7 (32- or 64-bit), Windows 8 (32- or 64-bit), Windows 10 (32- or 64-bit), Windows 11 (32- or 64-bit), Windows Server 2008, 2008 RS, 2012, 2016, 2019, and 2022.
- CPU: 2.4+ GHz, Multi-core processor (2+ cores, 4+ threads).
- Hard drive space: Software components fully installed require only ~10MB, but storage requirements for patient data are much larger and vary from clinic-to-clinic. A minimum of 100 GB hard drive is suggested for larger patient sets.
- Memory (RAM): 2+ GB.
- Display Resolution: A minimum of 1280 x 1024, 24- or 32- bit color depth.
- Optional Compatibility with Eclipse™ Treatment Planning System.

1.12. Cybersecurity

- Network firewall with port 443 open for HTTPs communication
- Radformation server HTTPs API endpoints protected by authentication token requirement; only clients with valid ClearCalc license are allowed to communicate with HTTPs endpoints.
- All local storage data is encrypted using AES-256 bit encryption.
- ClearCalc Plugin can only be accessed through Eclipse, as the application is an Eclipse plugin which requires users to have an Eclipse username and password.
- The Administration and DICOM standalone applications are username and password protected. Passwords are hashed using the Scrypt hashing algorithm or users can configure Windows Active Directory to restrict access to users with valid Windows Active Directory credentials.
- Recommended to update local computers to Windows 11/10, or at least the latest Windows 7 ESU service pack in order to enable usage of latest TLS versions and cipher suites.
- Recommended to remove NSA obsolete ciphers from local computers e.g. TLS_RSA_WITH_3DES_EDE_CBC_SHA to remain up to date with latest NSA security recommendations for secure HTTPs connections.

2. Device Description

The ClearCalc System is software that is used to evaluate the accuracy of treatment plan calculations. ClearCalc has two applications. An administration application and a user interface application.

2.1 ClearCalc Administration Application

The ClearCalc™ Administration Application is used to set department standards and user account settings. The following are set in the administration application:

- Photon Beam Data and Settings
- Electron Beam Data and Settings
- Brachytherapy Source Data and Settings
- Diode Data and Settings
- Superficial Data and Settings
- Orthovoltage Data and Settings
- Report Settings
- Users
- System Settings
- Software License Key

2.2. ClearCalc Plugin Application

The ClearCalc plugin application is run either via the Eclipse™ treatment planning system through the ClearCheck script or via a standalone DICOM application that launches the plugin. If using the Eclipse™ integration, the Eclipse™ API is used to read in patient photon, electron, and brachytherapy treatment plan data in order for ClearCalc to evaluate the accuracy of plan calculation. If using the standalone application, ClearCalc will utilize incoming DICOM files to read in patient photon, electron, and brachytherapy treatment plan data.

2.3. Operating Environment

Both applications will run on the Microsoft .NET framework 4.0+ and will be able to run on Windows 7, Windows 8, Windows 10, Windows 11, and designated Windows Citrix Servers.

2.4. Design and Implementation Constraints

Both applications will run on the Microsoft .NET framework 4.0+.

2.5. Memory Constraints

System will require at least 10MB of memory to install both applications. Global and Patient files are saved to NTFS. User's NTFS memory constraints will be determined by the size of the globals

data file. Globals data size will be determined by the number of imaging devices, treatment units, and energies that are commissioned by the user in Admin.

2.6. Periodic Maintenance

When an update to the software is available, users will be notified. All changes and additions made to the software will be listed for each version.

ClearCalc Software
To install an updated version of ClearCalc, open a web browser to https://www.radformation.com and log in with your account. On the right-hand side of the page, you will see a region for ClearCalc and a link to download the updated installer (with the version number identified). Download the installer and run it from the target computer to update your ClearCalc software.

Cloud-based Dose Calculation Service (RadMonteCarlo)
The cloud-based Dose Calculation Service backend is updated by Radformation. Note that in the event of recall or hazard, mandatory upgrades of the cloud-based may occur - in all such cases, users will be notified via email within 24 hours.

3. Warning

ClearCalc software works with incoming DICOM files or with input from the Eclipse™ Treatment Planning System and Radformation is not responsible for any output AND/OR functional behavior resulting from the user-designated DICOM input or any input from Eclipse™ TPS or working environment other than what is stated in the installation guide.

ClearCalc may, in rare instances, incorrectly generate expected doses due to incorrect treatment parameters, incorrect dose calculation, or other treatment planning data or user entry issues. Users **MUST** carefully review all dose results for accuracy prior to any radiation treatment.

4. Precautions

- For maximum utilization of this software, users should read the user manual supplied with the software and follow its instructions for achieving accurate results as well as ensure that their computer environment matches the software specifications.

- Final dose evaluation should be done in the user's Treatment Planning System. ClearCalc is a secondary verification and not intended to replace the primary calculation of a CT-based treatment plan.
- Caution: Federal Law restricts this device usage by or on the order of a radiation therapist (or medical dosimetrist, medical physicist, radiation oncologist).

Cybersecurity

- Cloud-based resources (external dose calculation engines and services) are accessible via HTTPS requests to Radformation's cloud endpoints. HTTPS stands for "Hypertext Transfer Protocol Secure" and is a combination of the Hypertext Transfer Protocol (HTTP) with the Secure Socket Layer (SSL)/Transport Layer Security (TLS) protocol. The addition of SSL/TLS ensures that all communication between the client and the server is encrypted and is not vulnerable to snooping or man-in-the-middle attacks.
- The user must take appropriate measures to ensure that their system they install the ClearCalc on is protected from viruses or malware by using appropriate prevention and mitigation strategies such as installing and maintaining appropriate anti-virus software.

5. Contra-indications

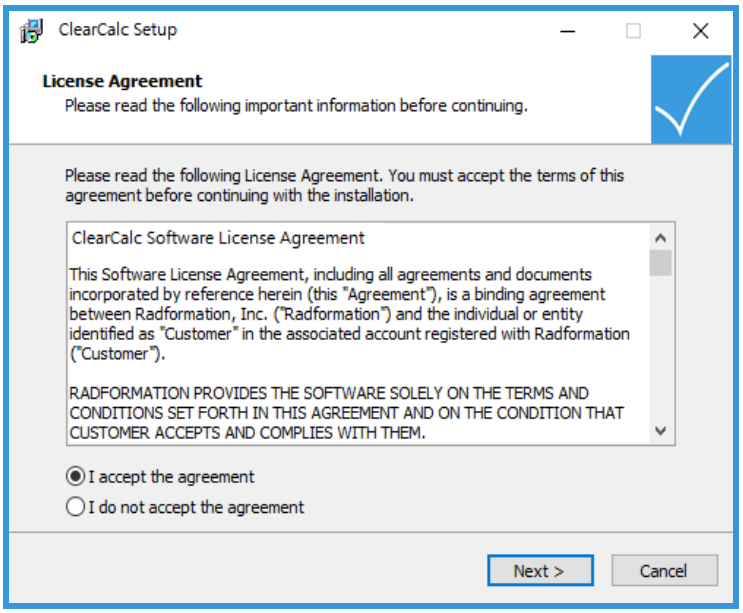
None known.

6. Instructions for Use

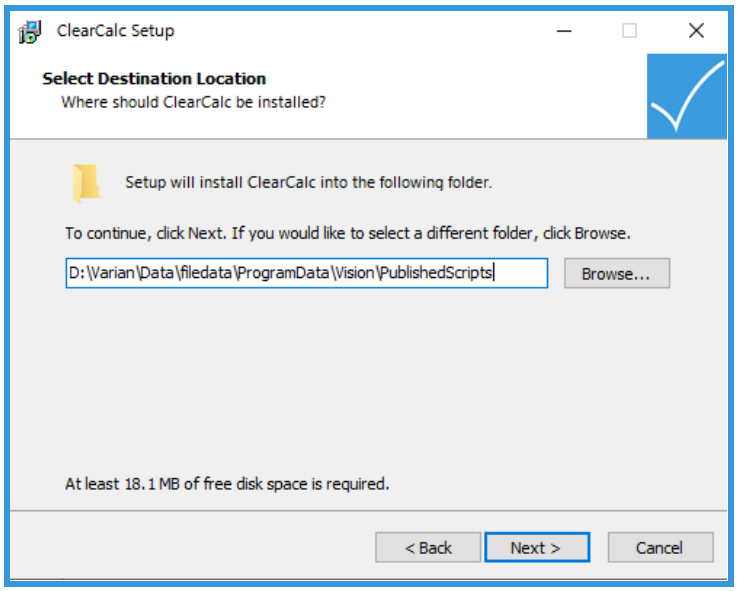
7.1 Installation

Note: If you are running ClearCalc via ClearCheck, the software will be installed during the ClearCheck installation - no additional ClearCalc installation is necessary for active ClearCheck users. This procedure is to be used for Standalone-only installations.

1. Download setup.exe from the Radformation website.
2. Run setup.exe
3. Accept ClearCalc License Agreement

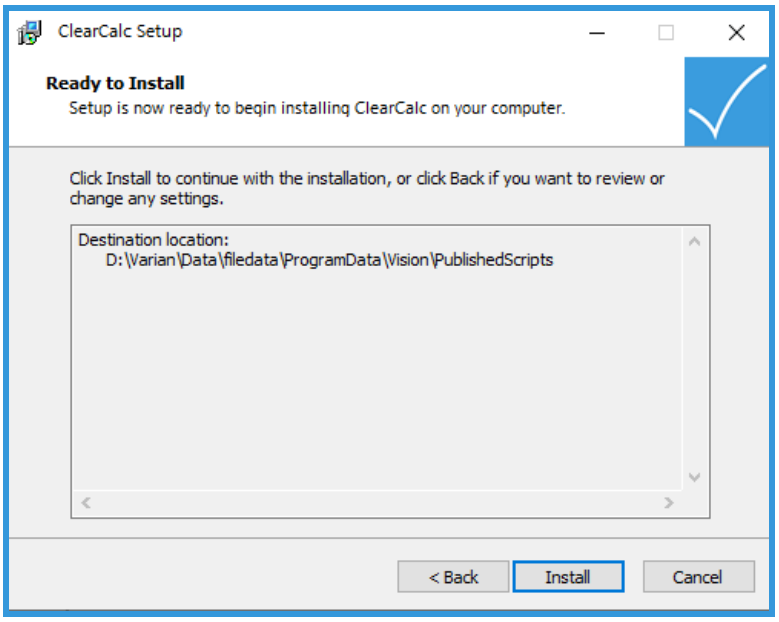


4. Browse to your preferred installation folder that all users have access to.

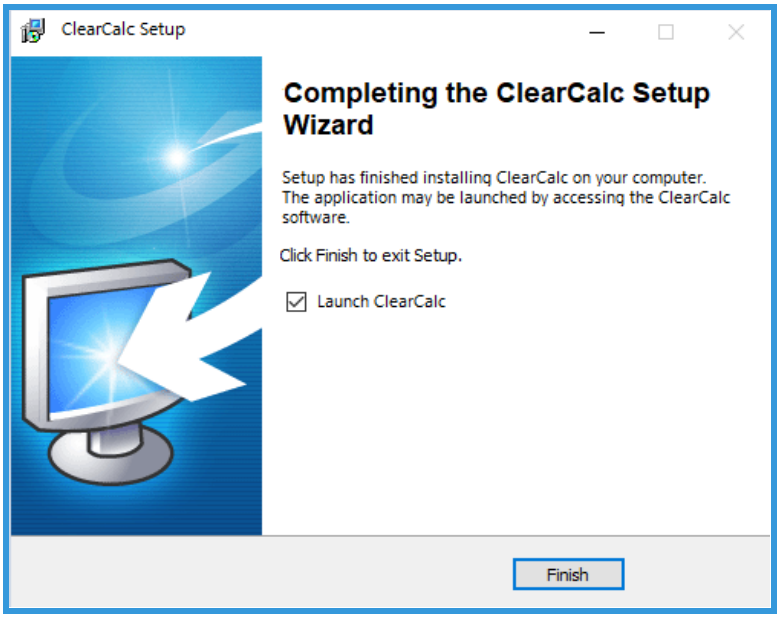


5. Choose if a desktop shortcut should be installed.

6. Select Install.

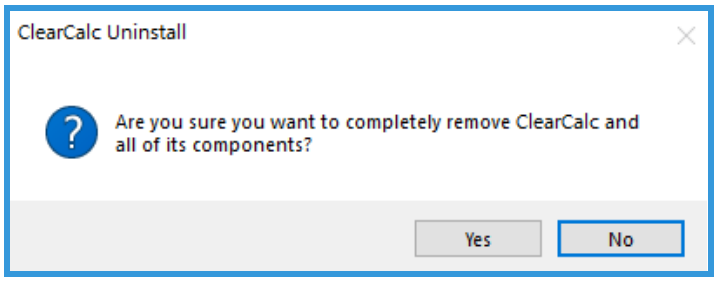


7. Launch ClearCalc Administration to set up the department templates and settings.

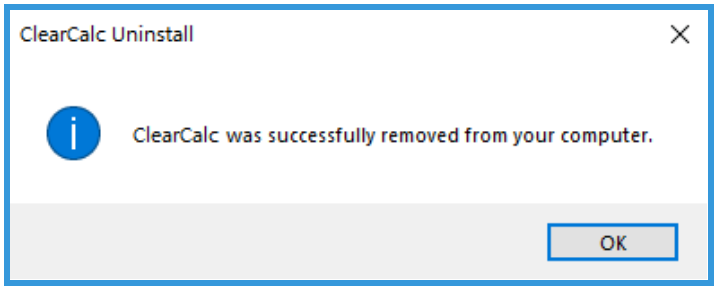


7.2 Uninstallation

1. Navigate to ClearCalc Folder
2. Run unins000.exe
3. Select Yes to uninstall ClearCalc



4. Select OK after uninstallation



7.3 Additional Compatibility with Varian Eclipse™ and the API

In addition to accepting DICOM files from any Treatment Planning System, ClearCalc is compatible with the Eclipse™ Treatment Planning System via the ClearCheck application. It can use the Eclipse™ Scripting Application Programming Interface (ESAPI) to extract patient information directly from Eclipse™. The data is read into ClearCalc through the Eclipse™ scripting .DLL files. Once the data is read into ClearCalc, it then performs the independent calculation.

7.4 Using ClearCalc

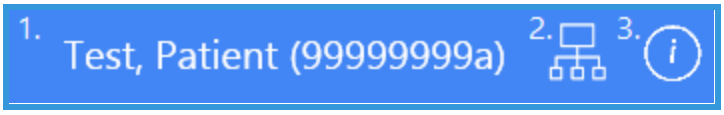
To use ClearCalc, launch the program from your configured installation location - via ESAPI for Eclipse users and via the ClearCalc.exe for Standalone users.

1. **Overview Left Hand Toolbar for ClearCalc**

Left to right:

1. Close ClearCalc (CTRL+Q is the Keyboard Shortcut)
2. Save Changes (CTRL+S is the Keyboard Shortcut)
3. Toggle the sidebar
4. Generate ClearCalc results directly to PDF(CTRL+G is the Keyboard Shortcut)
5. Print ClearCalc results back to ClearCheck for inclusion in ClearCheck report - hides for all Standalone application modules and the Diodes module (CTRL+D is the Keyboard Shortcut)
6. Diode module: grayed out for non-applicable plans such as SRS cone, VMAT plans, and non-configured modalities/energies (when in Diode module, icon will toggle to ClearCalc icon)
7. Log File Analysis module: hides for non-applicable plans such as SRS Cones and non-modulated fields (when in Log File module, icon will toggle to ClearCalc icon)
8. RadMonteCarlo module: grayed out when this module is not licensed (CTRL+R is the Keyboard Shortcut)

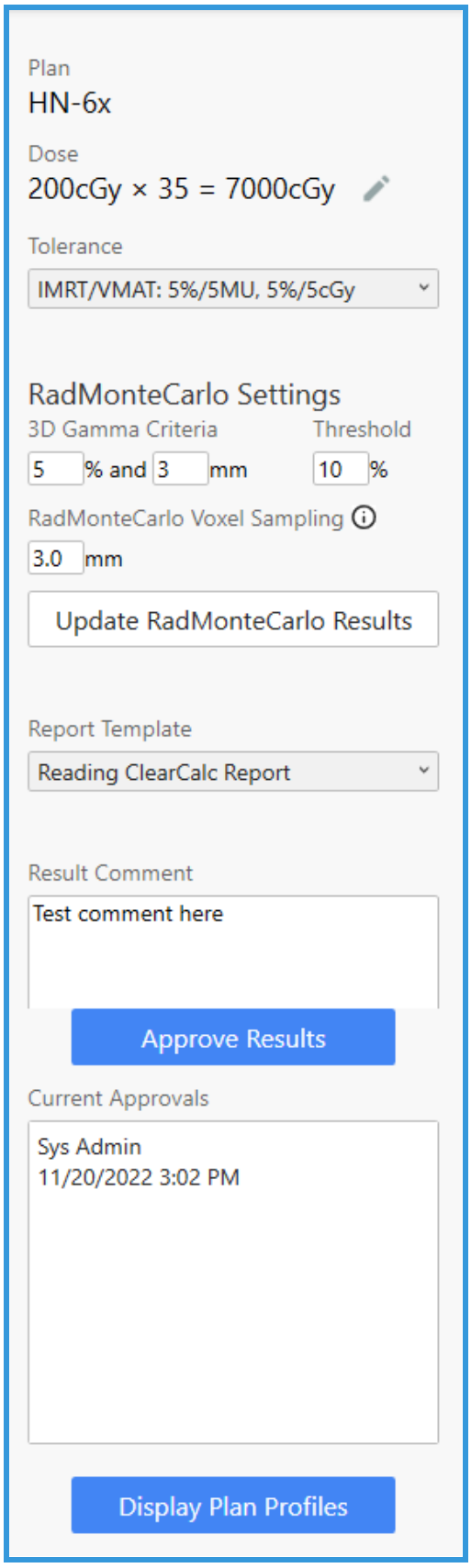
2. **Overview Right Hand Toolbar for ClearCalc**



Left to right:

1. Patient information: Last Name, First Name (Patient ID)
2. ClearCalc Administration
3. ClearCalc Information

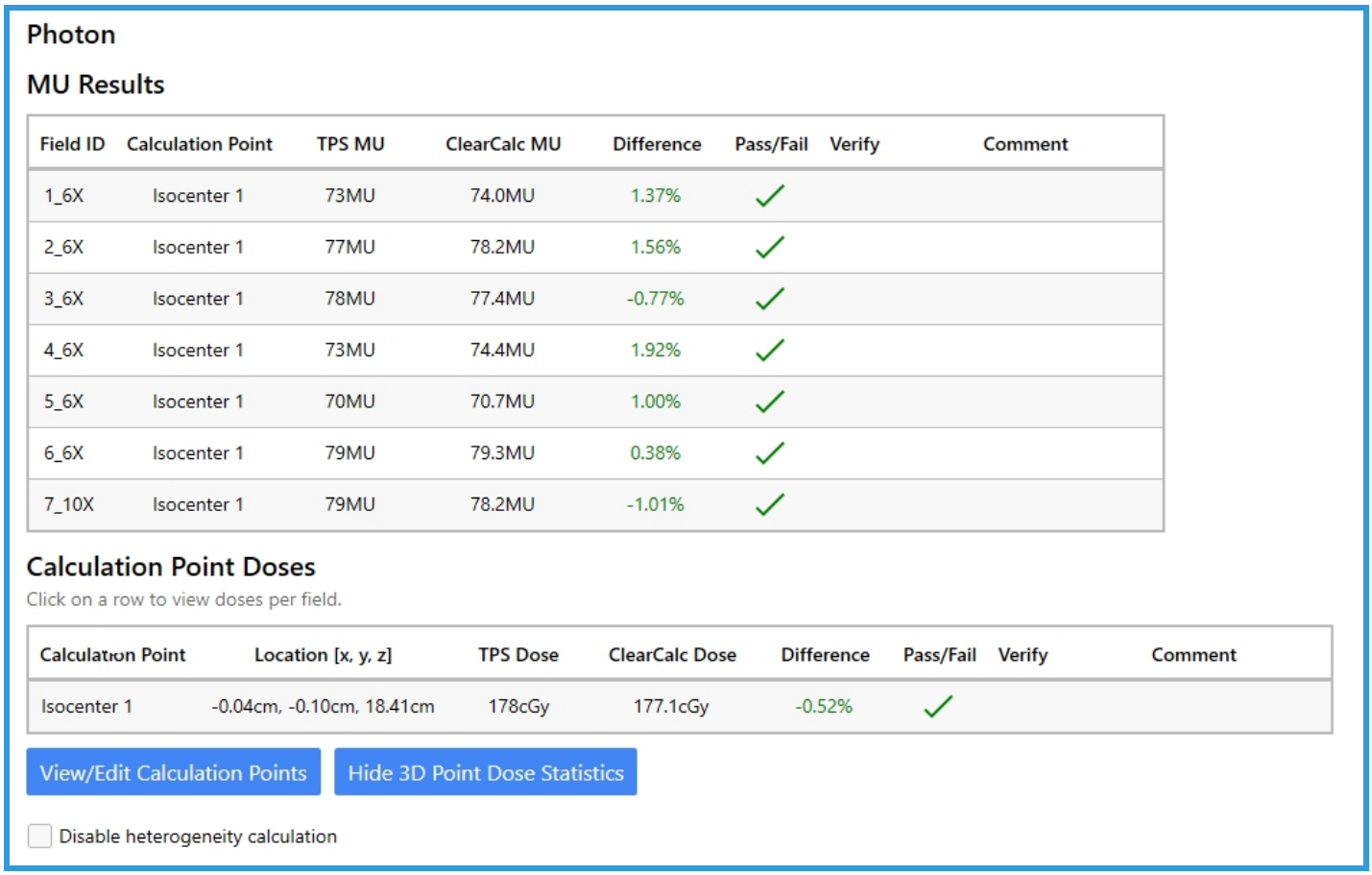
3. Overview of Left Sidebar for ClearCalc for External Beam Plan



Top to bottom:

1. Course ID
2. Plan ID
3. Prescription of plan in format: Dose per fraction x Number of Fractions = Total Dose
    a. Rx edit tool (Pencil icon): available in DICOM Standalone module only
4. Photon Tolerance ComboBox
    a. Displays auto-selected tolerance based on the properties of the analyzed plan. If desired, user can select a different tolerance from the ComboBox
5. RadMoneCarlo Settings (only visible/available with RadMonteCarlo license)
    a. Percent difference criteria
    b. Distance to Agreement criteria
    c. Low dose threshold
    d. Voxel sampling
    e. Update RadMonteCarlo Results button
6. Report ComboBox
    a. Default report is auto-selected. If desired, the user can select a different report template from the ComboBox
7. Result Comment test entry cell
8. Approve Results Button
    a. This is an optional view setting and may be activated by the user in ClearCalc Administration on the Settings tab
9. Current Approvals list
    a. When active, shows current approvals for open plan
10. Display Plan Profiles button
    a. Allows user to view the plan's Transverse, Sagittal, and Coronal profiles as well as toggle heterogeneity corrections on - this is aimed at assisting with troubleshooting and providing additional plan information

4. Overview of Center Window for FSPB Photon Plans

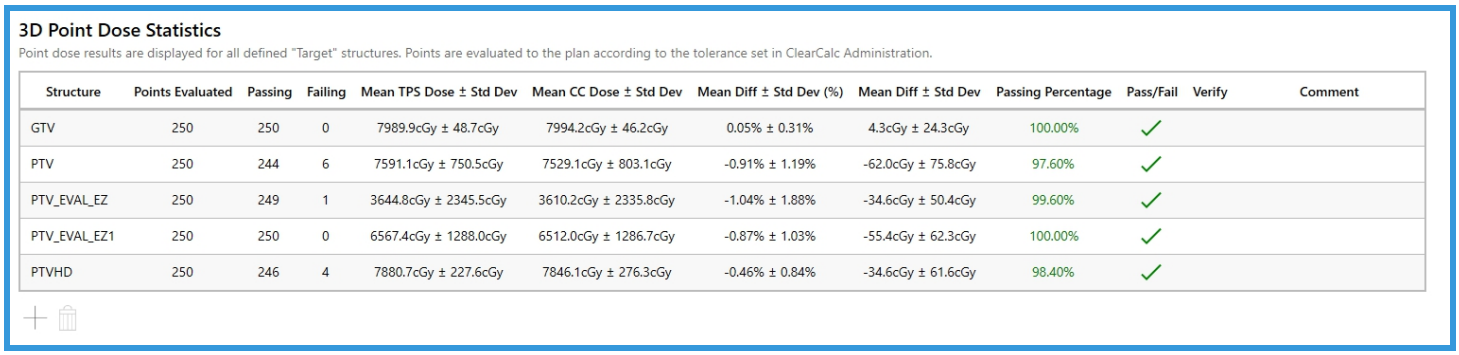


Top to bottom:

1. Photon Properties Section
2. MU Results table
    a. Hides for plan-dose-only plans and TomoTherapy plans, as beam-specific dose required for MU calculations)
3. Within the MU Results table:
    a. Field ID from Treatment Plan
    b. Calculation Point chosen by ClearCalc for the field
    c. MU from Treatment Planning System
    d. ClearCalc independently calculated MU
    e. Difference (percentage error = [(ClearCalc MU - TPS MU)/TPS MU]*100%)
    f. Pass/Fail Indication
    g. Verify OK Checkbox (Failing results only)
    h. MU Comment
4. Calculation Point Dose Table
    a. Displays the Calculation Points selected for fields in the ClearCalc analysis as well as those manually added by the user
    b. Calculation Point ID

c. Location (x, y, z) of respective calculation point
d. Treatment Planning System Dose to respective Calculation Point
e. ClearCalc independent dose to respective Calculation Point
f. Difference (percentage error = [(ClearCalc MU - TPS MU)/TPS MU]*100%)
g. Pass/Fail Indication
h. Verify OK Checkbox (Failing results only)
i. Calculation Point Comment
j. Clicking on any Calculation Point row displays a per-field subtable for each reference point - only when per-field MU/doses are available

5. Button to enter the photon ClearCalc Calculation Point Selection window - hides for SRS plans, as Isocenter is always used
6. Button to toggle 3D Point Dose Statistics table on/off
7. Toggle heterogeneity-corrected calculation on/off



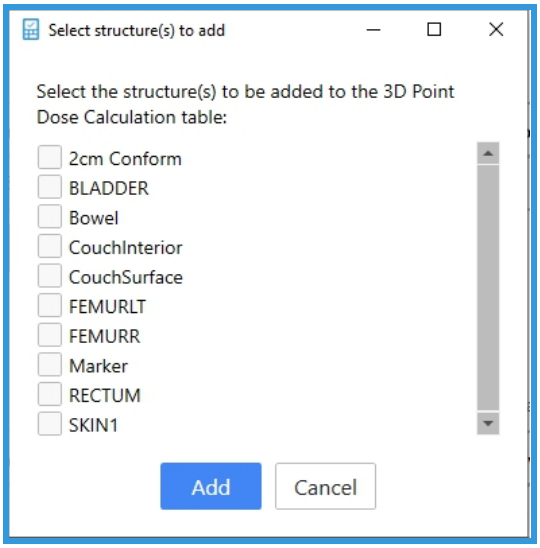
3D Point Dose Statistics

Point dose results are displayed for all defined "Target" structures. Points are evaluated to the plan according to the tolerance set in ClearCalc Administration.

Structure	Points Evaluated	Passing	Failing	Mean TPS Dose ± Std Dev	Mean CC Dose ± Std Dev	Mean Diff ± Std Dev (%)	Mean Diff ± Std Dev	Passing Percentage	Pass/Fail	Verify	Comment
GTV	250	250	0	7989.9cGy ± 48.7cGy	7994.2cGy ± 46.2cGy	0.05% ± 0.31%	4.3cGy ± 24.3cGy	100.00%	✓		
PTV	250	244	6	7591.1cGy ± 750.5cGy	7529.1cGy ± 803.1cGy	-0.91% ± 1.19%	-62.0cGy ± 75.8cGy	97.60%	✓		
PTV_EVAL_EZ	250	249	1	3644.8cGy ± 2345.5cGy	3610.2cGy ± 2335.8cGy	-1.04% ± 1.88%	-34.6cGy ± 50.4cGy	99.60%	✓		
PTV_EVAL_EZ1	250	250	0	6567.4cGy ± 1288.0cGy	6512.0cGy ± 1286.7cGy	-0.87% ± 1.03%	-55.4cGy ± 62.3cGy	100.00%	✓		
PTVHD	250	246	4	7880.7cGy ± 227.6cGy	7846.1cGy ± 276.3cGy	-0.46% ± 0.84%	-34.6cGy ± 61.6cGy	98.40%	✓		

8. 3D Point Dose Statistics Table (only displays if 3D Point Dose Statistics table is manually enabled or enabled by default in Administration)
    a. Analyzed Structure ID
        i. Table is pre-populated with structures of target types or containing target-type names (PTV, CTV, GTV) upon launching ClearCalc for the first time on a plan
    b. Total number of points evaluated in the referenced structure
    c. Passing points evaluated in the referenced structure (uses “Reference Point Tolerance” from Administration)
    d. Failing points evaluated in the reference structure (uses “Reference Point Tolerance” from Administration)
    e. Mean dose of the referenced structure from the TPS plan, with the standard deviation
    f. Mean dose of the referenced structure from the ClearCalc calculated dose, with the standard deviation
    g. Mean percentage dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure, with the standard deviation

h. Mean absolute dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure, with the standard deviation
i. Passing percentage of all evaluated points for the referenced structure (uses "3D Point Dose Tolerance" from Administration)
j. Pass/Fail Indication
k. Verify OK Checkbox (Failing results only)
l. 3D Point Dose Comment
m. Plus icon allows users to add additional structures from the plan to the table
    i. This will populate a window allowing the user to select the additional structures to add to the table



n. Trash can icon allows users to delete the highlighted structure from the table

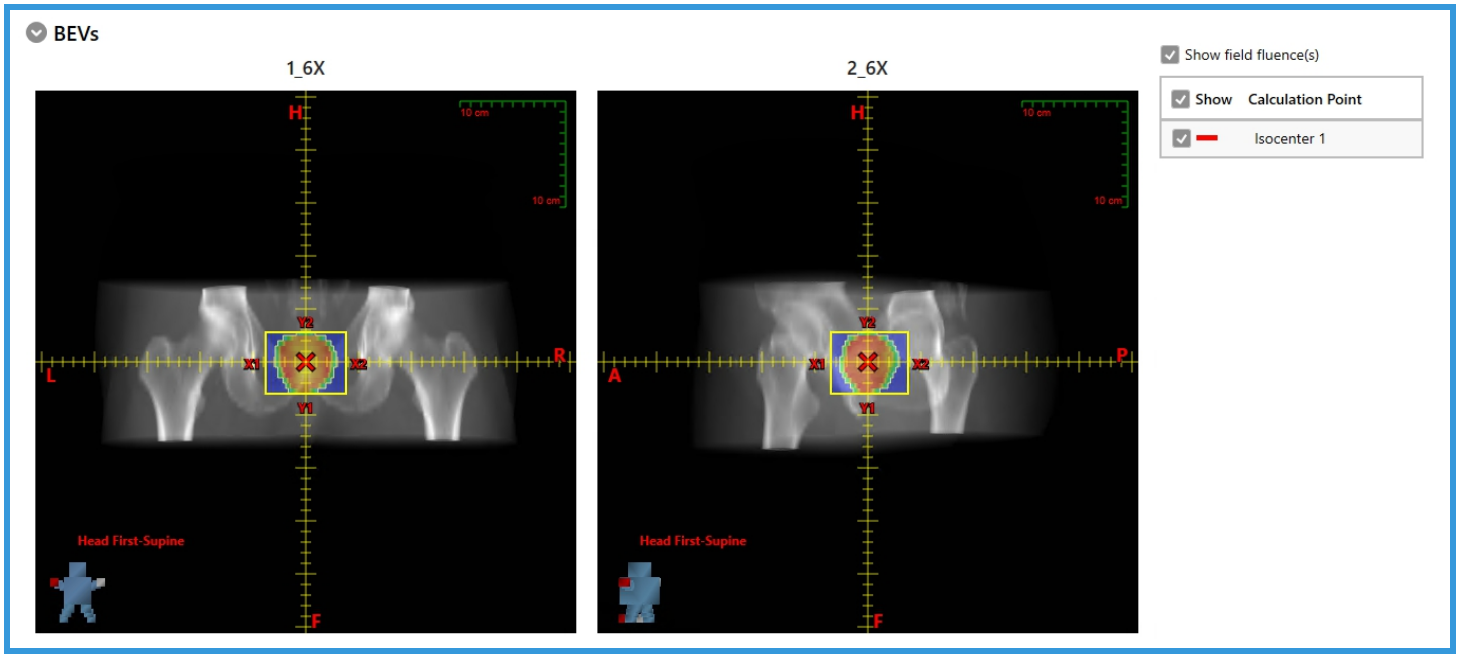
5. Overview of Calculation Parameters for FSPB Conventional Photon Plans

Calculation Parameters

Field ID	1_6X	2_6X
Machine ID	Eclipse CAP	Eclipse CAP
Energy	6X	6X
Gantry Rtn [deg]	226.0	50.0
Collimator Rtn [deg]	10.0	350.0
Table Rtn [deg]	0.0	0.0
Isocenter	Isocenter 1	Isocenter 1
Dose Calculation Point	Isocenter 1	ClearCalc Point 1
TPS MU	154.3	146.0
TPS Dose	132.5cGy	106.4cGy
ClearCalc Dose	136.6cGy	104.3cGy
X1 [cm]	+10.6	+10.6
X2 [cm]	-8.5	-8.5
Y1 [cm]	+6.0	+3.3
Y2 [cm]	-3.3	-6.0
MLC Model	Millennium 120	Millennium 120
MLC Plan Type	Static	Static
Wedge	-	-
Applicator	-	-
Tray	-	-
Block	-	-
Bolus	0.5cm Bolus	0.5cm Bolus
SSD [cm]	92.1	93.3
Depth [cm]	8.738	7.547
Equivalent Depth [cm]	8.486	7.042
SBD [cm]	91.2	92.4
PSSD [cm]	-	91.617
Point Depth [cm]	-	12.410
Point Equivalent Depth [cm]	-	12.183

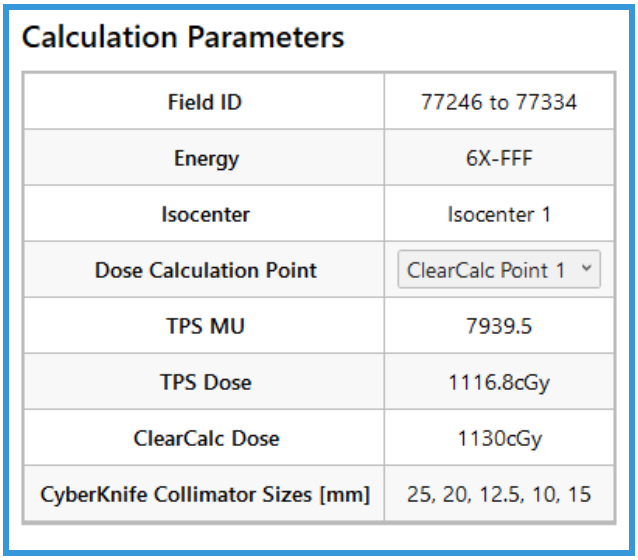
Top to bottom:

1. Field ID
2. Machine ID
3. Energy of field
4. Gantry parameter for field
5. Collimator parameter for field
6. Table Rtn parameter for field
7. Isocenter for field
8. Dose Calculation Point ComboBox
    a. Allows the user to toggle between all active Calculation Points for the plan for the respective field
9. TPS MU for field
10. TPS Dose per field, when available
11. ClearCalc Dose for field at the selected calculation point (empty for plan-dose-only plans)
12. X1 jaw setting
13. X2 jaw setting
14. Y1 jaw setting
15. Y2 jaw setting
16. MLC model for plan
17. MLC Plan type
18. Wedge ID (if present in plan)
19. Applicator ID (if present in plan)
20. Tray ID (if present in plan)
21. Block ID (if present in plan)
22. Bolus ID (if present in plan)
23. Source to Skin Distance of field, at arc start if applicable
24. Depth of isocenter, at arc start if applicable
25. Equivalent Depth of isocenter
26. Source to Bolus Distance of field, if bolus is linked to the field
27. Point SSD, if point other than isocenter is used for the field calculation
28. Point depth, if point other than isocenter is used for the field calculation
29. Point equivalent depth, if point other than isocenter is used for the field calculation



30. Beam's Eye View section
    a. Displays all field BEVS with options to toggle field fluence and Calculation Point overlays
    b. Beams' Eye View Section with Collapse/Expand arrow
    c. Field ID label for BEV
    d. Graticule overlay
    e. Field overlay with block or first control point outline
    f. Patient orientation
    g. Patient 3D view
    h. Patient orientation BEV labels
    i. Jaw label
    j. Diode reading location
    k. Image scale

6. Overview of Calculation Parameters for CyberKnife Photon Plans



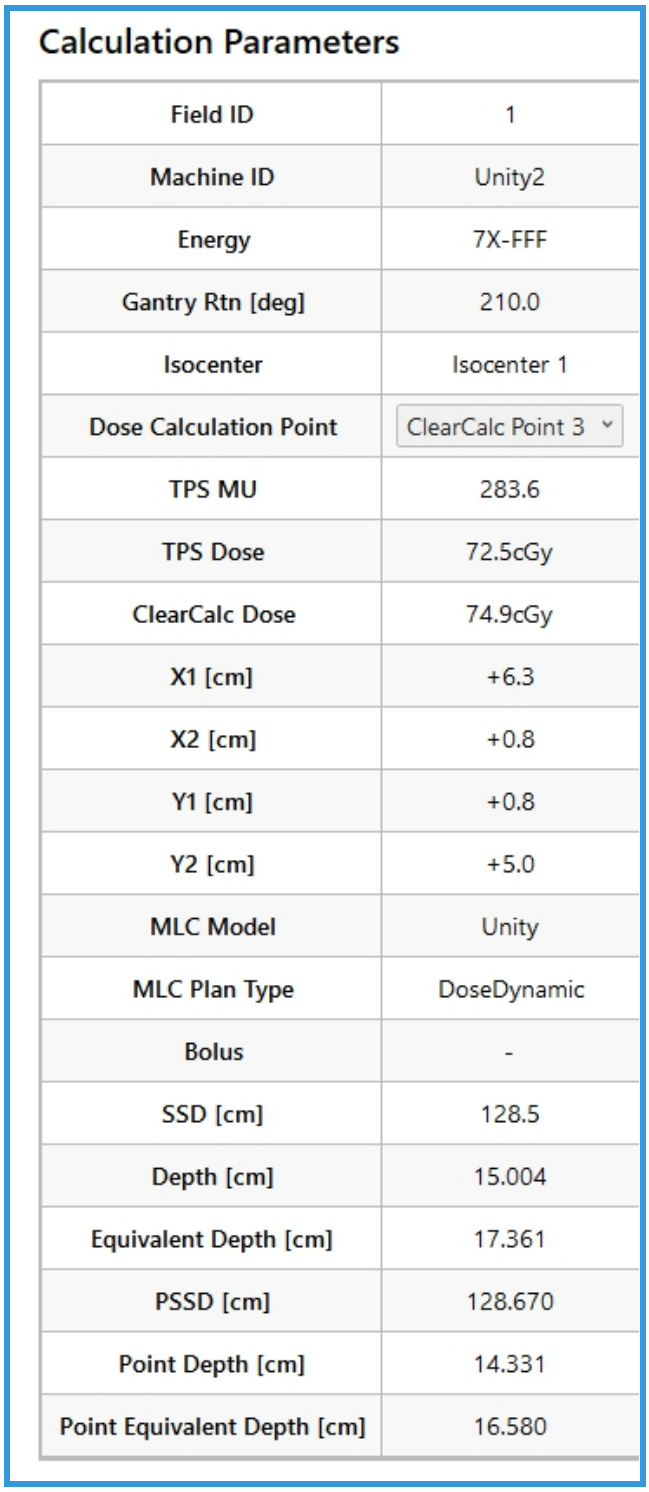
Calculation Parameters

Field ID	77246 to 77334
Energy	6X-FFF
Isocenter	Isocenter 1
Dose Calculation Point	ClearCalc Point 1
TPS MU	7939.5
TPS Dose	1116.8cGy
ClearCalc Dose	1130cGy
CyberKnife Collimator Sizes [mm]	25, 20, 12.5, 10, 15

Top to bottom:

1. Field ID
2. Energy of field
3. Isocenter
4. Dose Calculation Point ComboBox
5. TPS MU
6. TPS Dose
7. ClearCalc Dose of field for selected calculation point
8. CyberKnife Collimator Sizes for field

7. Overview of Calculation Parameters for FSPB Unity Plans



Calculation Parameters

Field ID	1
Machine ID	Unity2
Energy	7X-FFF
Gantry Rtn [deg]	210.0
Isocenter	Isocenter 1
Dose Calculation Point	ClearCalc Point 3
TPS MU	283.6
TPS Dose	72.5cGy
ClearCalc Dose	74.9cGy
X1 [cm]	+6.3
X2 [cm]	+0.8
Y1 [cm]	+0.8
Y2 [cm]	+5.0
MLC Model	Unity
MLC Plan Type	DoseDynamic
Bolus	-
SSD [cm]	128.5
Depth [cm]	15.004
Equivalent Depth [cm]	17.361
PSSD [cm]	128.670
Point Depth [cm]	14.331
Point Equivalent Depth [cm]	16.580

Top to bottom:

1. Field ID
2. Machine ID
3. Energy of field
4. Gantry parameter for field
5. Isocenter for field
6. Dose Calculation Point ComboBox
    a. Allows the user to toggle between all active Calculation Points for the plan for the respective field
7. TPS MU for field
8. TPS Dose per field, when available
9. ClearCalc Dose for field at the selected calculation point (empty for plan-dose-only plans)
10. X1 jaw setting
11. X2 jaw setting
12. Y1 jaw setting
13. Y2 jaw setting
14. MLC model for plan
15. MLC Plan type
16. Bolus ID (if present in plan)
17. Source to Skin Distance of field
18. Depth of isocenter
19. Equivalent Depth of isocenter
20. Source to Bolus Distance of field, if bolus is linked to the field (not displayed here since bolus is not present)
21. Point SSD, if point other than isocenter is used for the field calculation
22. Point depth, if point other than isocenter is used for the field calculation
23. Point equivalent depth, if point other than isocenter is used for the field calculation

8. Overview of Calculation Parameters for FSPB MRIdian Plans

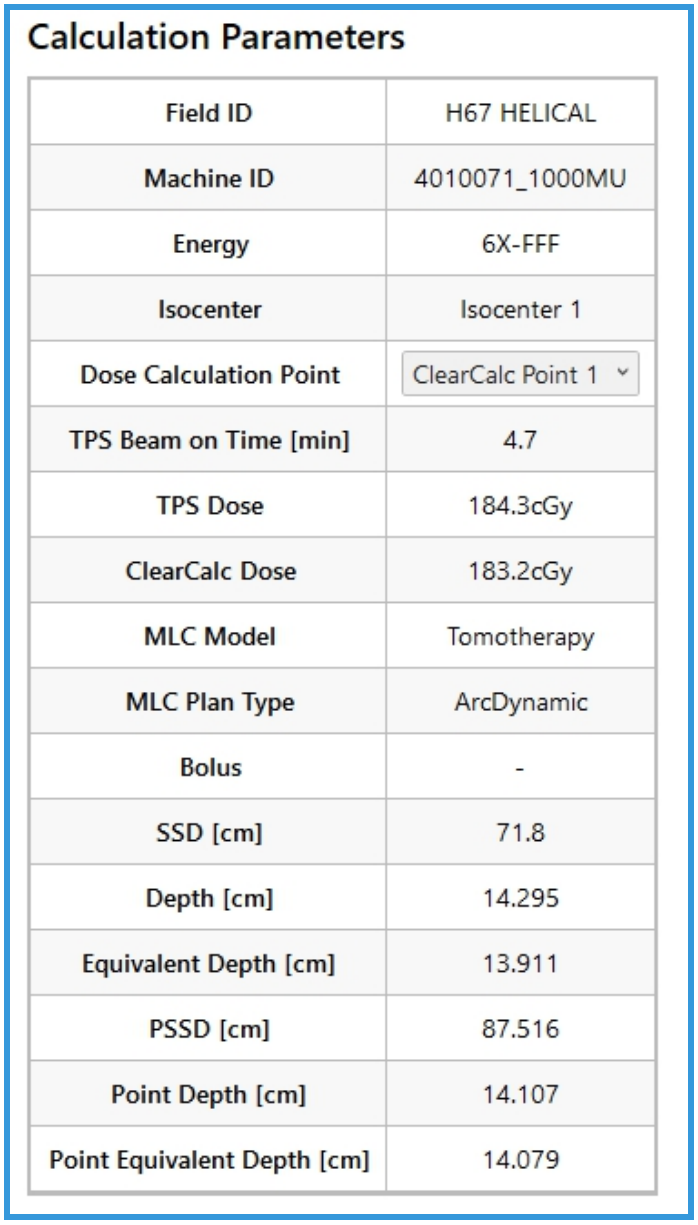
Calculation Parameters

Field ID	Beam 1_1
Machine ID	238
Energy	6X-FFF
Gantry Rtn [deg]	0.0
Isocenter	Isocenter 1
Dose Calculation Point	ClearCalc Point 1
TPS MU	585.8
ClearCalc Dose	128.8cGy
MLC Model	MRIdian
Bolus	-
SSD [cm]	73.5
Depth [cm]	16.480
Equivalent Depth [cm]	16.199
PSSD [cm]	73.526
Point Depth [cm]	12.132
Point Equivalent Depth [cm]	11.899

Top to bottom:

1. Field ID
2. Machine ID
3. Energy of field
4. Gantry parameter for field
5. Isocenter for field
6. Dose Calculation Point ComboBox
    a. Allows the user to toggle between all active Calculation Points for the plan for the respective field
7. TPS MU for field
8. ClearCalc Dose for field at the selected calculation point (empty for plan-dose-only plans)
9. MLC model for plan
10. Bolus ID (if present in plan)
11. Source to Skin Distance of field
12. Depth of isocenter
13. Equivalent Depth of isocenter
14. Source to Bolus Distance of field, if bolus is linked to the field (not displayed here since bolus is not present)
15. Point SSD, if point other than isocenter is used for the field calculation
16. Point depth, if point other than isocenter is used for the field calculation
17. Point equivalent depth, if point other than isocenter is used for the field calculation

9. Overview of Calculation Parameters for FSPB TomoTherapy Plan



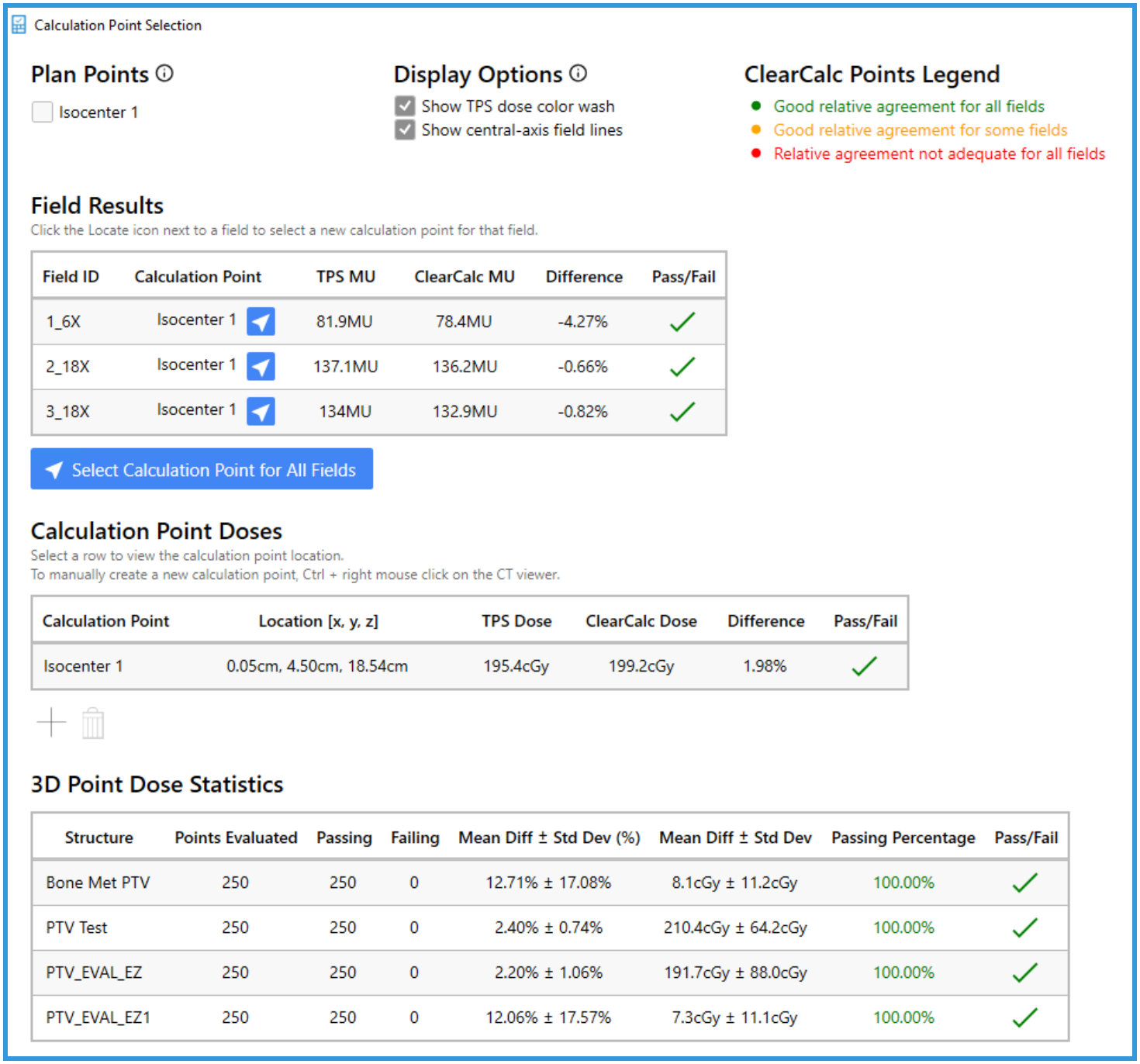
Calculation Parameters

Field ID	H67 HELICAL
Machine ID	4010071_1000MU
Energy	6X-FFF
Isocenter	Isocenter 1
Dose Calculation Point	ClearCalc Point 1
TPS Beam on Time [min]	4.7
TPS Dose	184.3cGy
ClearCalc Dose	183.2cGy
MLC Model	Tomotherapy
MLC Plan Type	ArcDynamic
Bolus	-
SSD [cm]	71.8
Depth [cm]	14.295
Equivalent Depth [cm]	13.911
PSSD [cm]	87.516
Point Depth [cm]	14.107
Point Equivalent Depth [cm]	14.079

Top to bottom:

1. Field ID
2. Machine ID
3. Energy of field
4. Isocenter for field
5. Dose Calculation Point ComboBox
    a. Allows the user to toggle between all active Calculation Points for the plan for the respective field
6. TPS Beam on Time for field
7. TPS Dose per field, when available
8. ClearCalc Dose for field at the selected calculation point (empty for plan-dose-only plans)
9. MLC model for plan
10. MLC Plan type
11. Bolus ID (if present in plan)
12. Source to Skin Distance of field
13. Depth of isocenter
14. Equivalent Depth of isocenter
15. Source to Bolus Distance of field, if bolus is linked to the field (not displayed here since bolus is not present in the field)
16. Point SSD, if point other than isocenter is used for the field calculation
17. Point depth, if point other than isocenter is used for the field calculation
18. Point equivalent depth, if point other than isocenter is used for the field calculation

10. Overview of Photon Calculation Point Selection Window for FSPB Photon Plans (not available for cone SRS plans due to TMR-based calculation)

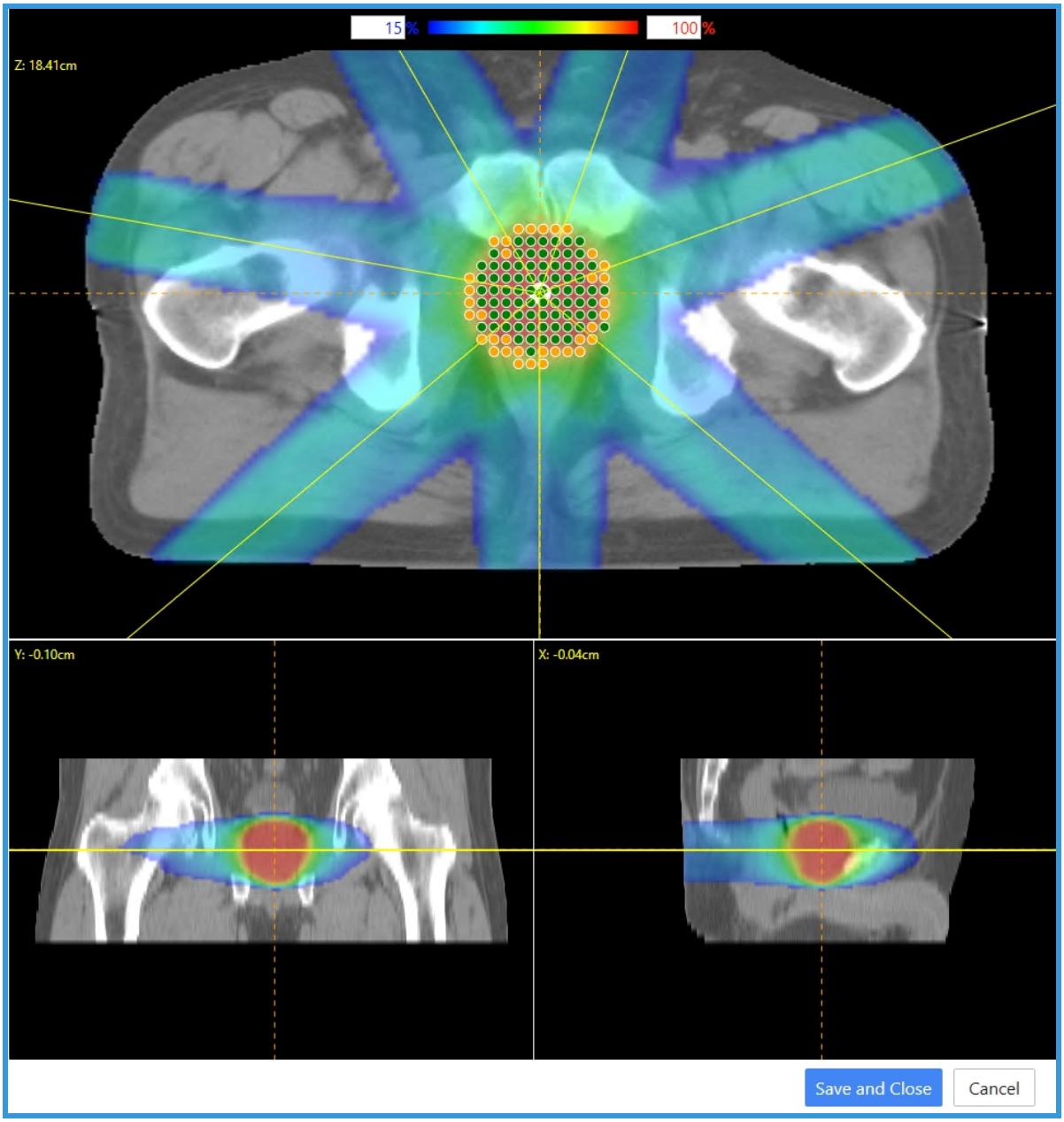


Top to bottom:

1. Plan Points from Eclipse (CheckBox to toggle on/off)
2. Display Options for 3-view CT overlay of TPS dose and CAX field lines
3. Legend for color-coded ClearCalc created calculation points
    a. Green indicates that all fields pass at the relative MU tolerance set in Admin for the displayed point

   b. Yellow indicates that some fields pass at the relative MU tolerance set in Admin for the displayed point
   c. Red indicates that no fields pass at the relative MU tolerance set in Admin for the displayed point
4. Field MU Results table (copied from main UI as applicable)
   a. Field ID from Eclipse
   b. Calculation Point auto-chosen by ClearCalc for field
   c. "Locate icon" allows the user to choose a new calculation point for the single, respective field (button colors orange when active)
      i. To choose a new calculation point, after activating the "Locate" icon, click on any point displayed on the CT to switch to that point
   d. TPS MU (hides for plan-dose-only plans)
   e. ClearCalc independently calculated MU (hides for plan-dose-only plans)
   f. Difference, percentage error = [(ClearCalc MU - TPS MU)/TPS MU]*100% (hides for plan-dose-only plans)
   g. Pass/Fail results from main UI (hides for plan-dose-only plans)
5. Select Calculation Point for All Fields button allows the user to choose a new calculation point for all fields on the CT view (button colors orange when active)
   a. To choose a new calculation point, after activating the button, click on any point displayed on the CT to switch to that point
6. Calculation Point Doses table (copied from main UI as applicable)
   a. Calculation Point ID
      i. Except for points named in the plan, these names are editable by the user
   b. Location of Calculation Point
   c. TPS Dose
   d. ClearCalc independently-calculated dose
   e. Difference (percentage error = [(ClearCalc Dose - TPS Dose)/TPS Dose]*100%)
   f. Pass/Fail results from main UI
   g. Plus icon allows user to add additional points to the Calculation Point to the table
   h. Trash can icon allows user to delete the highlighted point row from table
7. 3D Point Dose Statistics Table (copied from the main UI and only displays if 3D Point Dose Statistics table is enabled in main UI results)
   a. Analyzed Structure ID
      i. Table is only populated with structures displaying in the main results UI
   b. Total number of points evaluated in the referenced structure
   c. Passing points evaluated in the referenced structure (uses "Reference Point Tolerance" from Administration)
   d. Failing points evaluated in the reference structure (uses "Reference Point Tolerance" from Administration)

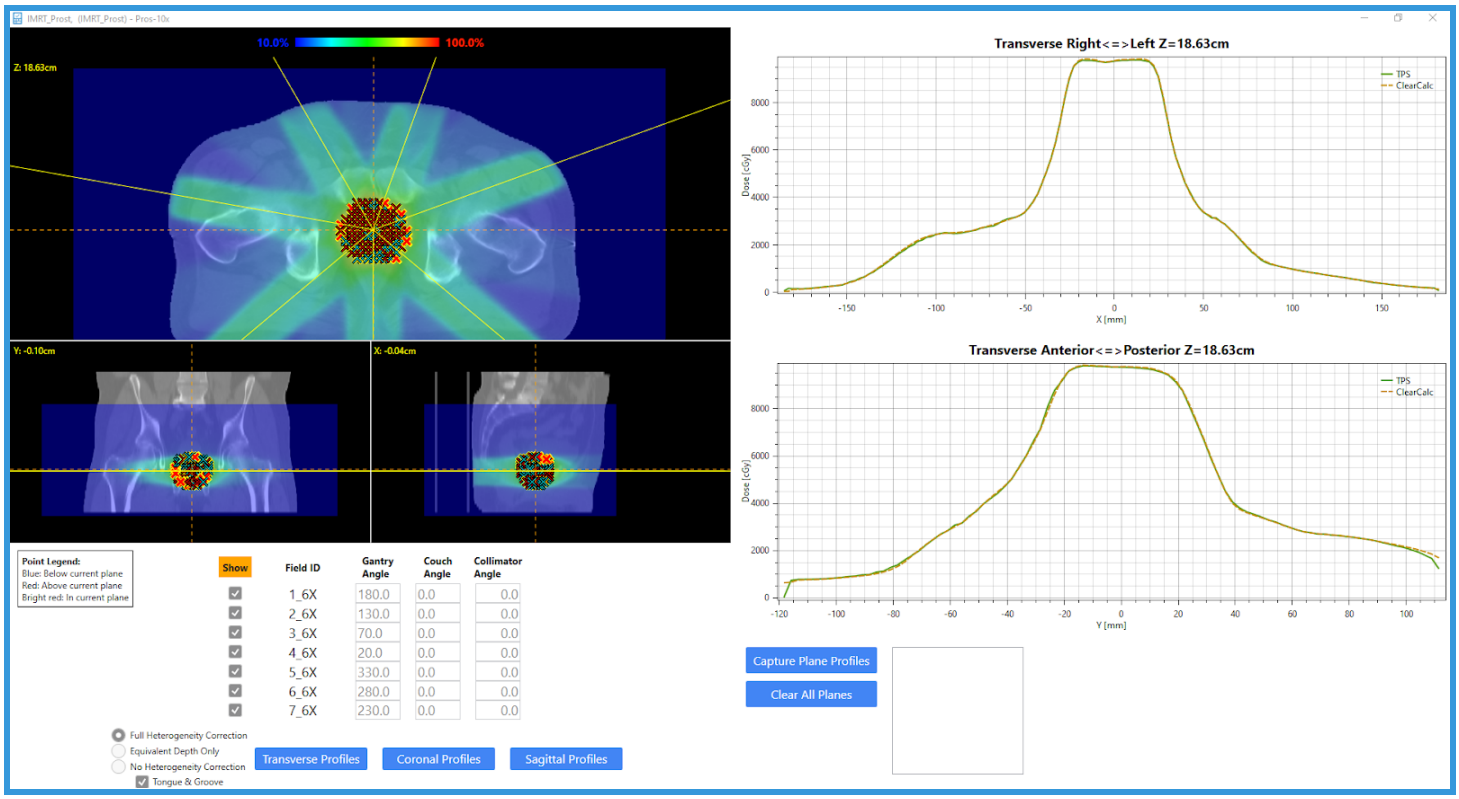
e. Mean percentage dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure, with the standard deviation
f. Mean absolute dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure, with the standard deviation
g. Passing percentage of all evaluated points for the referenced structure (uses “3D Point Dose Tolerance” from Administration)
h. Pass/Fail Indication



8. CT 3-view of patient's RTImage files including display edit options:
    a. Scroll: mouse wheel

   b. Zoom: CTRL + scroll
   c. Pan: CTRL + drag
9. Dose color wash heat map overlay from Treatment Planning System
   a. User-editable range via text boxes
10. ClearCalc generated calculation point (shown color-coded)
   a. Create new point: CTRL + right mouse click at desired location
11. White point surround showing point chosen for display for calculation point
12. Image location crosshairs (dotted yellow line - grab and drag)
13. Isocenter cross hairs (solid yellow line)
   a. When a field is selected in the MU Results table, the isocenter crosshair line will display bold,if applicable
14. Image location (X, Y, Z) show at the upper left corner of each CT view (in IEC61217 coordinates)
15. Save and Close button saves all changes made to calculation points and then closes the Calculation Point Selection window and returns to the main UI results
16. Cancel button closes lose the Calculation Point Selection window without making any changes and returns to the main UI results
17. 3D Point Dose Statistics Table (only displays if 3D Point Dose Statistics table is displaying in the main UI results prior to entering the Calculation Point Selection Window)
   a. Structure ID analyzed
   b. Total number of points evaluated in the referenced structure
   c. Points evaluated in the referenced structure (uses “Reference Point Tolerance” from Administration)
   d. Failing points evaluated in the reference structure (uses “Reference Point Tolerance” from Administration)
   e. Mean percentage dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure with the standard deviation
   f. Mean absolute dose difference between the TPS plan and the ClearCalc value for each evaluated point dose in the referenced structure with the standard deviation
   g. Passing percentage of all evaluated points for the referenced structure (uses “3D Point Dose Tolerance” from Administration)
   h. Pass/Fail Indication

11. Overview of Display Plan Profiles Window for FSPB Photon Plans (not available for cone SRS plans due to TMR-based calculation)



Left:

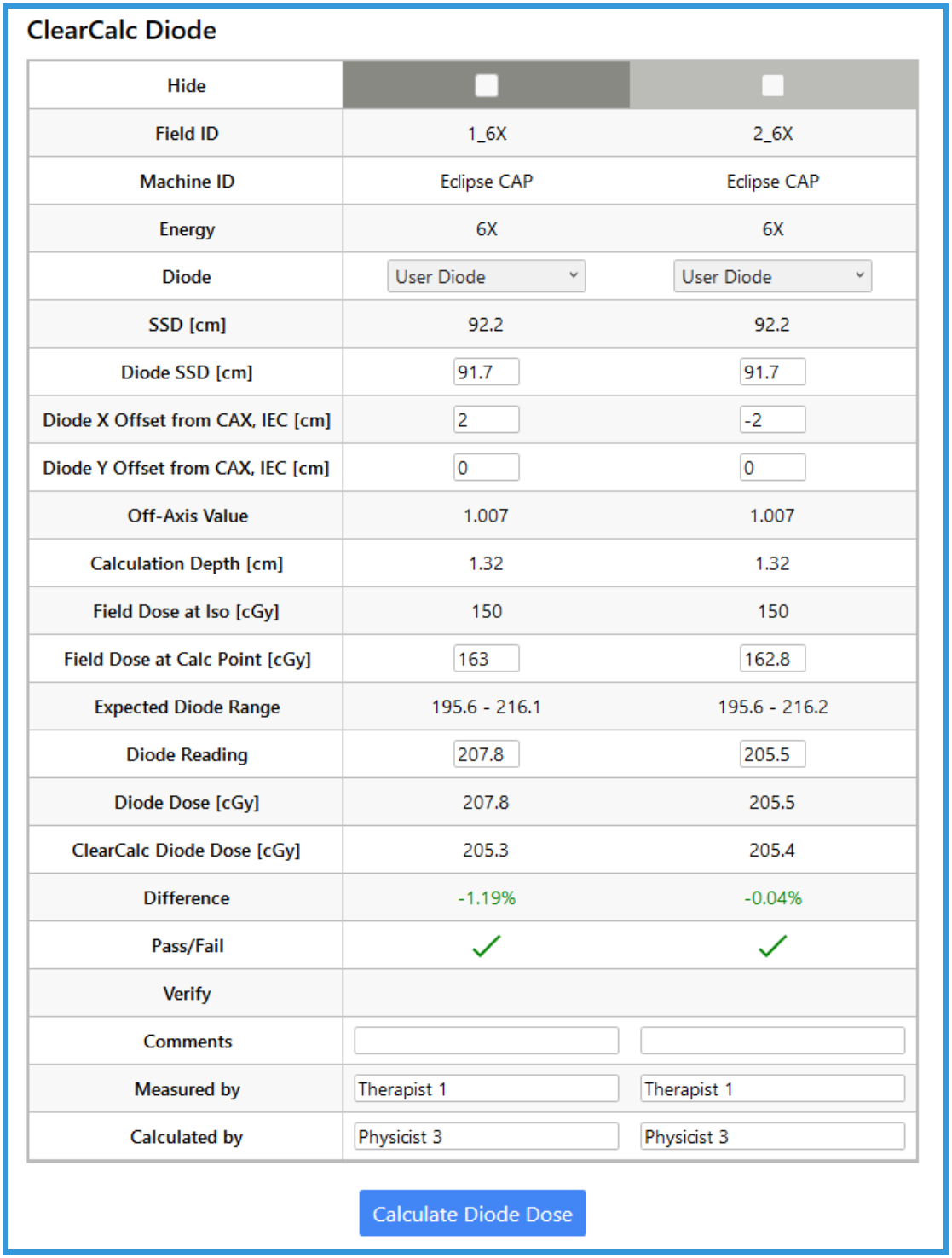
1. 3-view CT overlay of ClearCalc dose, CAX field lines, and dose plane profile points
2. Point Legend:
    a. Blue points: inferior to current plane
    b. Red points: superior to current plane
    c. Bright red points: in current view plane
3. Treatment fields DataGrid (read only)
    a. Show/hide field(s)
    b. Field ID
    c. Gantry angle
    d. Couch angle
    e. Collimator Angle
4. Toggle calculation options
    a. Full Heterogeneity Correction
    b. Equivalent Depth Only
    c. No Heterogeneity Correction
    d. Tongue & Groove effect
5. Dose Plane Profile view options
    a. Transverse Profile: displays patient right-left and anterior-posterior dose plane profiles

b. Coronal Profile: displays patient right-left and inferior-superior dose plane profiles
c. Sagittal Profile: displays anterior-posterior and inferior-superior dose plane profiles

Right:

6. 2-view dose plan profile view: Displays ClearCalc and TPS dose plane profiles. Clicking in the graph region enables a cursor tool that displays point dose and percent differences
7. Capture Plan Profiles button: Screen captures the currently displayed 3-view CT overlay and dose plan profiles graphs. The user may continue to select new plane profiles, choose the desired view (Transverse, Coronal, or Sagittal), capture new plane profiles, and results will sequentially populate the list window
8. Clear All Planes: deletes all dose plane profiles from the list window
9. List Window: displays captured plan profiles in sequential order
    a. Captured profiles can be printed to PDF reports or sent to ClearCheck reports, per report template settings

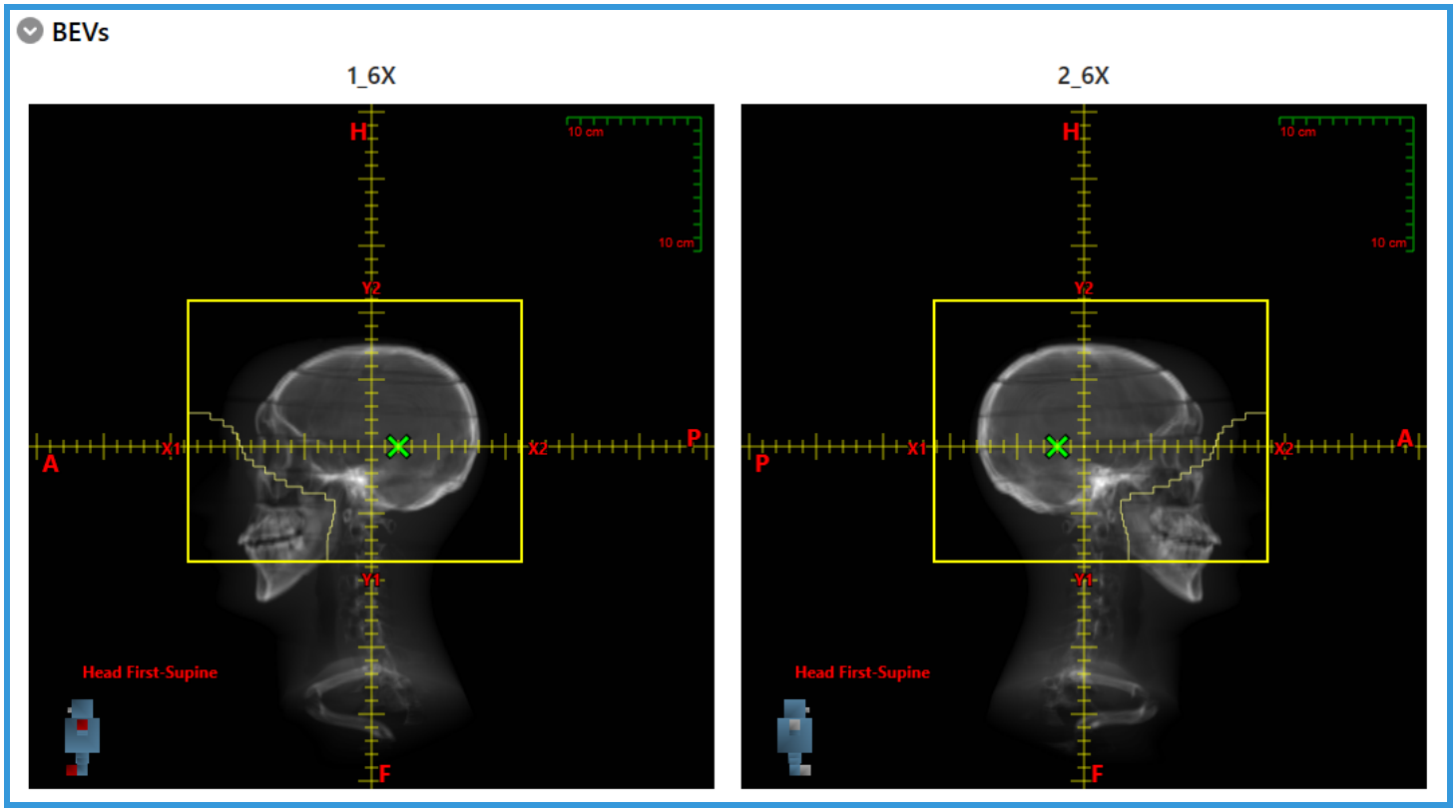
11. Overview Center Window for Photon Diode Module



Top to bottom:

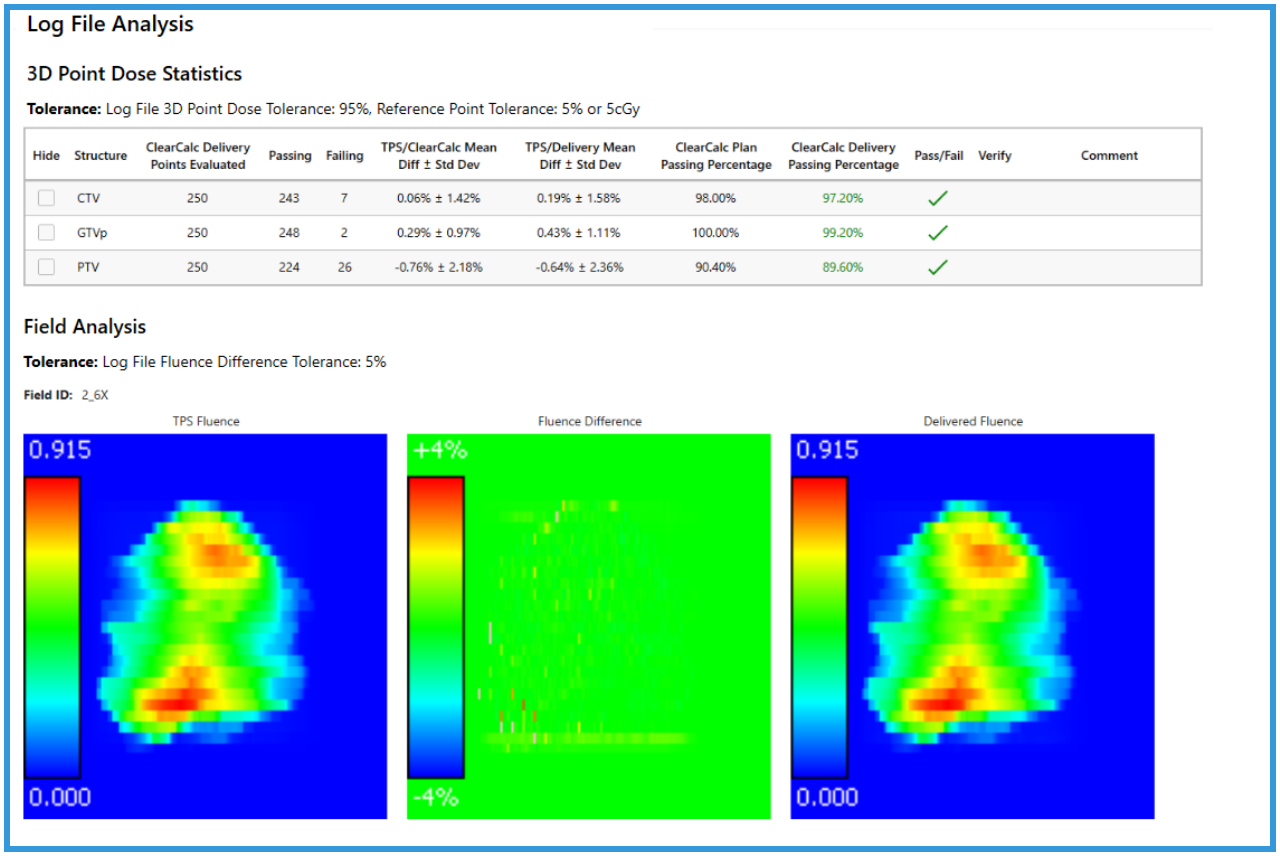
1. ClearCalc Diode DataGrid Heading
2. Hide CheckBox allows user to hide the field from Diodes results view/PDF
3. Field ID
4. Machine ID

5. Energy
6. Diode ComboBox (options available are only those diodes configured in Admin)
7. SSD
8. Diode SSD (factors in Diode diameter to SSD), editable
9. Diode off-axis distance, X-direction
    a. Set to zero for CAX measurements
    b. Off axis directions are user-view oriented
        i. Positive values will move the off-axis location to the up/right
        ii. Negative values will move the off-axis location to the down/left
10. Diode off-axis distance, X-direction
    a. Set to zero for CAX measurements
    b. Off axis directions are user-view oriented
        i. Positive values will move the off-axis location to the up/right
        ii. Negative values will move the off-axis location to the down/left
11. Off-axis value (determined by ClearCalc based on the profile data for the machine in Admin
12. Calculation depth (calculated at d_{max} set in Admin)
13. Field dose at Iso
14. Field Dose at Calc Point (only displays if offset for X, Y, or X/Y is anything other than 0)
15. Expected Diode reading (based on the estimated ClearCalc dose and the diode tolerance set in Admin)
    a. The “Calculate Diode Dose” button must be pressed to display this value
16. Diode Reading (user-entered)
17. Diode dose (= Diode Reading x Diode Conversion Factor (set in Admin) x Diode Correction Factor (set in Admin)
18. ClearCalc Diode dose (dose calculated to d_{max} dose for SSD with ClearCalc FSPB for the field)
19. Difference (percentage error = [(ClearCalc Diode Dose - Diode Reading Dose)/Diode Dose Reading] * 100%)
20. Pass/Fail Indication
21. Verify OK Checkbox (Failing results only)
22. Diode Dose Comment
23. Measured By entry
24. Calculated By entry
25. Calculate Diode Dose button to perform diode calculation



26. Beams' Eye View Section with Collapse/Expand arrow
    1. Field ID label for BEV
    a. Graticule overlay
    b. Field overlay with block or first control point outline
    c. Patient orientation
    d. Patient 3D view
    e. Patient orientation BEV labels
    f. Jaw label
    g. Diode reading location
    h. Image scale

12. Overview of Log File Analysis for Photons Plans with Supported Log Files



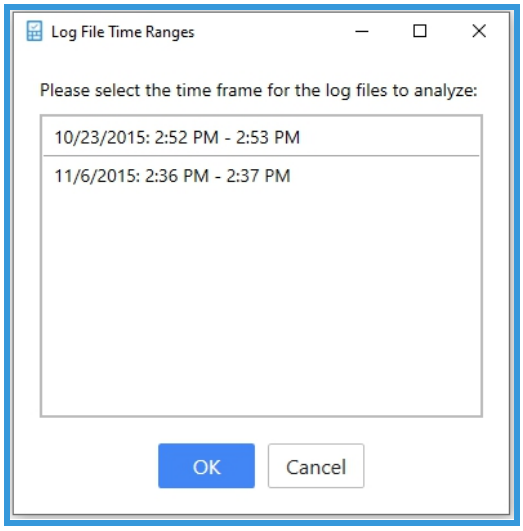
Top to Bottom:

1. 3D Point Dose Statistics
    a. Tolerance criteria displayed from Administration: Log File 3D Point Dose Tolerance, Reference Point Tolerance
    b. 3D Point Dose Statistics Table (only displays if 3D Point Dose Statistics table is manually enabled or enabled by default in Administration)
        i. Hide CheckBox allows user to hide the row from Log File Analysis results view and PDF report
        ii. Analyzed Structure ID: Table is pre-populated with structures of target types or containing target-type names (PTV, CTV, GTV) upon launching ClearCalc for the first time on a plan
        iii. Total number of points evaluated in the referenced structure for the delivery
        iv. Passing points evaluated in the referenced structure for the delivery, uses “Log Files Tolerance” from Administration
        v. Failing points evaluated in the reference structure
        vi. Mean percentage dose difference between the TPS plan and the ClearCalc calculation for each evaluated point dose in the referenced structure, with the standard deviation

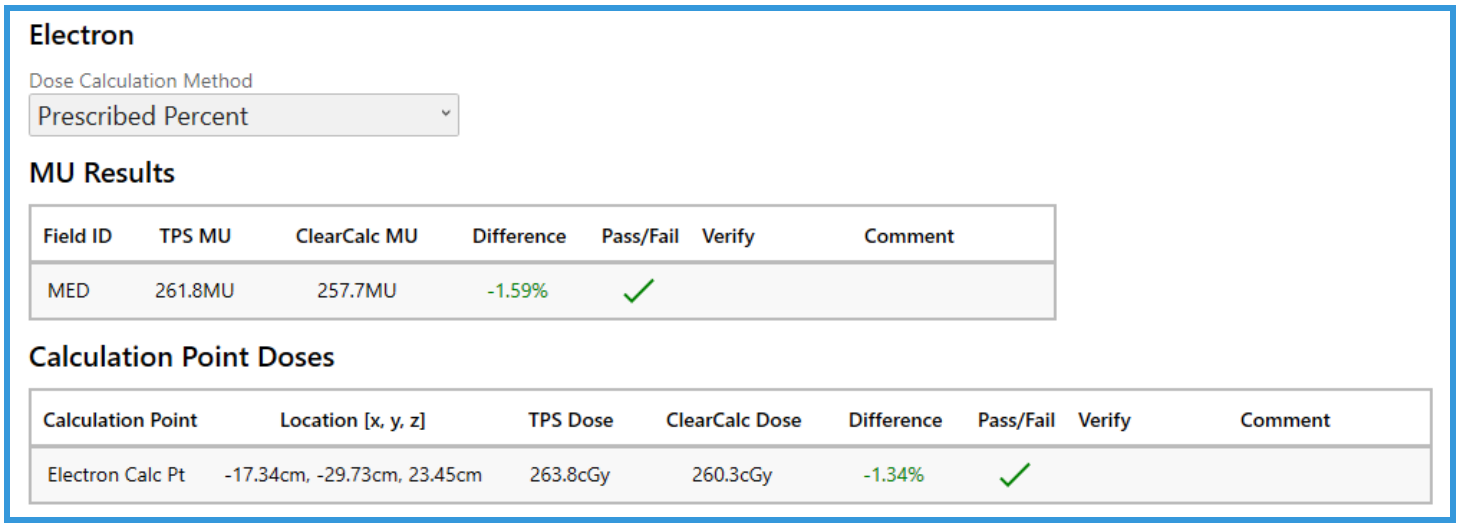
vii. Mean absolute dose difference between the TPS plan and the ClearCalc Delivery calculation for each evaluated point dose in the referenced structure, with the standard deviation
viii. ClearCalc Plan Passing Percentage: Passing percentage of all ClearCalc Plan points compared to TPS
ix. ClearCalc Delivery Passing Percentage: Passing percentage of all log file evaluated points for the referenced structure using the log files compared to TPS
x. Pass/Fail Indication
xi. Verify OK Checkbox (Failing results only)
xii. Log File Analysis Comment

2. Field Analysis
    a. Tolerance criteria displayed from Administration: Log File Fluence Difference Tolerance
    b. Field ID
    c. Fluence Analysis Graphic: A field-by-field graphic analysis displays the TPS generated fluence map (Left), and Delivered fluence map (Right). In between, a color-coded map displays the percent difference between the TPS and Delivered fluence maps.

Note: When multiple log file sets match the patient and plan loaded, ClearCalc will populate a window that allows the user to choose the corresponding log file set to utilize for analysis

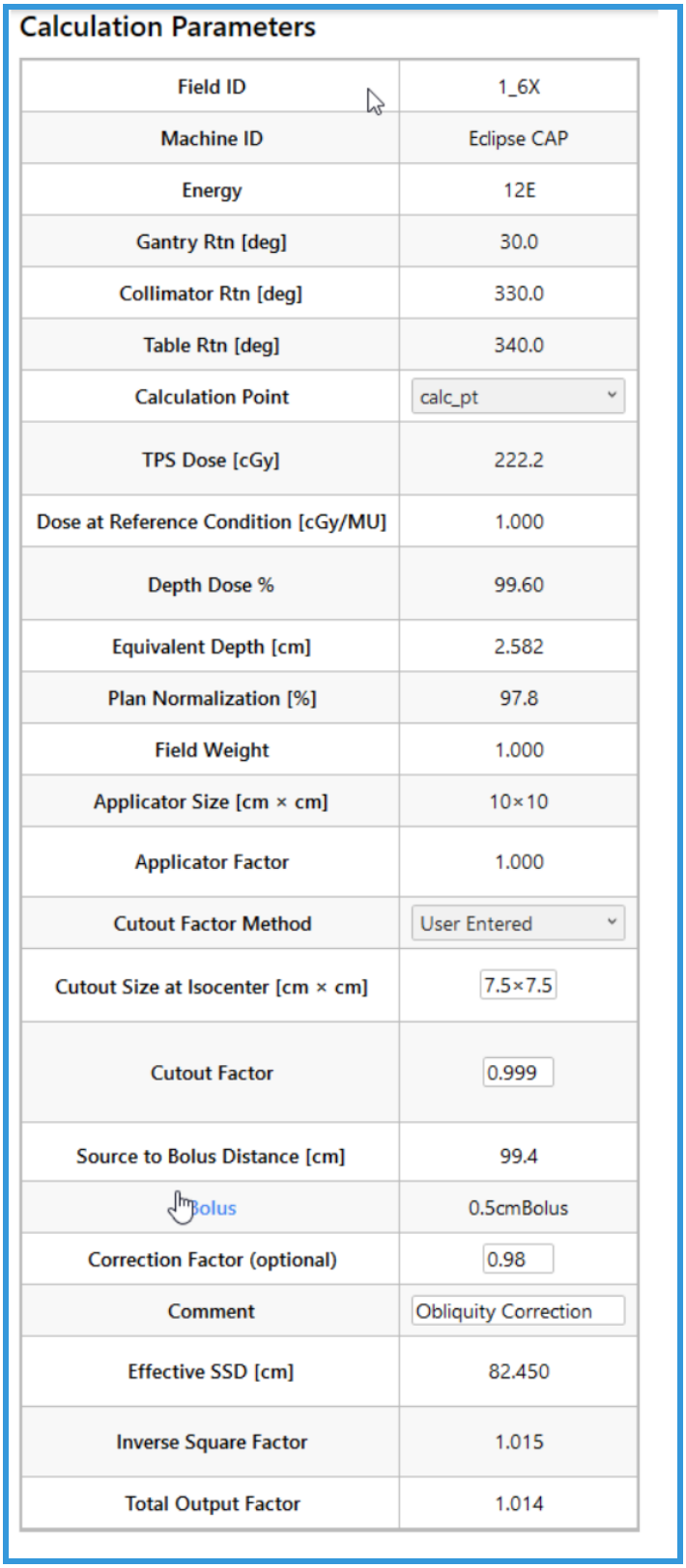


13. Overview Center Window for TG-71 Electron Plans



1. Electron Properties Section
2. Dose Calculation Method ComboBox, Prescribed Percent or Calculation Point
3. MU Results table
    a. Field ID from Treatment Plan
    b. MU from Treatment Planning System
    c. ClearCalc independently calculated MU
    d. MU Difference (percentage error = [(ClearCalc MU - TPS MU)/TPS MU] * 100%)
    e. Pass/Fail Indication
    f. Verify OK Checkbox (Failing results only)
    g. MU Comment
4. Calculation Point Dose Table displaying point(s) utilized for calculation (this table displays only if enabled in Admin)
    a. Calculation Point ID from Treatment Plan
    b. Location (x, y, z) of respective calculation point from Treatment Plan
    c. Treatment Planning System dose to respective Calculation Point
    d. ClearCalc independent dose to respective Calculation Point
    e. Dose Difference (percentage error = [(ClearCalc MU - TPS MU)/TPS MU] * 100%)
    f. Pass/Fail Indication
    g. Verify OK Checkbox (Failing results only)
    h. Calculation Point Comment

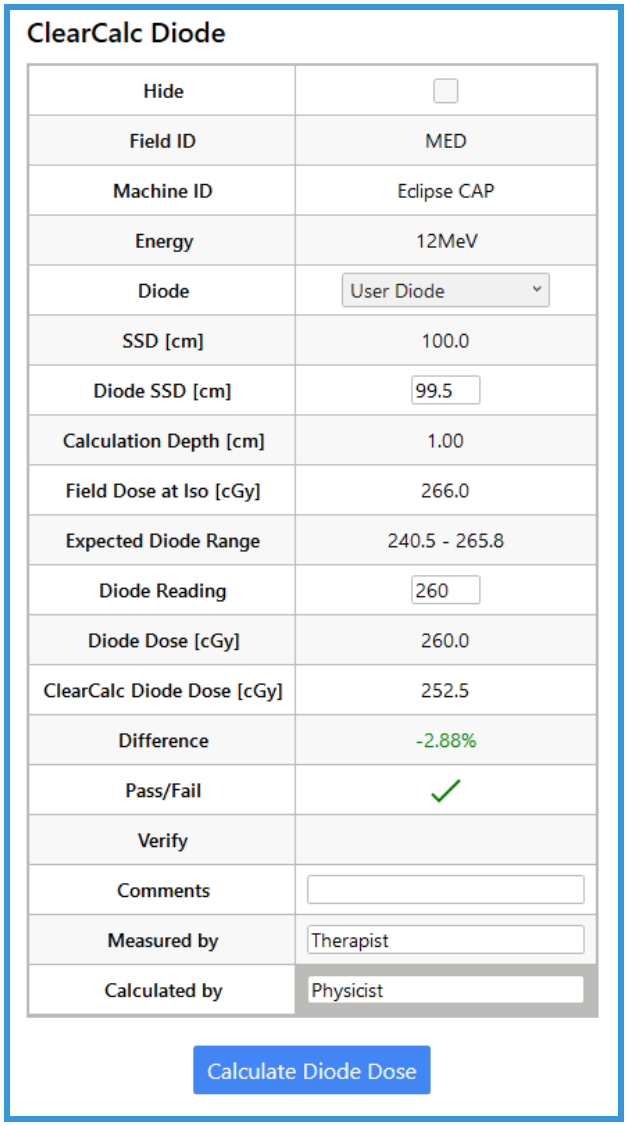
14. Overview of Calculation Parameters for TG-71 Electron Plans

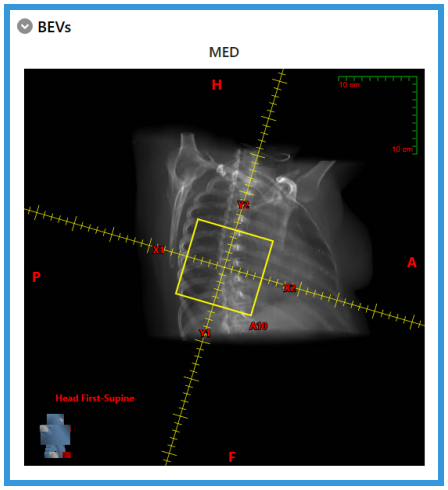


Top to Bottom:

1. Field ID
2. Machine ID
3. Energy of field
4. Gantry parameter for field
5. Collimator parameter for field
6. Table Rtn parameter for field
7. Calculation Point ComboBox - populates all calculation points with a location from the plan (hides for Prescribed Percentage calculation)
8. TPS Dose for field
9. Dose at Reference Condition
10. Depth Dose %, editable for Prescribed Percent dose calculations only
11. Equivalent depth, when based on Depth Dose % does not account for heterogeneities
12. Plan Normalization value
13. Field Weight
14. Applicator size from plan
15. Applicator Factor from ClearCalc Admin
16. Cutout Factor Method ComboBox
    a. Sector Integration: independent calculation by ClearCalc of cutout area using sector integration over the cutout shape
    b. User Entered: user may manually enter the cutout factor they measure
    c. Cutout Factor Library: user may choose from the selection of entered codes in ClearCalc Admin for the machine/energy/applicator
17. Cutout Size at Isocenter: editable for User Entered; hides for Sector Integration; changes to Cutout Code ComboBox for Cutout Library
18. Cutout Factor: manual entry for User Entered; hides for Sector Integration; displays value from Admin for selected code in Cutout Factor Library
19. Source to Skin Distance from plan
20. Source to Bolus Distance, if applicable
21. Bolus ID from plan
22. Correction Factor, optional manual value entry
23. Comment, optional free-entry text
24. Effective SSD (displays for Effective SSD inverse square correction method only, otherwise hides)
25. Inverse Square Factor, calculated
26. Total output factor used in calculation

15. Overview of Center Window for Electron Diode Module

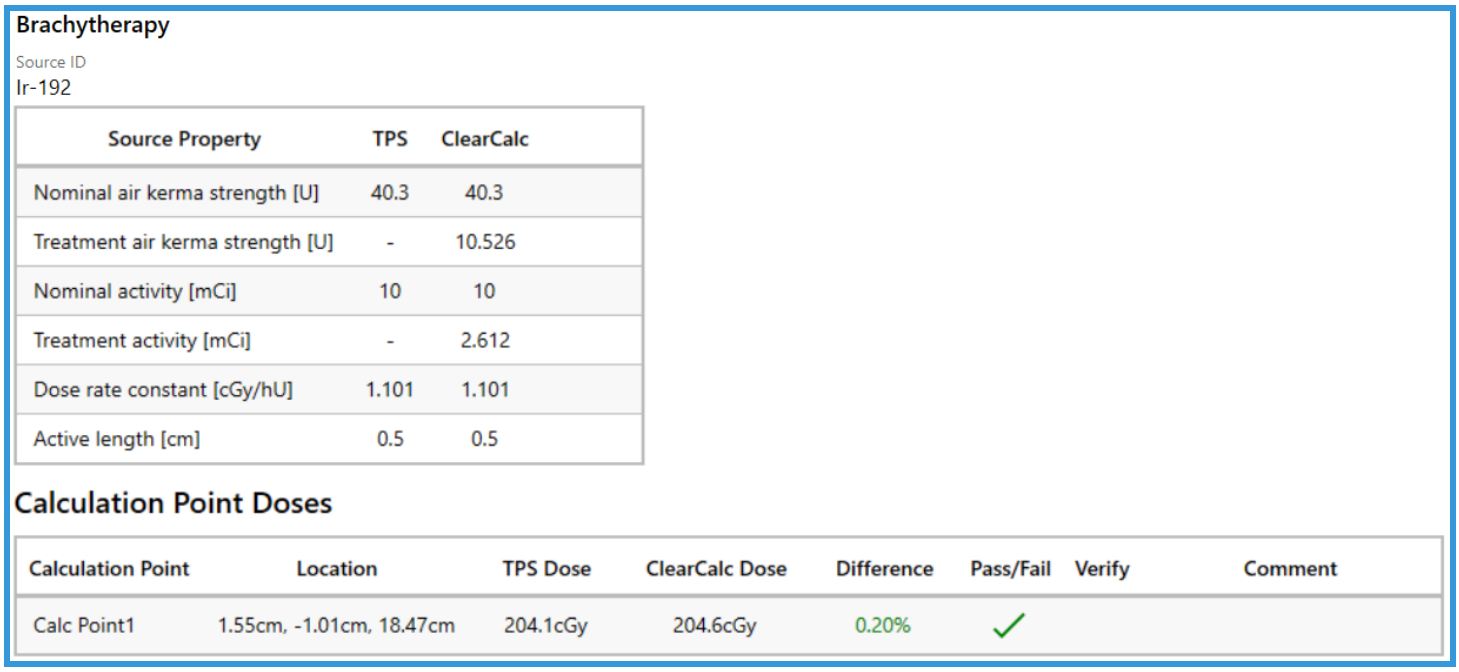




Top to Bottom:

1. Hide CheckBox, allows user to hide the field from Diodes results view/PDF
2. Field ID
3. Machine ID
4. Energy
5. Diode ComboBox (only displaying those diodes set up in Admin for the field configuration)
6. SSD
7. Diode SSD (factors in Diode diameter to SSD), editable
8. Calculation depth (calculated at d_{max} dose set in Admin)
9. Field dose at Isocenter
10. Expected Diode reading, based on the estimated ClearCalc dose and the diode tolerance set in Admin (the Calculate Diode Dose button must be pressed to display this value)
11. Diode Reading (user-entered)
12. Diode dose (= Diode Reading x Diode Conversion Factor (set in Admin) x Diode Correction Factor (set in Admin)
13. ClearCalc Diode dose (dose calculated to d_{max} dose for SSD with ClearCalc FSPB for the field)
14. Difference (percentage error = [(ClearCalc Diode Dose - Diode Reading Dose)/Diode Dose Reading] * 100%)
15. Pass/Fail Indication
16. Verify OK Checkbox (Failing results only)
17. Diode Dose Comment
18. Measured By entry
19. Calculated By entry
20. Calculate Diode Dose button to perform diode calculation
21. BEV section for Electron Field BEV display for respective diodes

16. Overview of Center Window for Brachytherapy Plans with Reference Point



Brachytherapy

Source ID
Ir-192

Source Property	TPS	ClearCalc
Nominal air kerma strength [U]	40.3	40.3
Treatment air kerma strength [U]	-	10.526
Nominal activity [mCi]	10	10
Treatment activity [mCi]	-	2.612
Dose rate constant [cGy/hU]	1.101	1.101
Active length [cm]	0.5	0.5

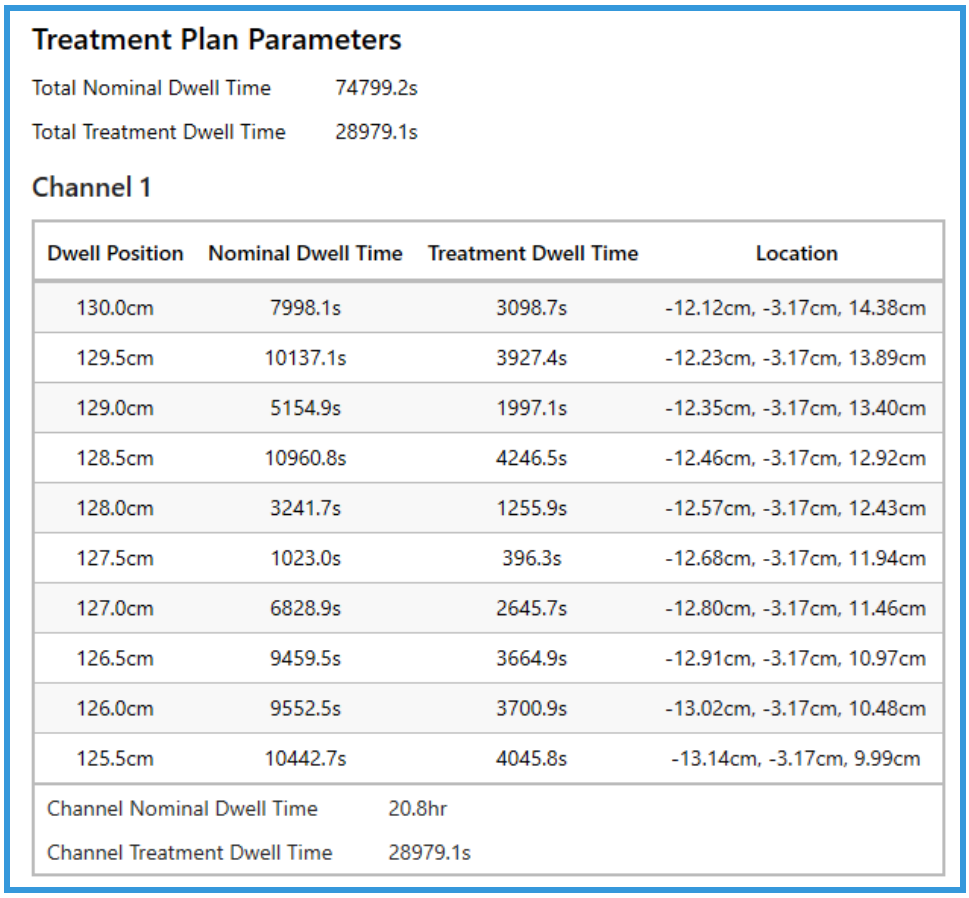
Calculation Point Doses

Calculation Point	Location	TPS Dose	ClearCalc Dose	Difference	Pass/Fail	Verify	Comment
Calc Point1	1.55cm, -1.01cm, 18.47cm	204.1cGy	204.6cGy	0.20%	✓		

Top to bottom:

1. Brachytherpy heading
2. TPS radioactive Source ID used for Treatment Plan
3. Source Property DataTable
    a. Nominal air kerma strength [U] (only displays for Nominal sources)
    b. Treatment air kerma strength [U] (displays based on the entered Treatment Date in the left sidebar for HDR/PDR plan types - for LDR sources, this is taken from the DICOM header)
    c. Nominal activity [mCi] (only displays for Nominal sources)
    d. Treatment activity [mCi]
        i. Calculated based on the entered Treatment Date for HDR/PDR plan types (displayed in the left sidebar)
        ii. Calculated based on the air kerma strength for LDR sources
    e. Dose Rate Constant [cGy/hU] (based on configuration settings in Admin)
    f. Active length [cm] (based on configuration settings in Admin)
    g. Source properties are listed for both Treatment Planning System and ClearCalc
4. Calculation Point Doses DataGrid
    a. Calculation Point ID from Treatment Plan
    b. Location (x, y, z) of respective calculation point from Treatment Plan
    c. Treatment Planning System dose to respective Calculation Point
    d. ClearCalc independent dose to respective Calculation Point
    e. Difference (percentage error = [(ClearCalc Calc Point Dose - TPS Calc Point Dose Dose)/TPS Calc Point Dose] * 100%)

f. Pass/Fail Indication
g. Verify OK Checkbox (Failing results only)
h. Calculation Point Comment



Treatment Plan Parameters

Total Nominal Dwell Time 74799.2s

Total Treatment Dwell Time 28979.1s

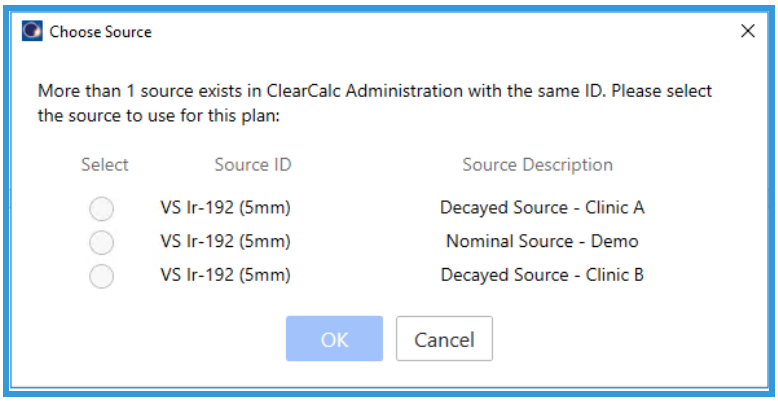
Channel 1

Dwell Position	Nominal Dwell Time	Treatment Dwell Time	Location
130.0cm	7998.1s	3098.7s	-12.12cm, -3.17cm, 14.38cm
129.5cm	10137.1s	3927.4s	-12.23cm, -3.17cm, 13.89cm
129.0cm	5154.9s	1997.1s	-12.35cm, -3.17cm, 13.40cm
128.5cm	10960.8s	4246.5s	-12.46cm, -3.17cm, 12.92cm
128.0cm	3241.7s	1255.9s	-12.57cm, -3.17cm, 12.43cm
127.5cm	1023.0s	396.3s	-12.68cm, -3.17cm, 11.94cm
127.0cm	6828.9s	2645.7s	-12.80cm, -3.17cm, 11.46cm
126.5cm	9459.5s	3664.9s	-12.91cm, -3.17cm, 10.97cm
126.0cm	9552.5s	3700.9s	-13.02cm, -3.17cm, 10.48cm
125.5cm	10442.7s	4045.8s	-13.14cm, -3.17cm, 9.99cm

Channel Nominal Dwell Time 20.8hr

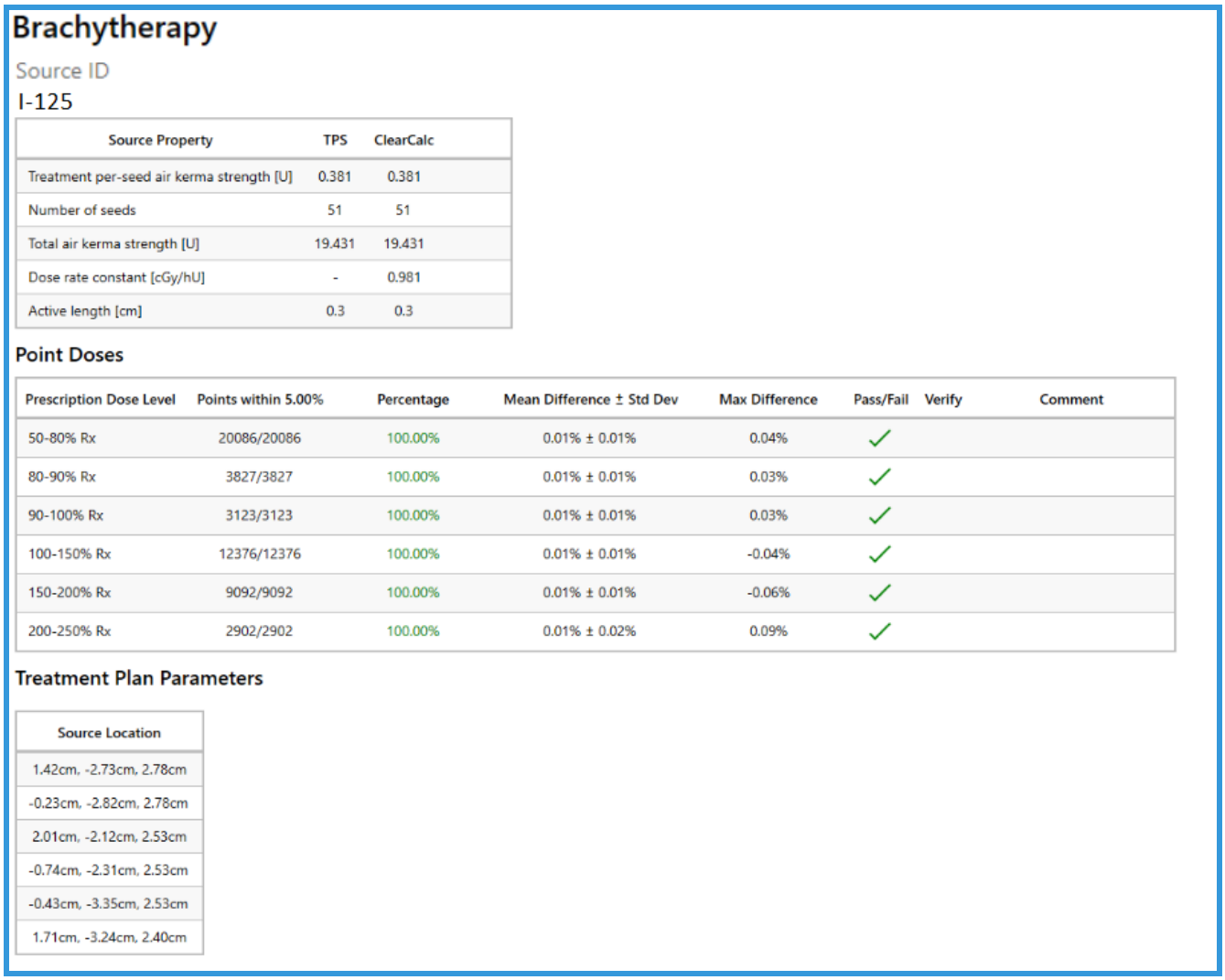
Channel Treatment Dwell Time 28979.1s

5. Treatment Plan Parameters heading
    a. Total Nominal Dwell Time for plan, if applicable
    b. Total Treatment Dwell Time, if applicable
    c. Per-channel tables from treatment plan
        i. Dwell position [cm] of each channel, beginning at the applicator tip
        ii. Nominal Dwell Time of the respective dwell position
        iii. Treatment Dwell Time of the respective dwell position
        iv. Location of the respective dwell position
        v. Channel Nominal Dwell Time, if applicable
        vi. Channel Treatment Dwell Time, if applicable



d. When more than 1 source with the same name exists in ClearCalc Administration, a Source Selection window shall appear that allows the user to select which source they would like to use.
    i. Displays the Source ID and Source Descriptions as they appear in Administration
    ii. User may select the source they wish to use with the radio button and choose OK
    iii. Selecting Cancel will abort the calculation

17. Overview of Center Window for Brachytherapy Plans without Reference Point (i.e. VariSeed)



Brachytherapy

Source ID

I-125

Source Property	TPS	ClearCalc
Treatment per-seed air kerma strength [U]	0.381	0.381
Number of seeds	51	51
Total air kerma strength [U]	19.431	19.431
Dose rate constant [cGy/hU]	-	0.981
Active length [cm]	0.3	0.3

Point Doses

Prescription Dose Level	Points within 5.00%	Percentage	Mean Difference ± Std Dev	Max Difference	Pass/Fail	Verify	Comment
50-80% Rx	20086/20086	100.00%	0.01% ± 0.01%	0.04%	✓		
80-90% Rx	3827/3827	100.00%	0.01% ± 0.01%	0.03%	✓		
90-100% Rx	3123/3123	100.00%	0.01% ± 0.01%	0.03%	✓		
100-150% Rx	12376/12376	100.00%	0.01% ± 0.01%	-0.04%	✓		
150-200% Rx	9092/9092	100.00%	0.01% ± 0.01%	-0.06%	✓		
200-250% Rx	2902/2902	100.00%	0.01% ± 0.02%	0.09%	✓		

Treatment Plan Parameters

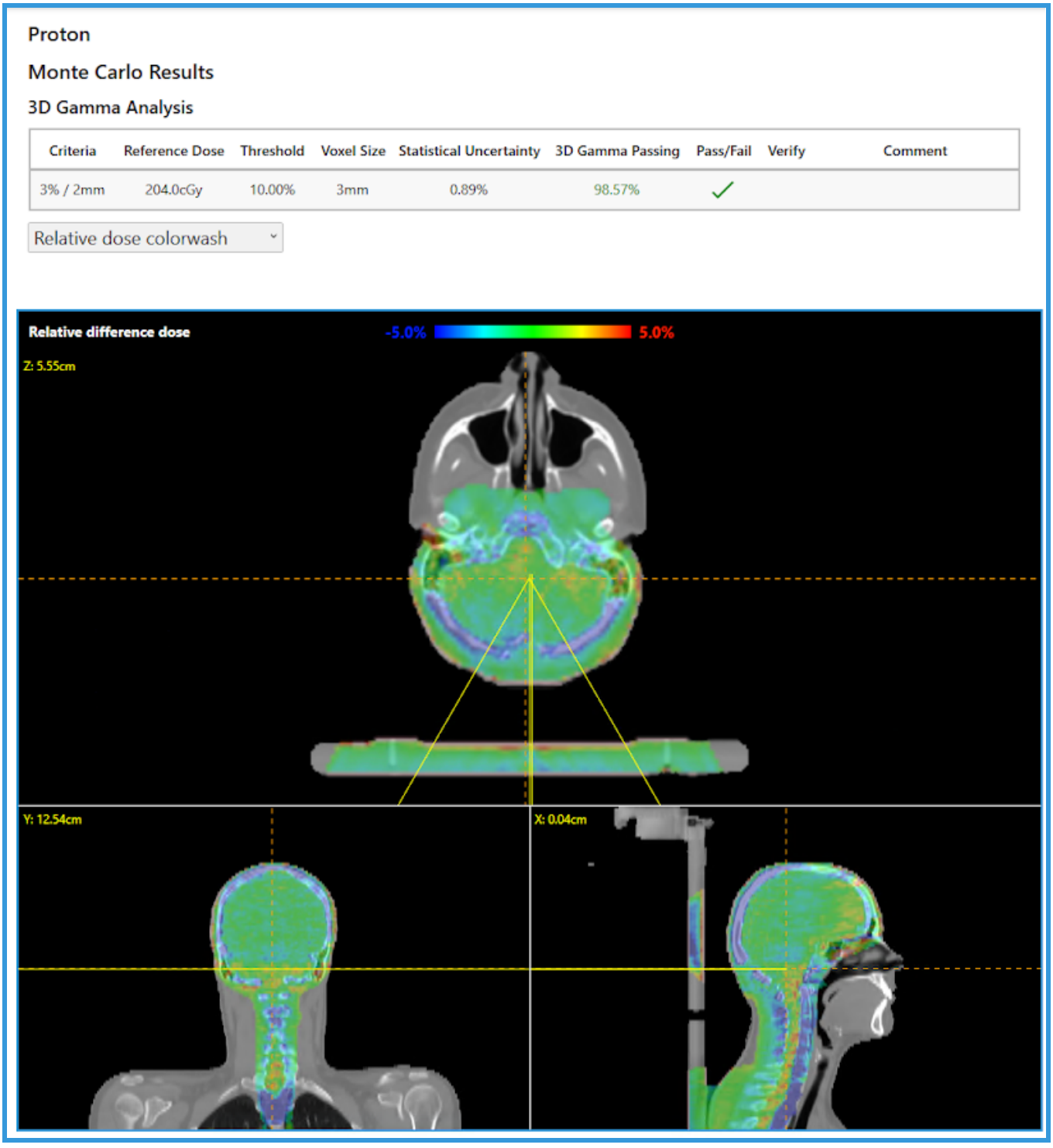
Source Location
1.42cm, -2.73cm, 2.78cm
-0.23cm, -2.82cm, 2.78cm
2.01cm, -2.12cm, 2.53cm
-0.74cm, -2.31cm, 2.53cm
-0.43cm, -3.35cm, 2.53cm
1.71cm, -3.24cm, 2.40cm

Top to bottom:

1. Brachytherapy heading
2. TPS radioactive Source ID used for Treatment Plan
3. Source Property DataTable
    a. Nominal air kerma strength [U] (only displays for Nominal sources)
        i. As these sources are implanted with a nominal strength, they will always be treated as Nominal in the calculation
    b. Number of seeds (when applicable)
    c. Total air kerma strength (when applicable)
    d. Dose Rate Constant [cGy/hU] (based on configuration settings in Admin)
    e. Active length [cm] (based on configuration settings in Admin)
4. Source properties from Treatment Planning System DICOM files (when present)
5. Source properties from ClearCalc Admin
6. Point Doses DataGrid
7. Prescription Dose Level ranges (based on Rx)

   a. These levels are fixed ranges that are relative to the plan perception dose at the following values: 50-80%, 80-90%, 90-100%, 100-150%, 150-200%, 200-250%
8. Number of points in the dose range that are within 5% of the projected dose given by ratio of “points passing 5%”/”total points in dose range”
9. Percentage of passing points analyzed
10. Mean difference and standard deviation for dose range
11. Maximum difference found in dose range
12. Pass/Fail Indication
13. Verify OK CheckBox (failing results only)
14. Point Dose Range Comment
15. Treatment Plan Parameters displaying source location

18. Overview of RadMonteCarlo Photon/Electron/Proton Results

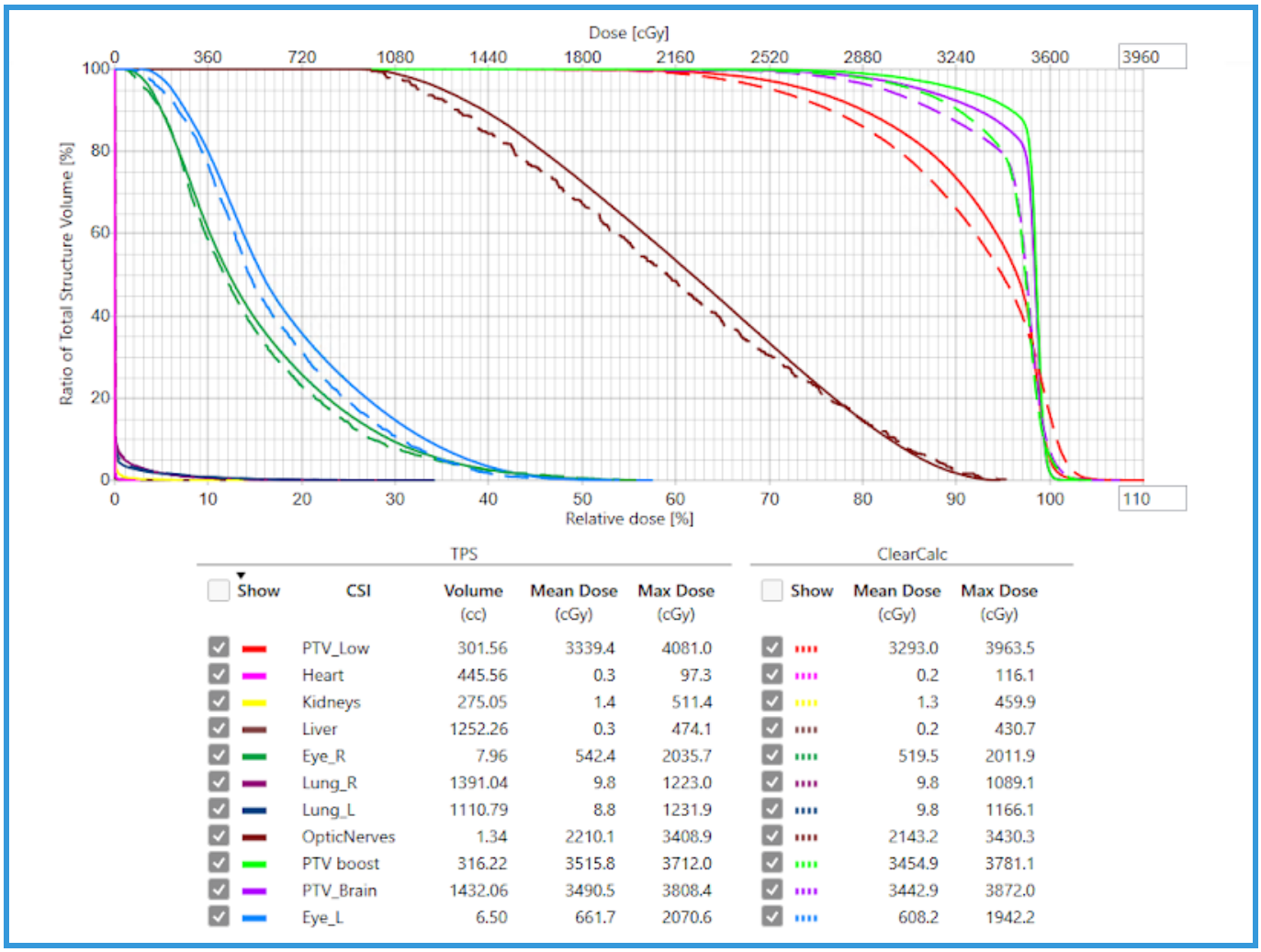


Top to bottom:

1. Monte Carlo Results heading
2. 3D Gamma Analysis table
    a. Criteria: RadMonteCarlo gamma analysis criteria of Percent Difference and Distance To Agreement applied to the dose matrix

b. Reference Dose: Maximum plan dose
c. Threshold: Low dose threshold applied to gamma analysis and 3D gamma index pass/fail colorwash
d. Voxel Size: Voxel size used in dose analysis evaluation
e. Statistical Uncertainty: Reported statistical uncertainty for RadMonteCarlo simulation
f. 3D Gamma Passing: The pass rate for the applied gamma analysis criteria
g. Pass/Fail: Reported pass/fail status on 3D gamma pass rate tolerance set in ClearCalc Admin
h. Verify: User may verify failing results at their discretion
i. Comment: Entry cell allows user to add comments for documentation

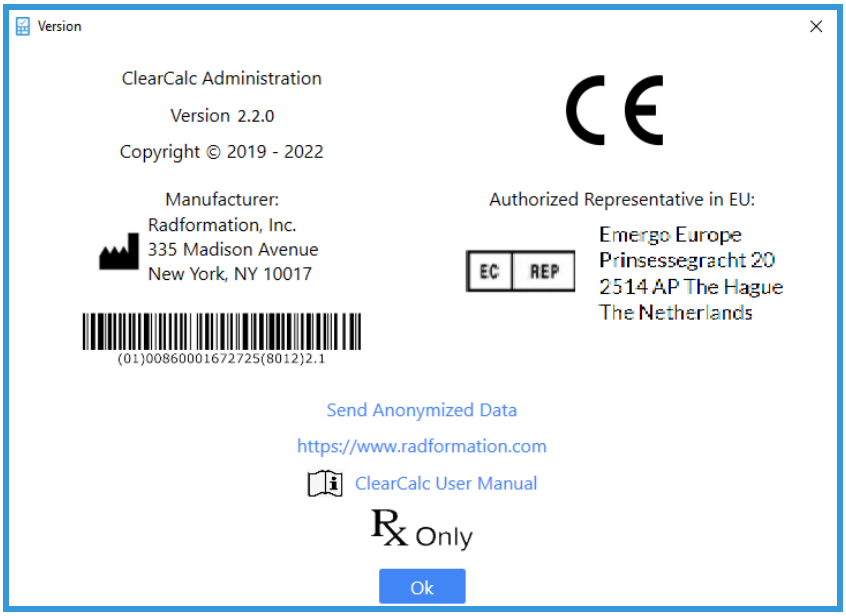
3. CT 3-view selection drop-down window displays one of the following:
    a. Controls
        i. Scroll: mouse wheel
        ii. Zoom: CTRL + scroll
        iii. Pan: CTRL + drag
    b. Gamma Index Pass/Fail Colorwash: Per-voxel 3D gamma color wash heat map overlay of the TPS dose compared to the calculated ClearCalc RadMonteCarlo dose.
        i. Green: Passes Gamma Index % Diff. / DTA criteria
        ii. Blue: Fails Gamma Index % Diff. / DTA criteria (RadMC “colder” than TPS)
        iii. Red: Fails Gamma Index % Diff. / DTA criteria (RadMC “hotter” than TPS)
    c. Relative dose colorwash: Review the relative dose % difference (RadMC dose matrix vs. TPS dose matrix) colorwash cloud superimposed over the planning image set
    d. TPS dose colorwash overlayed on the planning image set
    e. RadMC dose colorwash overlayed on the planning image set



		TPS				ClearCalc		
Show	CSI	Volume (cc)	Mean Dose (cGy)	Max Dose (cGy)	Show	Mean Dose (cGy)	Max Dose (cGy)
☑	PTV_Low	301.56	3339.4	4081.0	☑	3293.0	3963.5
☑	Heart	445.56	0.3	97.3	☑	0.2	116.1
☑	Kidneys	275.05	1.4	511.4	☑	1.3	459.9
☑	Liver	1252.26	0.3	474.1	☑	0.2	430.7
☑	Eye_R	7.96	542.4	2035.7	☑	519.5	2011.9
☑	Lung_R	1391.04	9.8	1223.0	☑	9.8	1089.1
☑	Lung_L	1110.79	8.8	1231.9	☑	9.8	1166.1
☑	OpticNerves	1.34	2210.1	3408.9	☑	2143.2	3430.3
☑	PTV boost	316.22	3515.8	3712.0	☑	3454.9	3781.1
☑	PTV_Brain	1432.06	3490.5	3808.4	☑	3442.9	3872.0
☑	Eye_L	6.50	661.7	2070.6	☑	608.2	1942.2

4. DVH showing:
    a. Structure from the plan
    b. TPS DVH values (resampled by ClearCalc)
    c. ClearCalc's RadMonteCarlo DVH values
    d. Structures may be toggled for TPS/ClearCalc independently
5. DVH values table showing:
    a. TPS values for planning structures (by column headers - left to right)
        i. Show: Controls structure visibility on DVH
        ii. Plan Name
        iii. Volume
        iv. Mean Dose
        v. Max Dose
    b. ClearCalc values for planning structures
        i. Show: Controls structure visibility on DVH
        ii. Mean Dose
        iii. Max Dose
    c. Structures may be toggled for TPS/ClearCalc independently

19. ClearCalc Information Window



Left to right:

1. Product name
2. Version number
3. Copyright date
4. Manufacturer address
5. UID barcode
6. CE Mark
7. Authorized Representative in EU address
8. Link to Radformation plan anonymizer tool
9. Link to Radformation website
10. Link to user manual
11. Donation that product is for use by Prescription Only
12. OK button to close

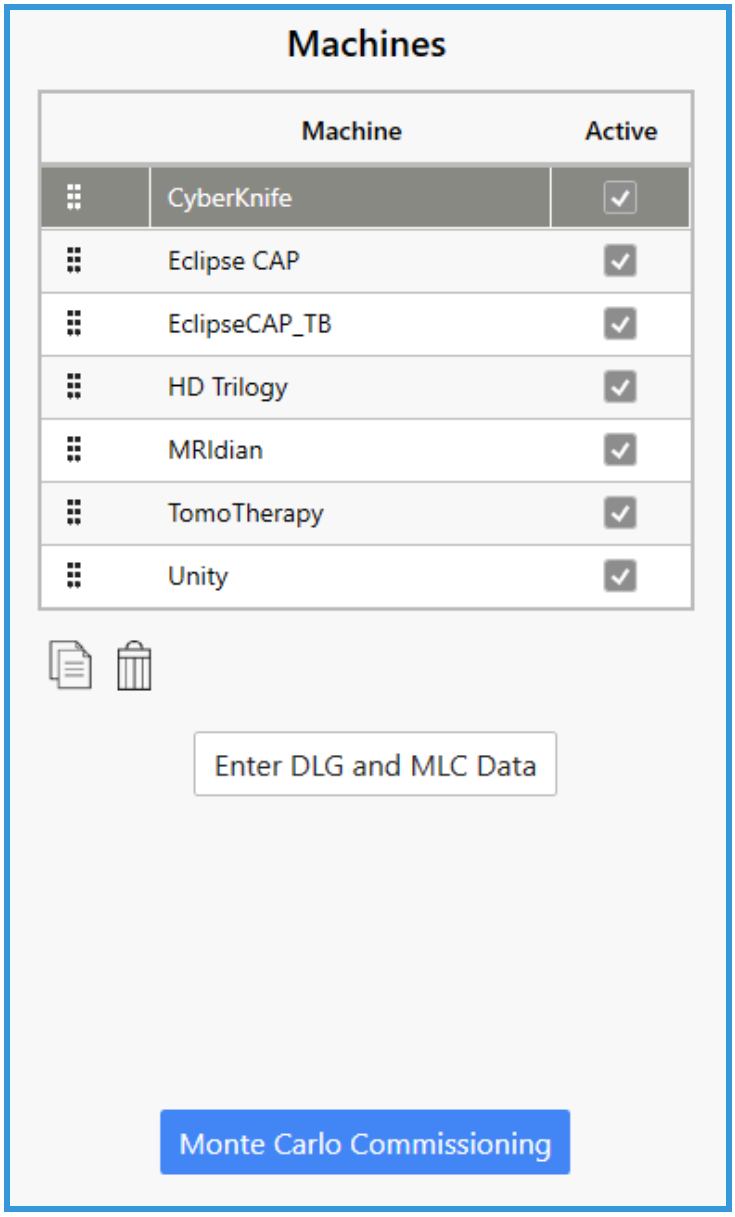
7.5 ClearCalc Administration

Please note that any changes made in the Administration application will be globally changed for the entire clinic. Also note that changes made are not retroactive and will only apply to future use.

1. Overview of Admin Toolbar

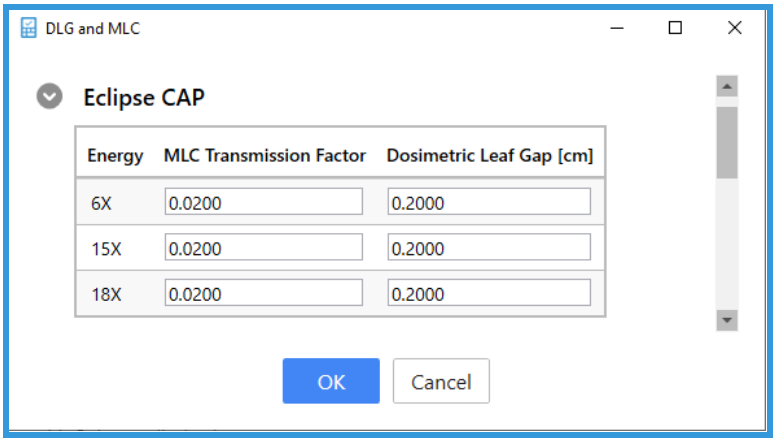
1. Close
2. Save
3. Undo
4. Redo
5. Sync Photon and Electron machines/energies from Eclipse Beam Data
6. Photon configuration tab
7. Electron configuration tab
8. Brachy configuration tab
9. Diode configuration tab
10. Superficial configuration tab
11. Orthovoltage configuration tab
12. Report configuration tab
13. Settings configuration tab
14. History Log access
15. Information window access

2. Overview of Photon Machines Sidebar



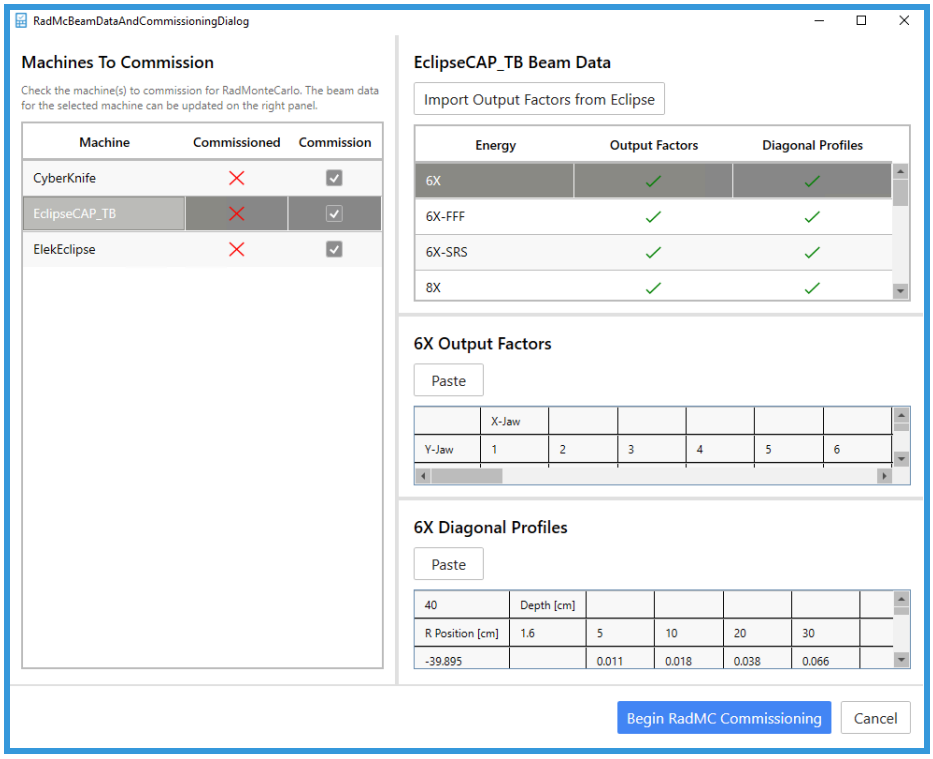
1. Machines List heading
2. Machines commissioned in ClearCalc DataGrid
3. Active Machines CheckBox
4. Copy current Machine
5. Delete selected Machine

6. Enter DLG and MLC Data button: Provides a window pop-up for manual entry of Dosimetric Leaf Gap [cm] and MLC Transmission Factors (This data is required to be manually entered for active machines and is not automatically pulled during the data sync.)



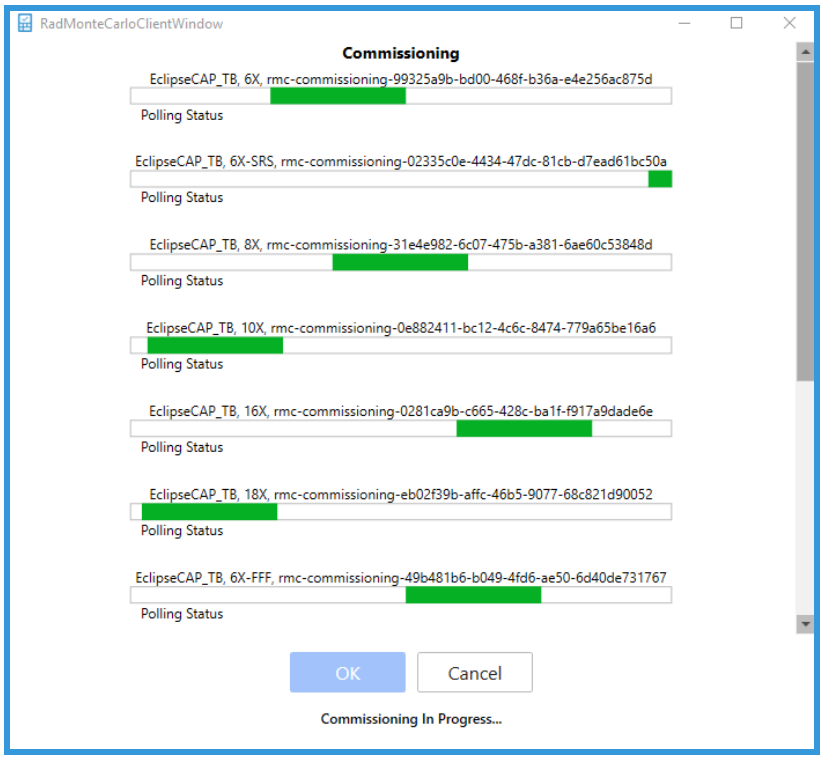
7. Monte Carlo Commissioning button: Allows the user to commission all available photon machines and energies for Monte Carlos calculations when licensed (only active with RadMonteCarlo license)

3. Overview of Photon Virtual Source Model Commissioning



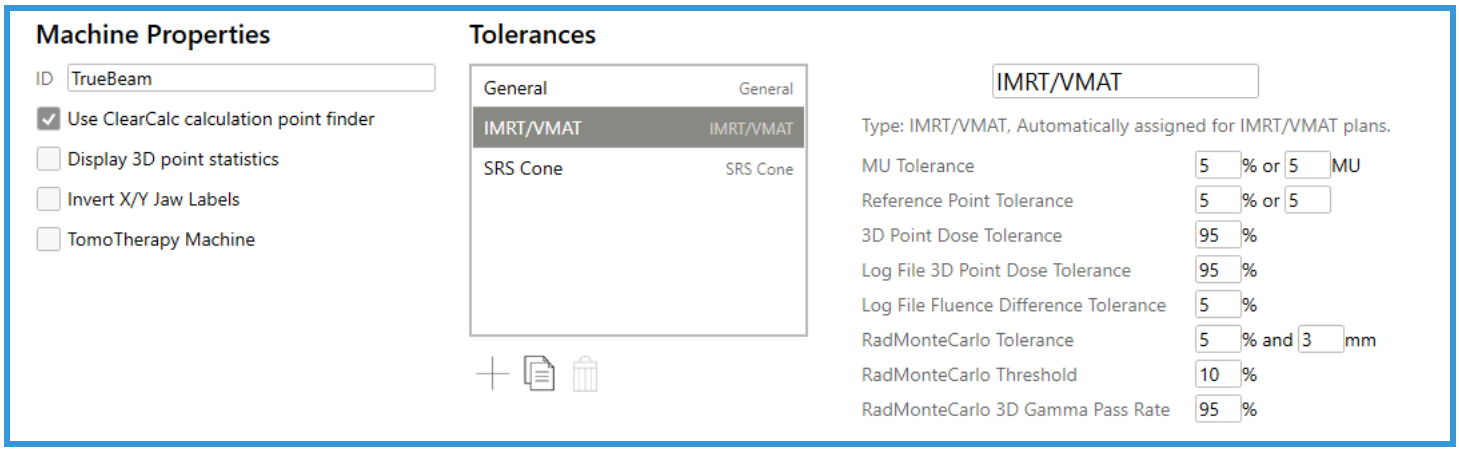
1. Machines to Commission heading
2. Machine virtual source model commissioning status DataGrid

3. Import Output factors From Eclipse sync tool
4. Status of input data for virtual source model commissioning DataGrid: Lists the status of supplemental input data required, per energy (green checkmark - indicates supplemental data entry is complete, red x - indicates input data is needed)
5. Energy-specific Output Factors heading
6. Output Factors DataGrid: displays output factor table for selected energy
7. Energy-specific Diagonal Profiles heading
8. Diagonal Profiles DataGrid::isplays diagonal profile table for selected energy
9. Begin MC Commissioning



10. Monte Carlo Commissioning Window: Monte CarloMonte Carlo commissioning progress window - shows progress of currently processing commissioning jobs for compatibility with RadMonteCarlo calculations

4. Overview of Photon Data Configuration



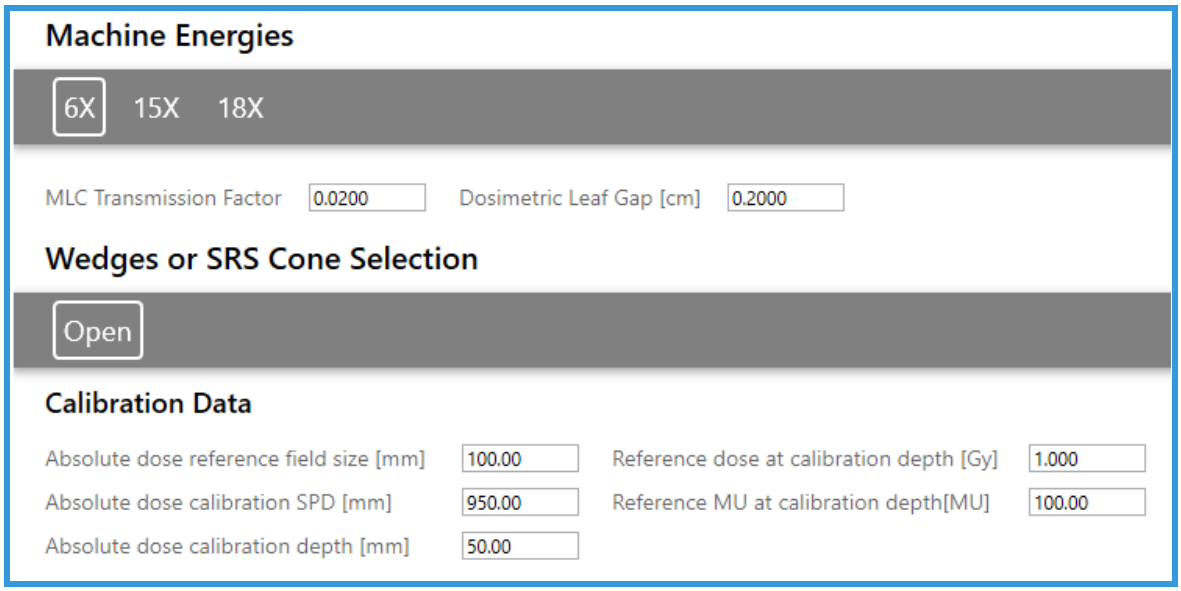
1. Machine Properties heading
2. ClearCalc Machine ID (this is auto-matched to incoming plan's Eclipse Machine ID - must be identical to auto-match)
3. Checkbox to toggle on/off the ClearCalc automatic reference point finder
4. Checkbox to toggle on/off the automatic display of the 3D Point dose statistics table in the UI
5. Checkbox to toggle on/off the X/Y jaw inversion
6. Checkbox to designate a machine as a TomoTherapy unit
7. Tolerances heading
    a. General Plan Type Tolerance
        i. Tolerance name entry cell: Tolerance Group names may be edited by user. Automatically assigned for non-IMRT/VMAT and non-SRS Cone plans.
        ii. MU tolerance: in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.
        iii. Reference Point dose tolerance: in % (primary) and dose (secondary) for Pass/Fail of reference point tolerance results. Set MU tolerance to zero to disable secondary tolerance.
        iv. 3D Point dose tolerance: for the 3D point dose evaluation (when active)
        v. RadMonteCarlo tolerance: for Gamma Analysis criteria - % diff and distance to agreement (mm)
        vi. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
        vii. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria
    b. IMRT/VMAT Plan Type Tolerance
        i. Tolerance name entry cell: Tolerance Group names may be edited by user. Automatically assigned for IMRT/VMAT plans.
        ii. MU tolerance: in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.

iii. Reference Point dose tolerance: in % (primary) and dose (secondary) for Pass/Fail of reference point tolerance results. Set MU tolerance to zero to disable secondary tolerance.
iv. 3D Point dose tolerance: for the 3D point dose evaluation (when active)
v. Log File 3D Point Dose Tolerance: for the 3D point dose evaluation in the Log File Analysis module
vi. Log File Fluence Difference Tolerance: % difference in the Log File Analysis module
vii. RadMonteCarlo tolerance: for Gamma Analysis criteria - % diff and distance to agreement (mm)
viii. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
ix. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria

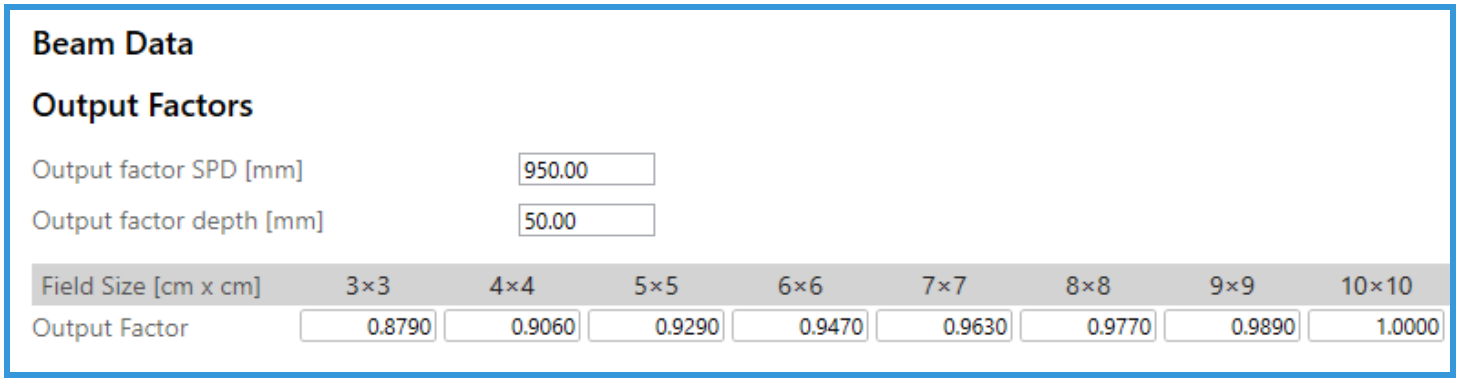
c. SRS Plan Type Tolerance
   i. Tolerance name entry cell: Tolerance Group names may be edited by user. Automatically assigned for SRS Cone plans.
   ii. MU tolerance: in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.
   iii. Reference Point dose tolerance: in % (primary) and dose (secondary) for Pass/Fail of reference point tolerance results. Set MU tolerance to zero to disable secondary tolerance.
   iv. 3D Point dose tolerance: for the 3D point dose evaluation (when active)
   v. RadMonteCarlo tolerance: for Gamma Analysis criteria - % diff and distance to agreement (mm)
   vi. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
   vii. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria

d. Custom Type Tolerance
   i. Tolerance name entry cell: Tolerance Group names may be edited by user.
      1. Unlimited custom tolerance groups may be created and will match the IMRT/VMAT set of criteria.
      2. **NOTE! Custom tolerances will not automatically, as the 3 default tolerances do, based on plan type/characteristics**
   ii. MU tolerance: in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.
   iii. Reference Point dose tolerance: in % (primary) and dose (secondary) for Pass/Fail of reference point tolerance results. Set MU tolerance to zero to disable secondary tolerance.
   iv. 3D Point dose tolerance: for the 3D point dose evaluation (when active)

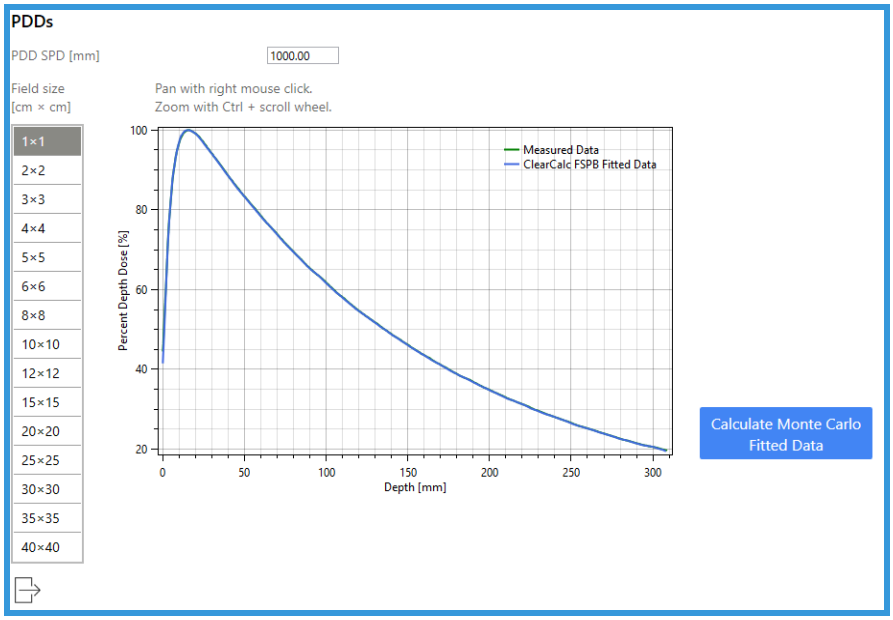
v. Log File 3D Point Dose Tolerance: for the 3D point dose evaluation in the Log File Analysis module
vi. Log File Fluence Difference Tolerance: % difference in the Log File Analysis module
vii. RadMonteCarlo tolerance: for Gamma Analysis criteria - % diff and distance to agreement (mm)
viii. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
ix. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria



19. Machine Energies heading
20. Available Machine energy options, white surround indicates active energy
21. MLC Parameters: a. MLC Transmission (entered by user via "Enter DLG and MLC Data" button) and b. Dosimetric Leaf Gap [cm] (may be entered by user via "Enter DLG and MLC Data" button or entered here)
22. Beam Modifier heading
23. Beam Modifier options (Open, Wedges, SRS Cones), white surround indicates active modifier
24. Calibration Data heading with auto-populated measured data, including:
    - Absolute dose referenced field size [mm]
    - Absolute dose calibration SPD [mm]
    - Absolute dose calibration depth [mm]
    - Reference dose at calibration depth [Gy]
    - Reference MU at calibration depth [MU]
        - Changes to Reference minutes [min] for designated TomoTherapy machines

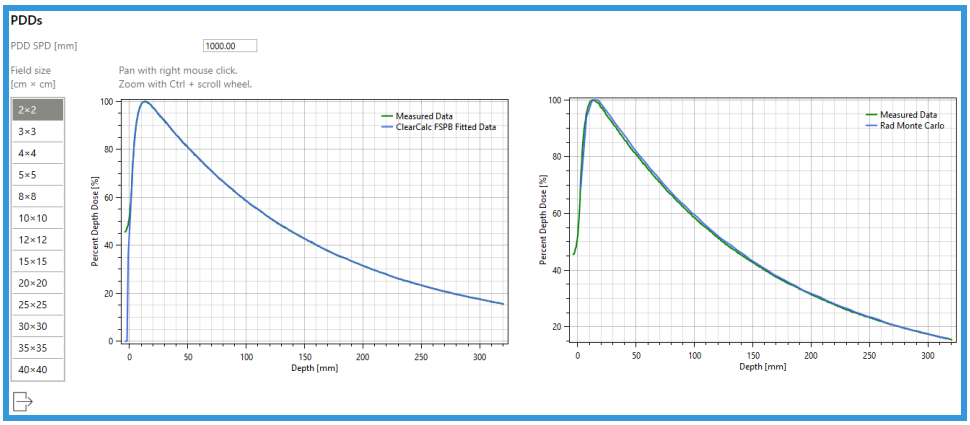


25. Beam Data heading
26. Output Factor Heading
27. Output Factor Source to Phantom Distance [mm]
28. Output factor depth [mm]
29. Output Factors Datagrid with field (or SRS cone) size-specific output factors for selected energy and modifier, if any
30. When SRS cones are present, additional DataGrid will appear with the active SRS cones, their size and Applicator ID

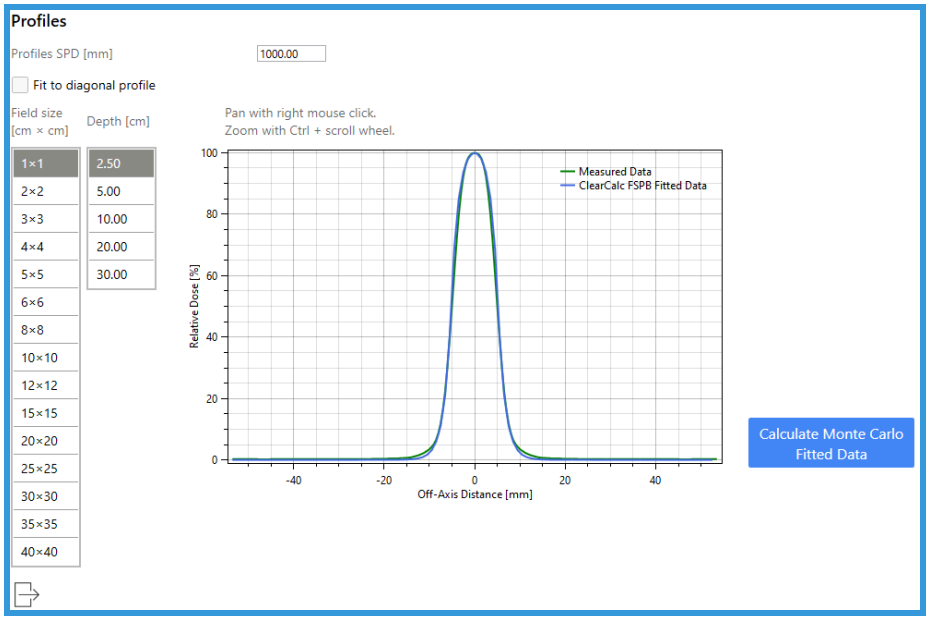


31. Percent Depth Dose heading
32. PDD Source to Phantom Distance [mm]
33. PDD graph per field size showing ClearCalc fitted data versus measured beam data, overlaid (replaced by TMR for SRS cones)

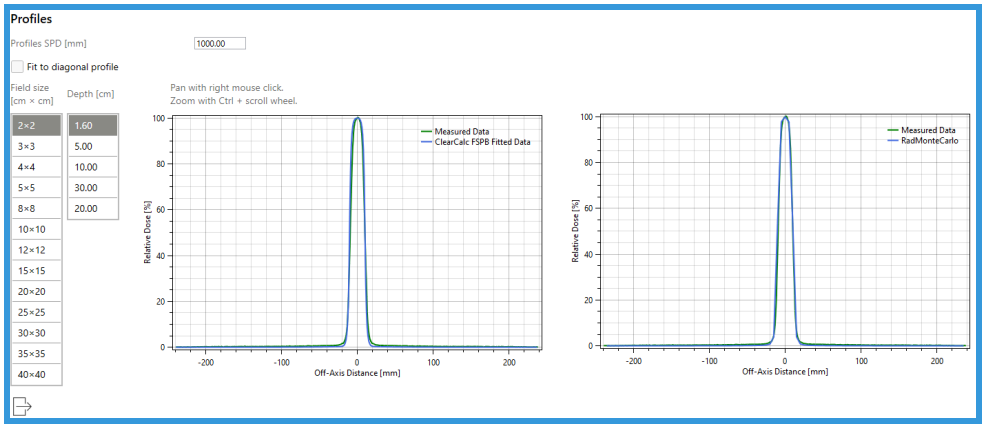
a. Calculate Monte Carlo Fitted Data: If selected, it will display an additional Monte Carlo generated/fitted PDD compared with measured data



34. Copy selected ClearCalc and measured Profile data to clipboard

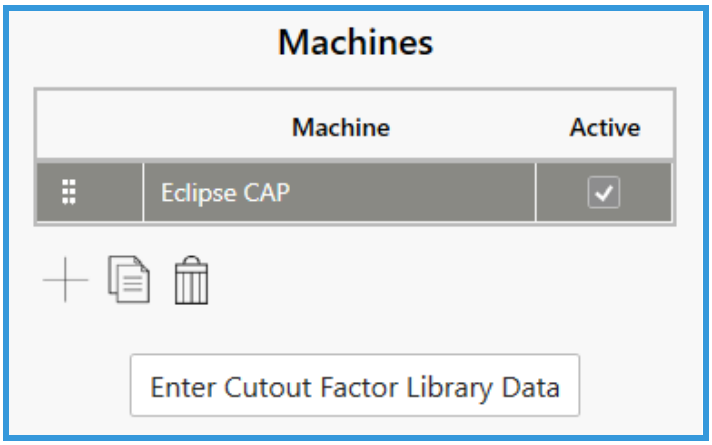


35. Profiles heading
36. Profiles Source to Phantom Distance [mm]
37. Fit to Diagonal Profiles CheckBox allows the user to visualize the diagonal profile fits, view only
38. Profiles per field size and depth showing ClearCalc fitted data versus measured beam data, overlaid (hides for SRS cones or when data is not available)
    b. Calculate Monte Carlo Fitted Data: If selected, it will display an additional Monte Carlo generated/fitted profile compared with measured data

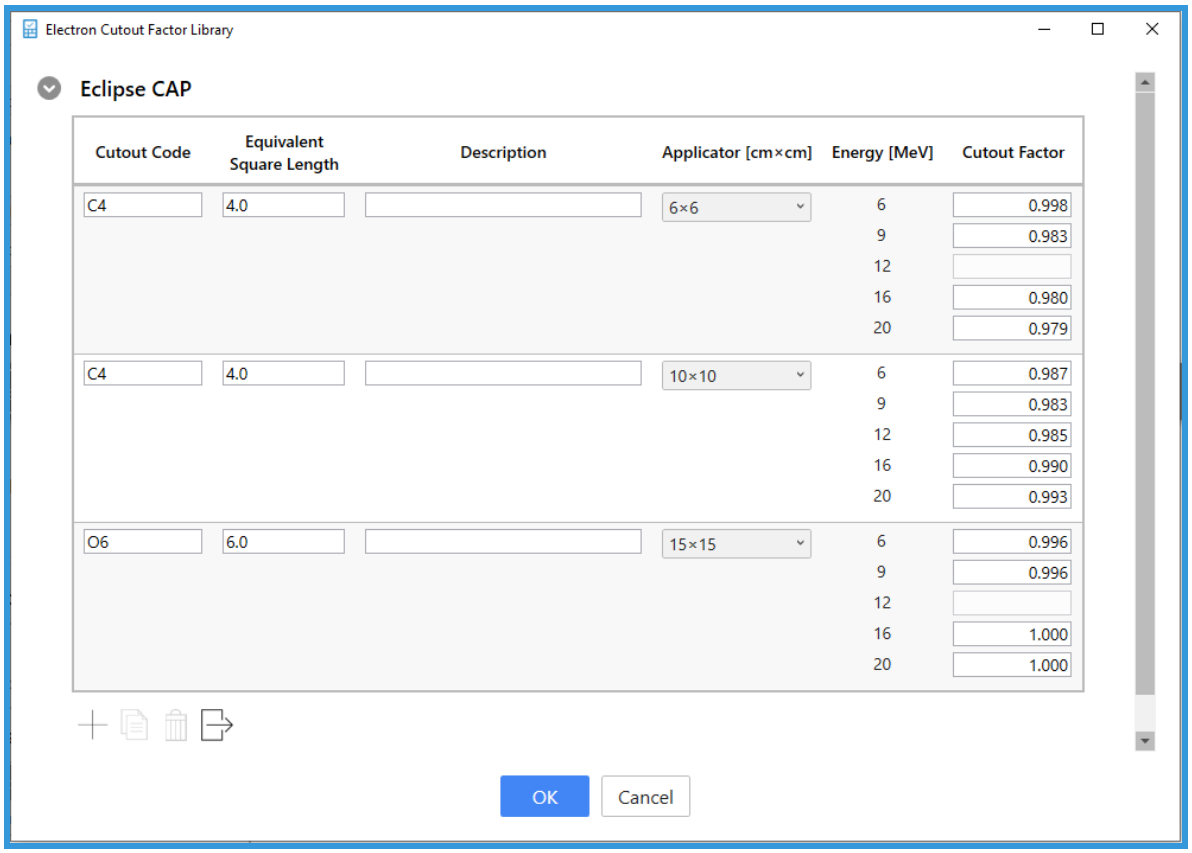


39. Copy selected ClearCalc and measured Profile data to clipboard

5. Overview of Electron Machines Configuration

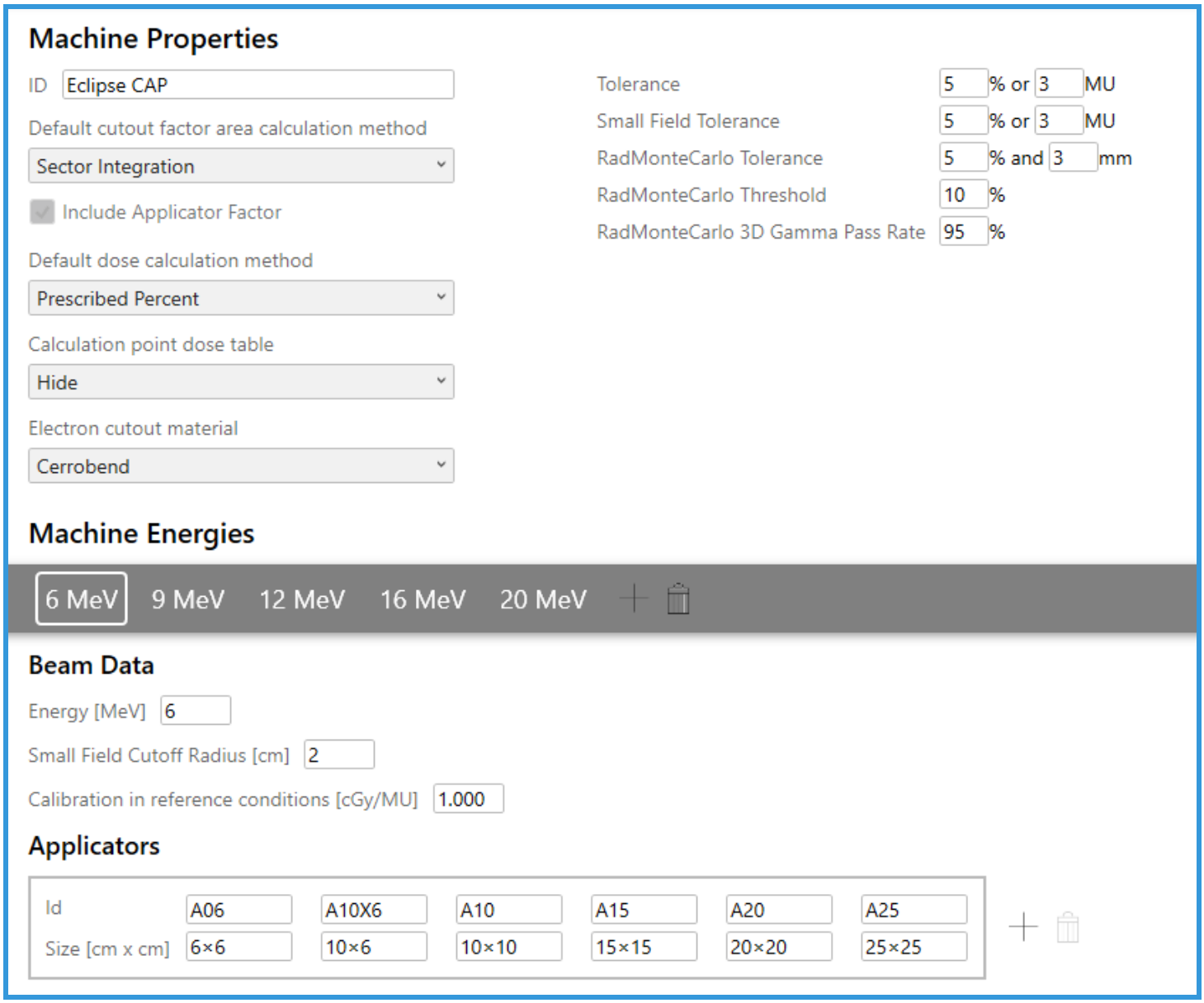


1. Machines List heading
2. Electron machines commissioned in ClearCalc DataGrid
3. Active Machines CheckBox
4. Add new Machine
5. Copy current Machine
6. Delete selected Machine
7. Cutout Factor Library Entry



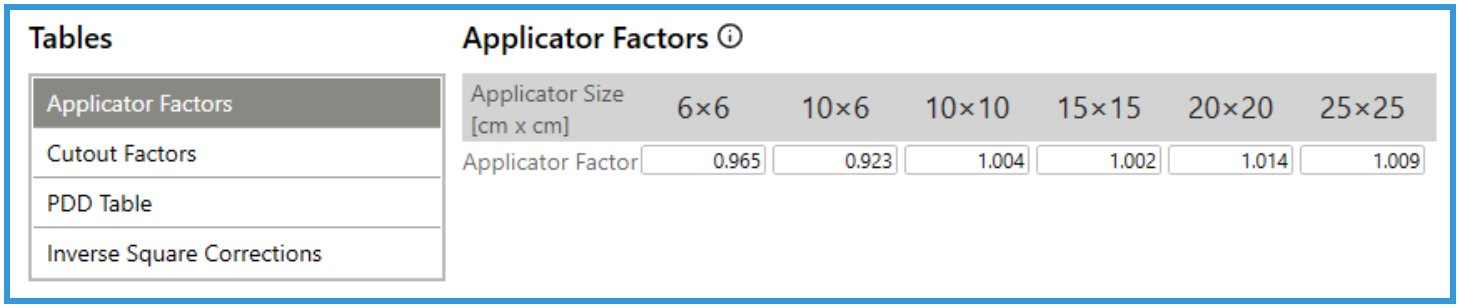
8. Cutout Factor Library Window
9. User desired Cutout Code
10. Equivalent Square Length of the cutout (not that circular or oval cutouts should be converted to equivalent square to ensure that the correct equivalent square size is used for data lookup)
11. User Description (information only - not used in calculation)
12. Applicator for Cutout Code
13. Available energies for the applicator (pre-populate based on machine data)
14. Cutout Factor for Cutout Code per energy
15. Plus icon allows the user to add an additional Cutout Code row
16. Copy icon allows the user to copy the currently selected row(s)
17. Trash can icon allows the user to remove the currently selected row(s)
18. Copy To icon allows the user to copy the entire cutout library for one machine to another available electron machine

6. Overview of Electron Data Configuration

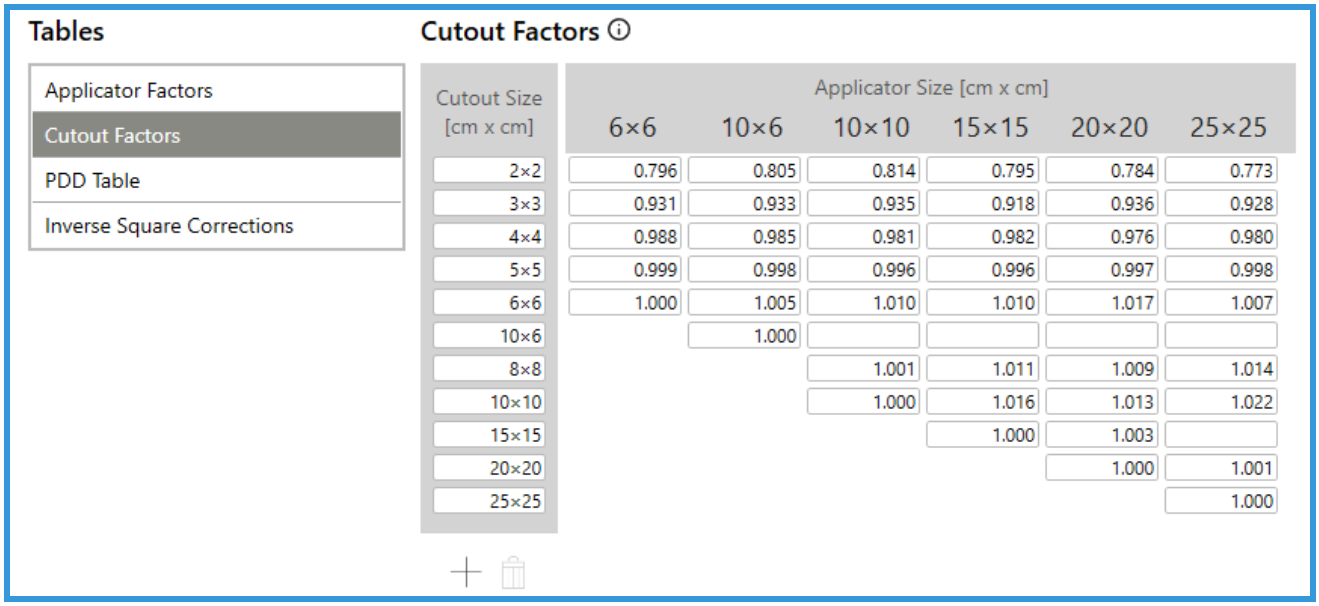


1. Machine Properties heading
2. ClearCalc Machine ID (this is auto-matched to incoming plan's Eclipse Machine ID - must be identical to auto-match)
3. Default cutout factor method: Sector Integration, User Entered, or Cutout Factor Library
4. Checkbox to allow the user to specify if the "User Entered" Applicator Factors independent of the cone size (applied to "User Entered" calcs only)
5. Default dose calculation method, Prescribed % or Calculation Point
6. Hide/show option for Calculation Point dose table
7. Electron Cutout Material (for RadMonteCarlo): Cerrobend or Copper

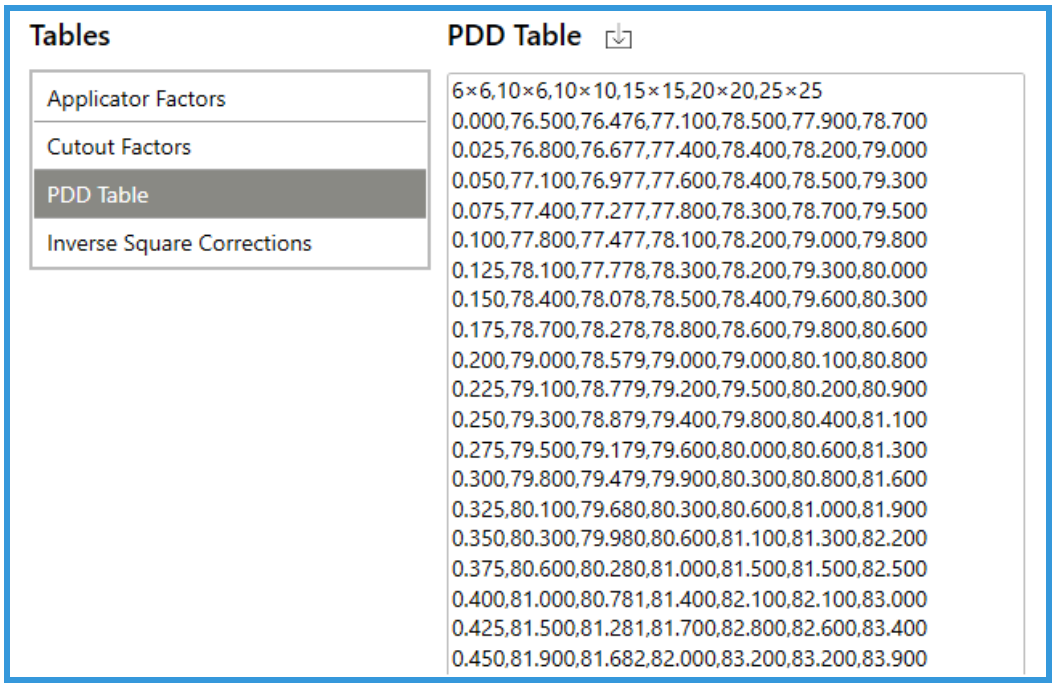
8. Tolerances:
    a. Tolerance: MU tolerance in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.
    b. Small Field Tolerance: Small field MU tolerance in % (primary) and MU (secondary) for Pass/Fail field results. Set MU tolerance to zero to disable secondary tolerance.
    c. RadMonteCarlo tolerance: for Gamma Analysis criteria - % diff and distance to agreement (mm)
    d. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
    e. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria
9. Machine Energies heading
10. Available Machine energy options, white surround shows active energy
11. Add additional electron energies
12. Delete selected energy
13. Beam Data heading
14. Energy for selected Beam [MeV]
15. Small Field Cutout Radius setting [cm]
16. Calibration for reference conditions [dose/MU]
17. Applicators DataGrid heading
18. Applicator ID row
19. Applicator size row
20. Add additional applicator
21. Delete selected applicator



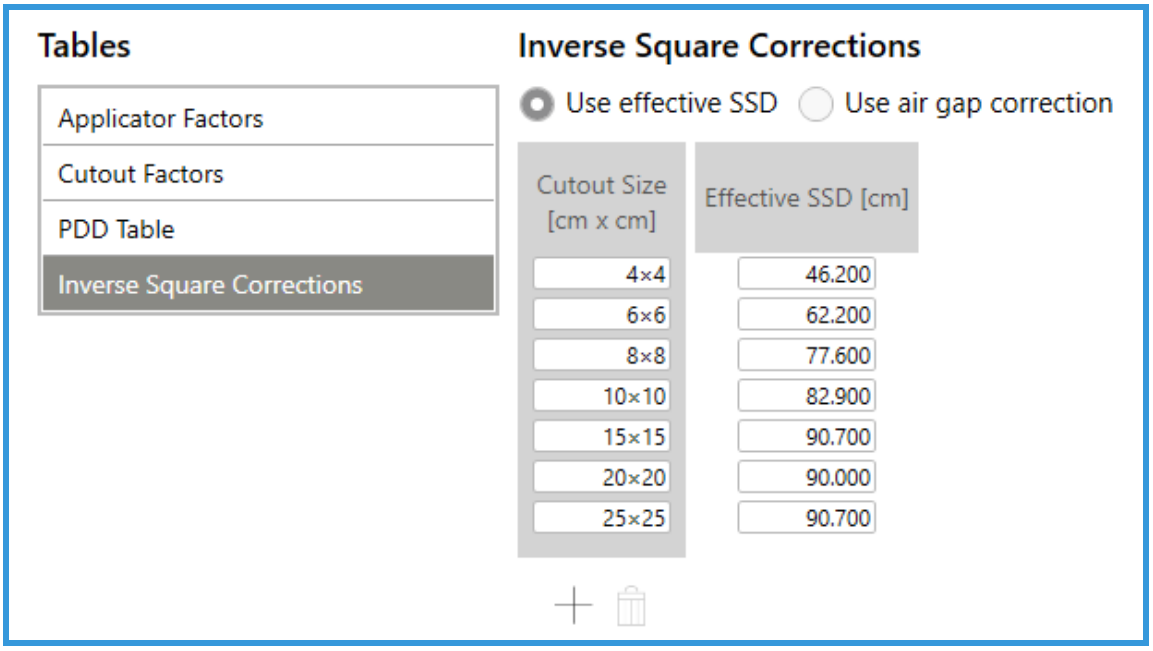
22. Tables DataGrid heading
23. Data Table entry selection
24. Applicator Factors DataGrid
25. Applicator Size available for data entry
26. Applicator factor TextBox for available Applicators



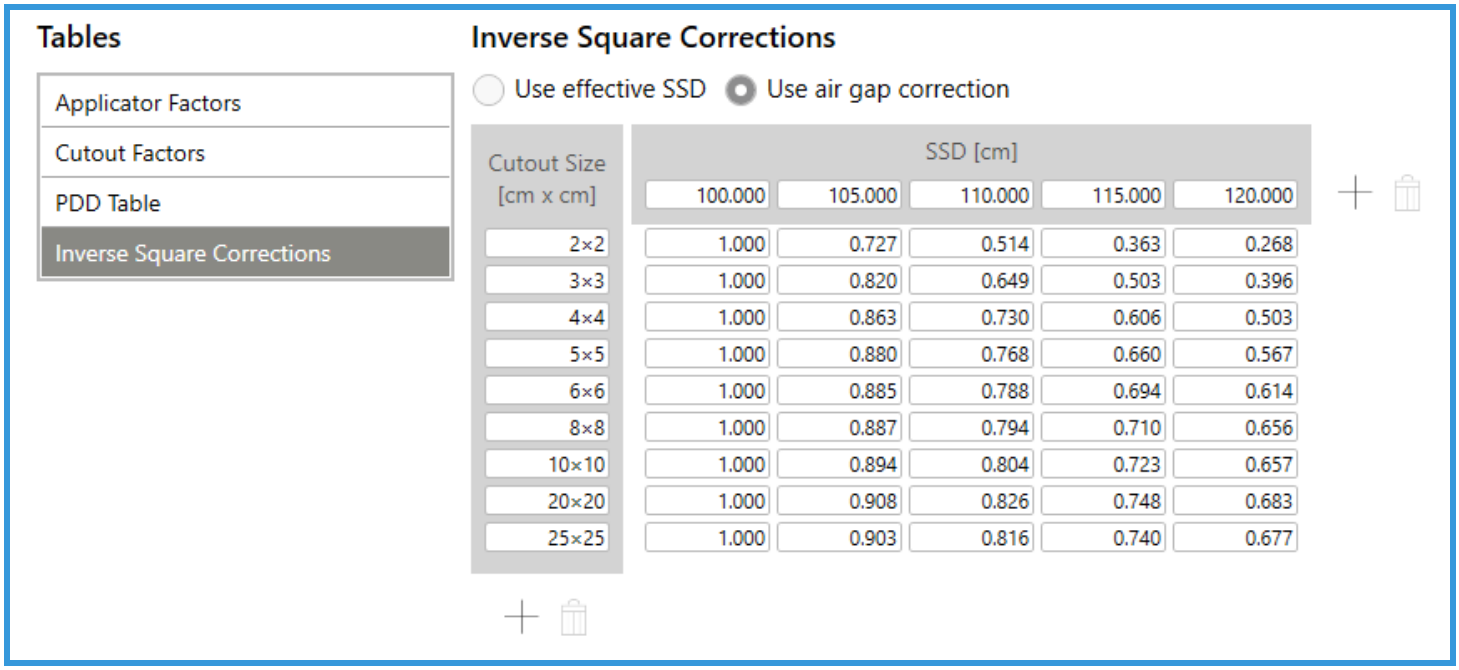
27. Cutout Factor DataGrid
28. Cutout sizes
29. Applicator Size available for data entry
30. Cutout Factor DataGrid entry
31. Add additional Cutout Size
32. Delete selected Cutout Size



33. Percent Depth Dose (PDD) Table DataGrid
34. Import button, allows user to import their PDDs in CSV or ASC format
35. Percent Depth Dose data DataGrid (read-only)



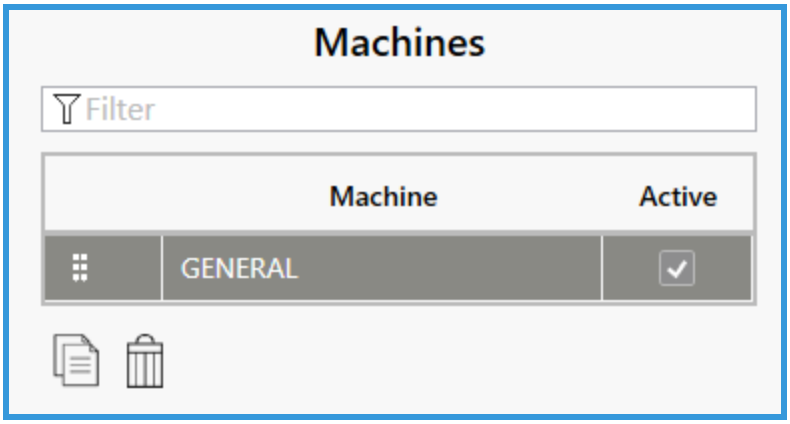
36. Inverse Square Corrections (IVS) DataGrid heading
37. IVS Method Toggle: Effective SSD or Air Gap
38. Effective SSD Method Cutout Size (Effective SSD DataGrid only)
39. Effective SSD Method Effective SSD values (Effective SSD DataGrid only)
40. Add additional Cutout Size (Effective SSD DataGrid only)
41. Delete selected Cutout Size (Effective SSD DataGrid only)



42. Cutout Size TextBoxes (Air Gap Correction DataGrid only)
43. SSD TextBoxes (Air Gap Correction DataGrid only)

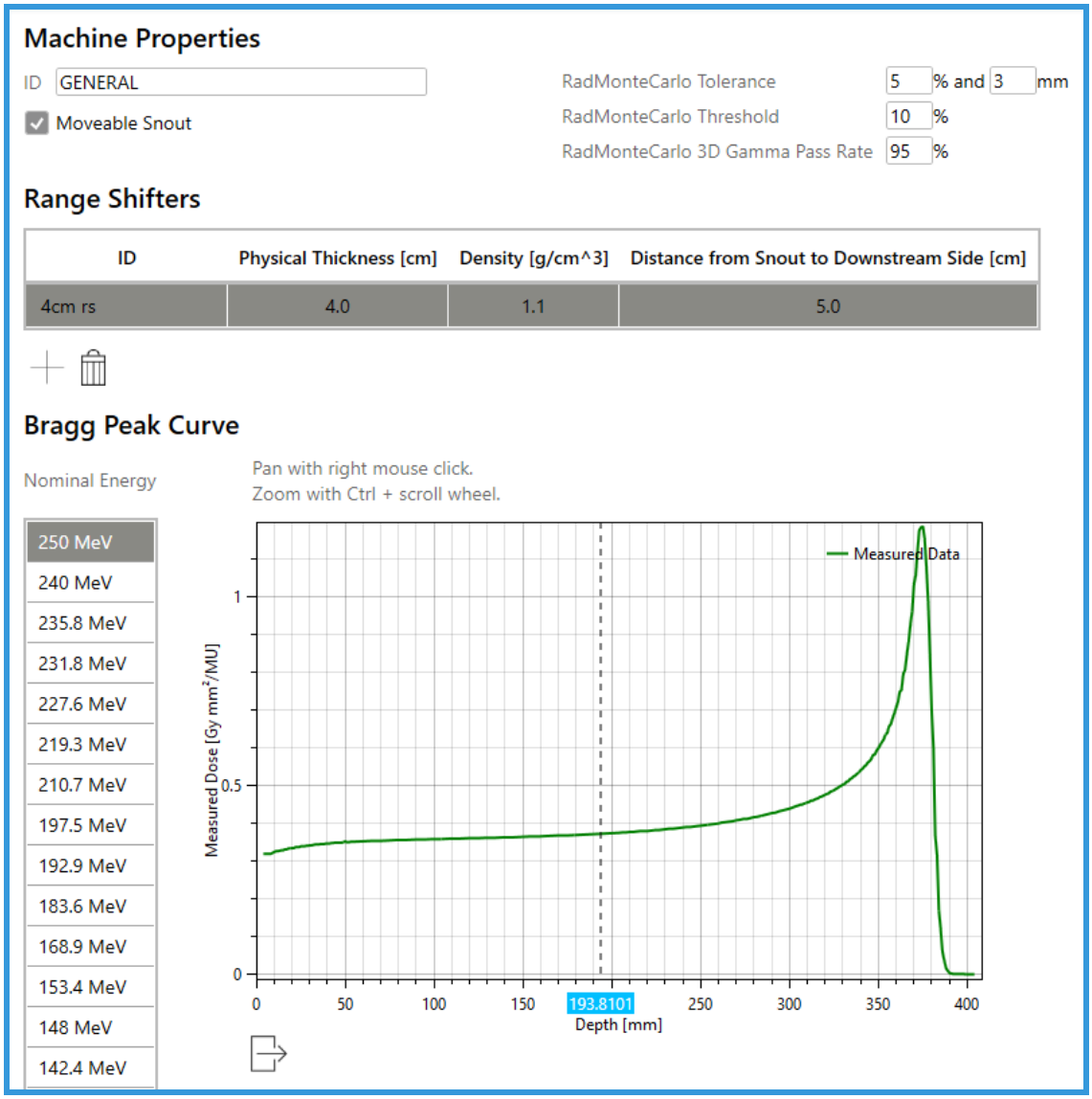
44. Add additional SSD (Air Gap Correction DataGrid only)
45. Delete selected SSD (Air Gap Correction DataGrid only)
46. Air Gap Correction data DataGrid (Air Gap Correction DataGrid only)
47. Add additional Cutout Size (Air Gap Correction DataGrid only)
48. Delete selected Cutout Size (Air Gap Correction DataGrid only)

7. Overview of Proton Machines Configuration



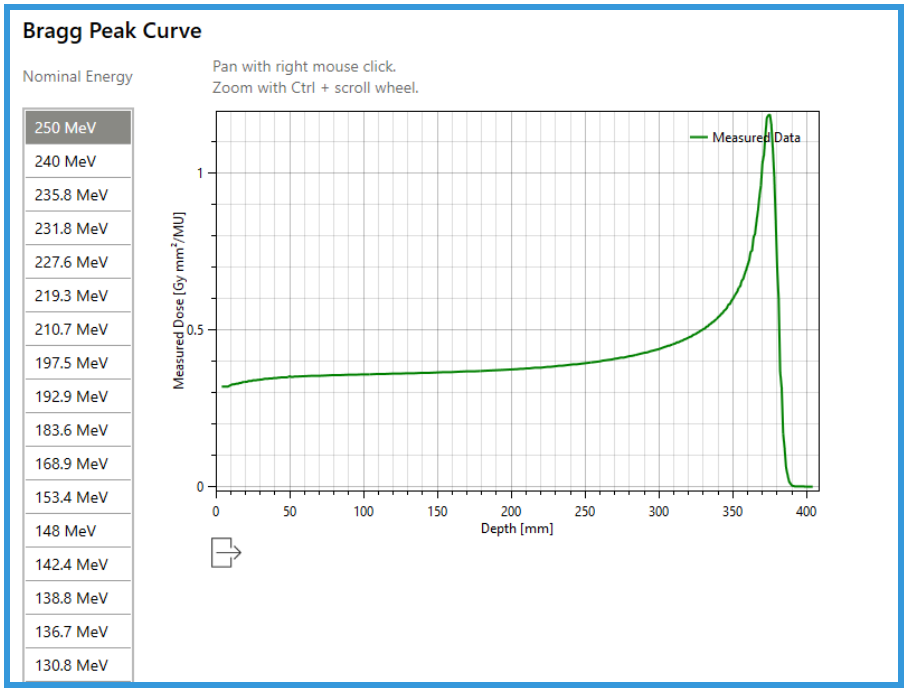
1. Machine List Heading
2. Filter search for proton units
3. Proton machines commissioned in ClearCalc DataGrid
4. Active Machines CheckBox
5. Copy current Machine
6. Delete selected Machine

8. Overview of Proton Data Configuration

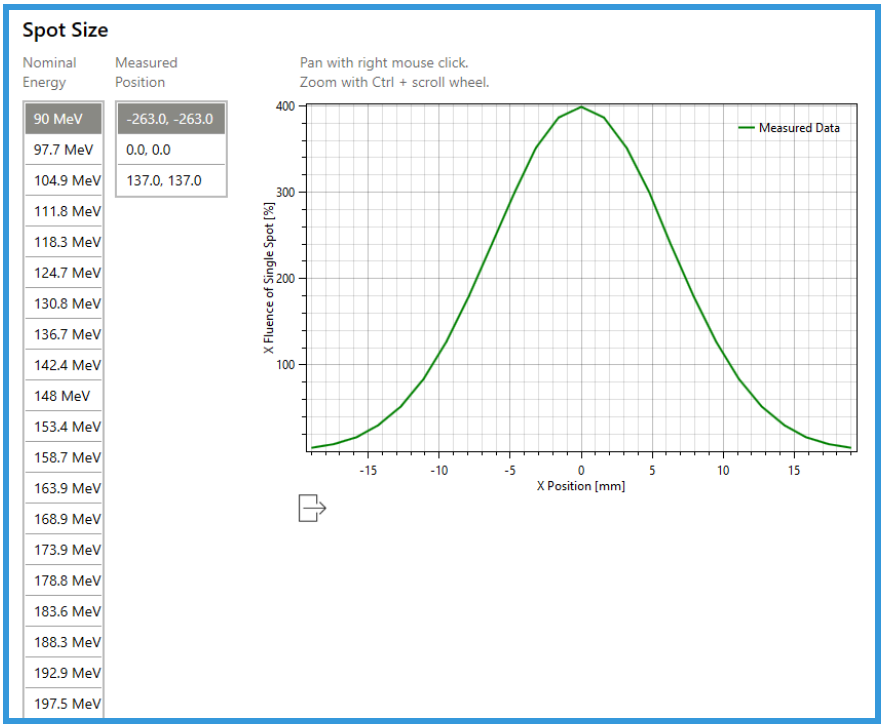


1. Machine Properties heading
2. ClearCalc Machine ID (this is auto-matched to incoming plan's Eclipse Machine ID - must be identical to auto-match)
3. Checkbox to toggle on/off the Moveable Snout
4. Tolerances:
    a. RadMonteCarlo tolerance: for Gamma Analysis criteria: % diff and distance to agreement (mm)
    b. RadMonteCarlo threshold: the low dose threshold limit used in Gamma analysis and 3D Gamma Index Pass/Fail Colorwash
    c. RadMonteCarlo Pass Rate: percentage of points meeting gamma index criteria
5. Range Shifters DataGrid heading
    a. Range Shifter ID: editable user entry
    b. Physical Thickness: editable user entry

c. Density: editable user entry
d. Distance from "_____" to Downstream Side: editable user entry:
    i. Titled: "Distance from Snout to Downstream Side" if moveable snout is check
    ii. Titled: "Distance from Isocenter to Downstream Side" if moveable snout is check
e. Copy Range Shifter
f. Delete Range Shifter

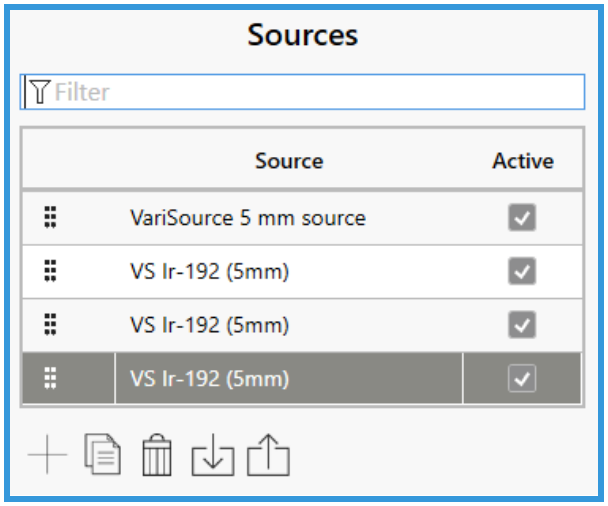


6. Bragg Peak Curve heading
7. Bragg Peak Curve Energy DataGrid
8. Measured Bragg Peak graph per energy
9. Copy selected ClearCalc measured Bragg Peak data to clipboard



10. Spot Size Heading
11. Spot Size Profile DataGrid
12. Measured Position DataGrid, per energy
13. Measured Spot size graph per energy, per measured position
14. Copy selected ClearCalc measured Spot Size data to clipboard

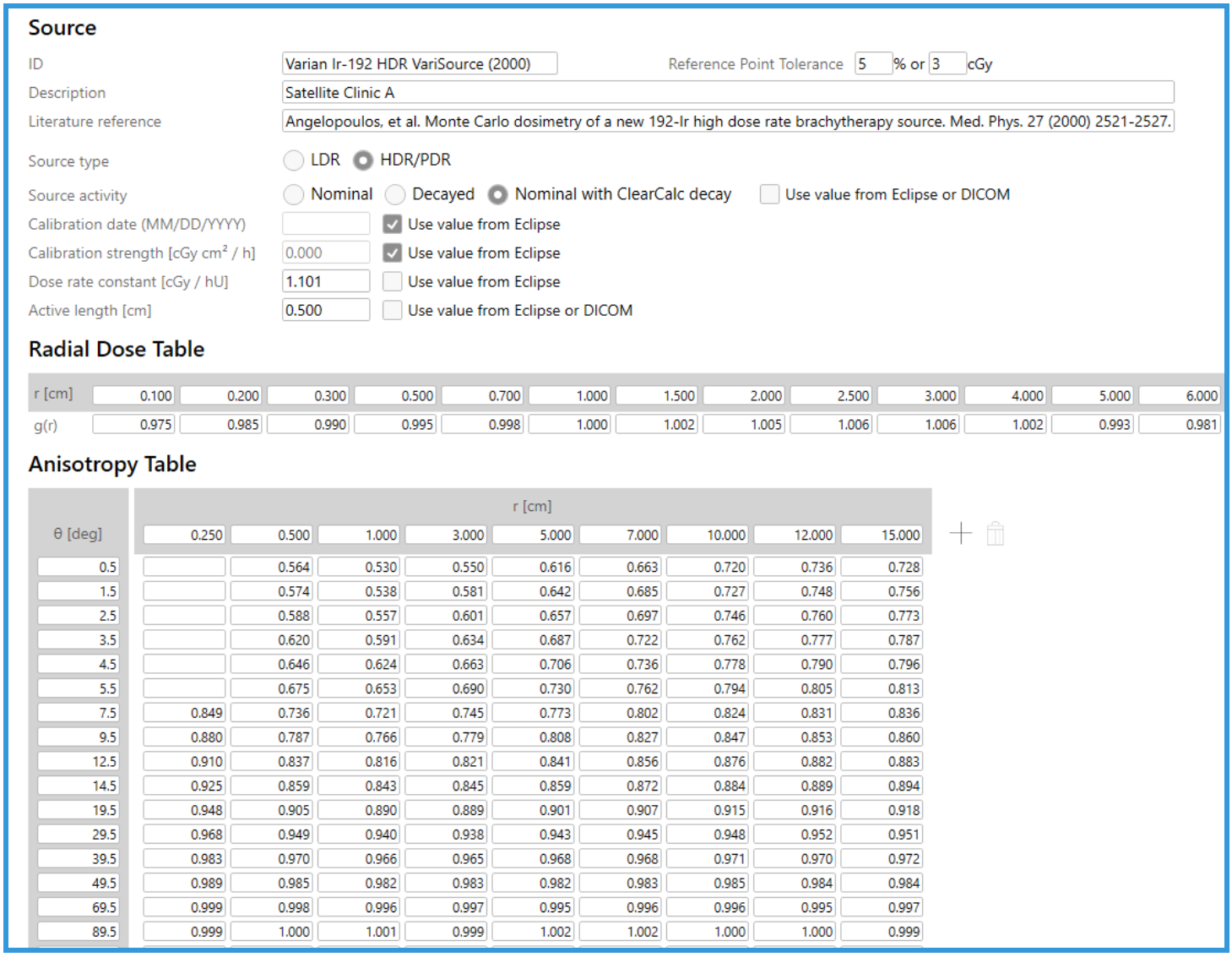
9. Overview of Brachy Source configuration



1. Sources heading
2. Filter search for ClearCalc Sources
3. Sources commissioned in ClearCalc DataGrid
4. Active Sources CheckBox
5. Add new Source

6. Copy current Source
7. Delete selected Source
8. Import compatible .source file
9. Export selected source to .source file

10. Overview of Brachytherapy Data Configuration



Source

ID: Varian Ir-192 HDR VariSource (2000) — Reference Point Tolerance: 5 % or 3 cGy

Description: Satellite Clinic A

Literature reference: Angelopoulos, et al. Monte Carlo dosimetry of a new 192-Ir high dose rate brachytherapy source. Med. Phys. 27 (2000) 2521-2527.

Source type: LDR / HDR/PDR

Source activity: Nominal / Decayed / Nominal with ClearCalc decay / Use value from Eclipse or DICOM

Calibration date (MM/DD/YYYY): Use value from Eclipse

Calibration strength [cGy cm² / h]: 0.000 — Use value from Eclipse

Dose rate constant [cGy / hU]: 1.101 — Use value from Eclipse

Active length [cm]: 0.500 — Use value from Eclipse or DICOM

Radial Dose Table

r [cm]	0.100	0.200	0.300	0.500	0.700	1.000	1.500	2.000	2.500	3.000	4.000	5.000	6.000
g(r)	0.975	0.985	0.990	0.995	0.998	1.000	1.002	1.005	1.006	1.006	1.002	0.993	0.981

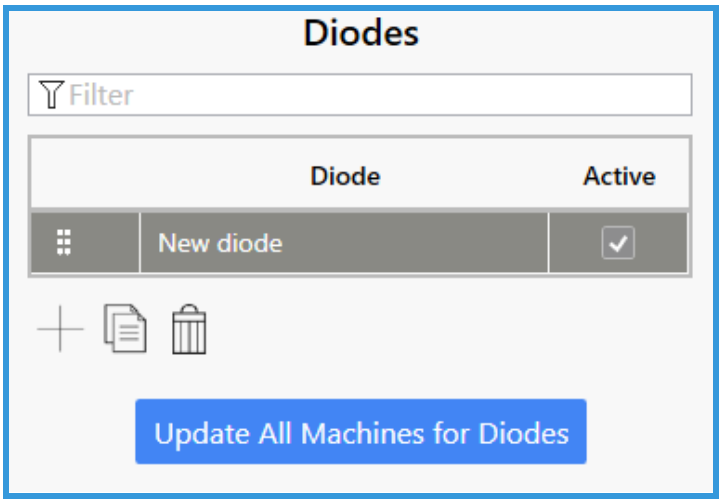
Anisotropy Table

θ [deg] \ r [cm]	0.250	0.500	1.000	3.000	5.000	7.000	10.000	12.000	15.000
0.5		0.564	0.530	0.550	0.616	0.663	0.720	0.736	0.728
1.5		0.574	0.538	0.581	0.642	0.685	0.727	0.748	0.756
2.5		0.588	0.557	0.601	0.657	0.697	0.746	0.760	0.773
3.5		0.620	0.591	0.634	0.687	0.722	0.762	0.777	0.787
4.5		0.646	0.624	0.663	0.706	0.736	0.778	0.790	0.796
5.5		0.675	0.653	0.690	0.730	0.762	0.794	0.805	0.813
7.5	0.849	0.736	0.721	0.745	0.773	0.802	0.824	0.831	0.836
9.5	0.880	0.787	0.766	0.779	0.808	0.827	0.847	0.853	0.860
12.5	0.910	0.837	0.816	0.821	0.841	0.856	0.876	0.882	0.883
14.5	0.925	0.859	0.843	0.845	0.859	0.872	0.884	0.889	0.894
19.5	0.948	0.905	0.890	0.889	0.901	0.907	0.915	0.916	0.918
29.5	0.968	0.949	0.940	0.938	0.943	0.945	0.948	0.952	0.951
39.5	0.983	0.970	0.966	0.965	0.968	0.968	0.971	0.970	0.972
49.5	0.989	0.985	0.982	0.983	0.982	0.983	0.985	0.984	0.984
69.5	0.999	0.998	0.996	0.997	0.995	0.996	0.996	0.995	0.997
89.5	0.999	1.000	1.001	0.999	1.002	1.002	1.000	1.000	0.999

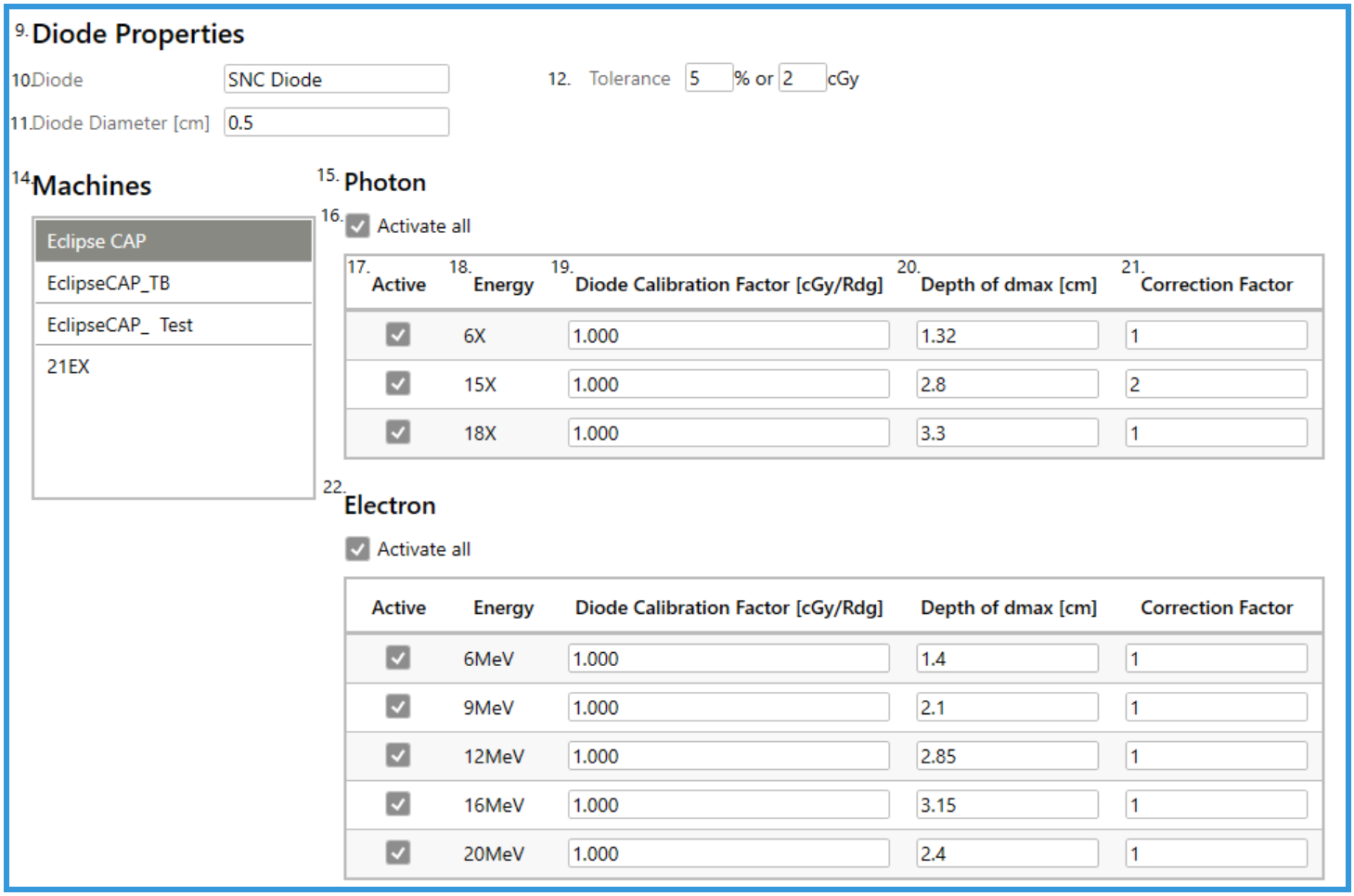
1. Source Properties heading
2. ClearCalc Source ID (this is auto-matched to incoming plan's based on the Eclipse Source ID - must be identical to auto-match)
3. Reference Point Tolerances (% and cGy)
4. Source description (useful when multiple sources have the same name at an institution/shared database situation - the Description will be used to populate options for source selection)
5. Source literature reference (pre-populated for the ClearCalc base sources), editable
6. Source type: LDR or HDR/PDR

7. Source activity:
    - Nominal (for non-decayed sources)
    - Decayed (for TPS-decayed sources)
    - Nominal with ClearCalc decay (for Nominal source that ClearCalc should decay for the user
    - Use value from Eclipse or DICOM (to utilize the value as is set in Eclipse, for API users, or exported in DICOM, for Standalone user)
8. Source Calibration Date (MMM/DD/YYYY) if set for ClearCalc independent decay calculations - user may also choose Use Value from Eclipse for pertinent sources when using the Eclipse API
9. Source Calibration Strength [cGy cm^2 / h] if set for ClearCalc independent decay calculations - user may also choose Use Value from Eclipse for pertinent sources when using the Eclipse API
10. Source Dose Rate Constant: user may also choose Use Value from Eclipse for pertinent sources when using the Eclipse API
11. Source Active Length: user may also choose Use Value from Eclipse or DICOM for pertinent sources when using the Eclipse API
12. Reference Point Tolerance: relative is primary tolerance, absolute is secondary
13. Radial Dose Table DataGrid heading
14. Distance
15. Dose Function
16. Add Radial Dose Table entry
17. Delete Radial Dose Table entry
18. Anisotropy Table DataGrid
19. Distance [cm]
20. Theta (degrees)
21. Add additional distances
22. Delete selected distance
23. Add additional thetas
24. Delete selected theta

11. Overview of Diode Configuration

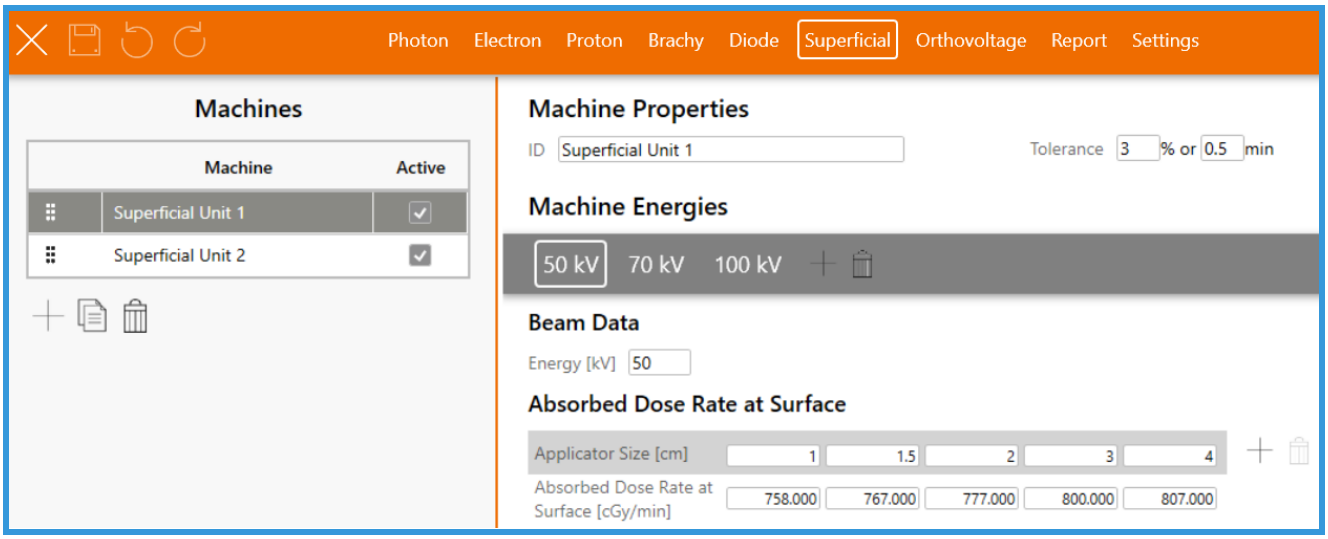


1. Diodes heading
2. Filter search for ClearCalc Diodes
3. Diodes configured in ClearCalc DataGrid
4. Active Diodes CheckBox
5. Add new Diode
6. Copy current Diode
7. Delete selected Diode
8. Update all Machines for Diodes button that synchronizes all active machines and their configured photon and electron energies with the available Diodes



9. Diode Properties heading
10. Diode name
11. Diode Diameter [cm]
12. Diode Tolerance % (primary) and absolute (secondary)
13. Machines table showing the currently-synchronized machines for the selected Diodes - this table updates active Admin machines when using the Update Diodes buttons
14. Active machine for editing (highlighted)
15. Photon energies table displaying a modality-specific table for the machine - each table with column headings:
16. Activate All CheckBox to activate all energies for the modality for the diode
17. Active CheckBox to toggle individual energies
18. Energy
19. Diode Calibration Factor [cGy/rdg]
20. Depth of maximum dose [cm] for the energy - pre-populated from the Admin data for the specified energy, editable
21. Correction Factor used to apply any more diode/energy-specific corrections
22. Electron energies table displaying a modality-specific table for the machine - with the same column headings as listed for photons

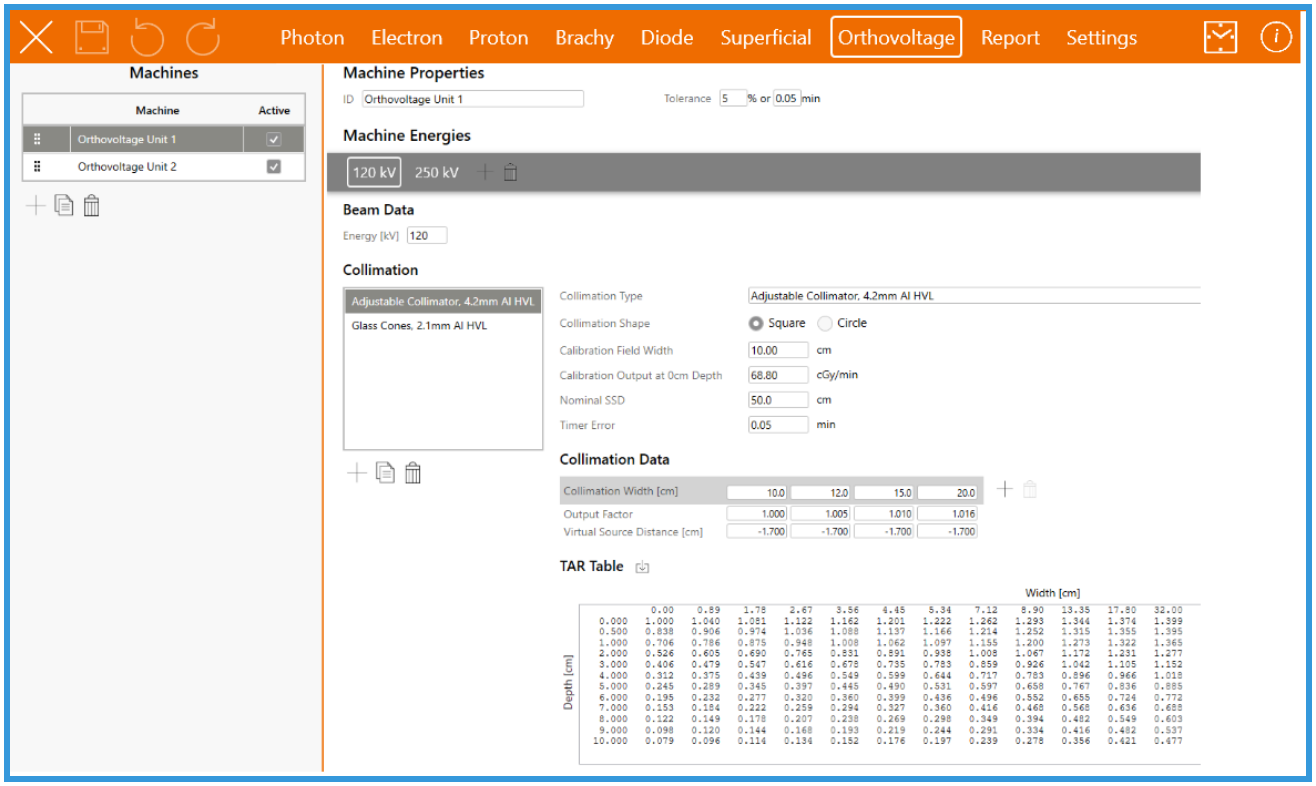
12. Overview of Superficial Calculation



Left to right, top to bottom:

1. Machines heading
2. List of configured machines in ClearCalc DataGrid
3. Active Superficial Machines CheckBox
4. Add new Superficial Machines
5. Copy current Superficial Machines
6. Delete selected Superficial Machines
7. Machine Properties heading
8. Superficial Machine ID
9. Superficial Tolerance (% and min)
10. Machine Energies heading
11. Available Machine energy options row, white surround shows active energy
12. Add additional electron energies
13. Delete selected energy
14. Beam Data heading
15. Active Beam Energy
16. Absorbed Dose Rate at Surface DataGrid
17. Applicator Size, editable via Plus icon to add and Trash can icon to Delete
18. Absorbed Dose Rate at Surface [cGy/min] for the corresponding applicator

13. Overview of Orthovoltage Configuration

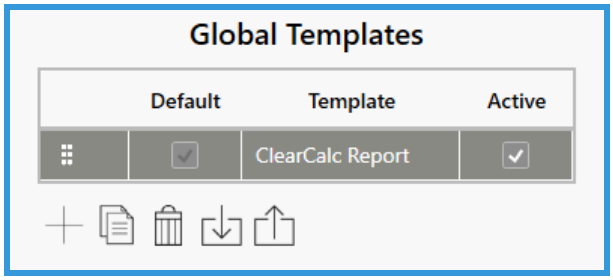


Left to right, top to bottom:

1. Machines heading
2. List of configured machines in ClearCalc DataGrid
3. Active Orthovoltage Machines CheckBox
4. Add new Orthovoltage Machines
5. Copy current Orthovoltage Machines
6. Delete selected Orthovoltage Machines
7. Machine Properties heading
8. Orthovoltage Machine ID
9. Orthovoltage Tolerance (% and min)
10. Machine Energies heading
11. Available Machine energy options row, white surround shows active energy
12. Add additional electron energies
13. Delete selected energy
14. Beam Data heading
15. Active Beam Energy
16. Collimation heading
17. Collimation Table
18. Add/Copy/Delete selected Collimation
19. Collimation Type text description
20. Collimation Shape, Square or Circle
21. Calibration Field Width [cm]

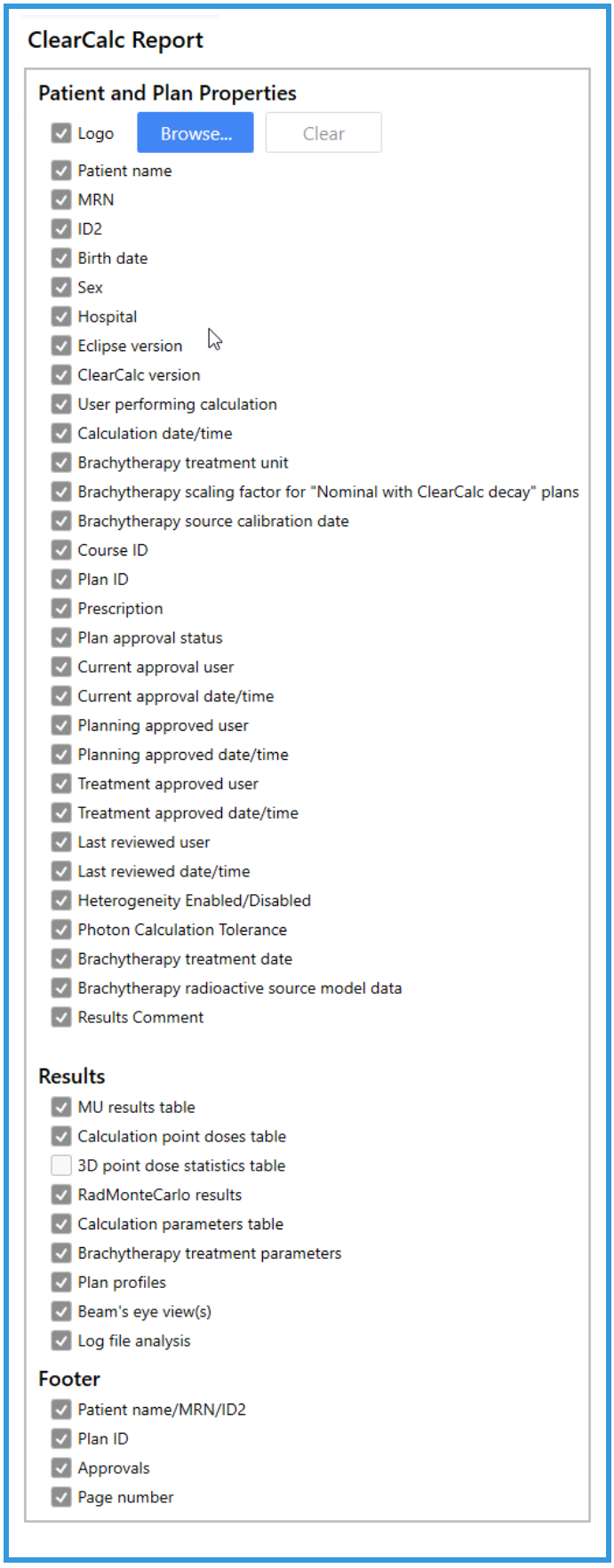
22. Calibration Output at 0 cm Depth [cGy/min]
23. Nominal SSD for Calibration settings
24. Timer error for Collimation Type
25. Collimation Data DataGrid
26. Collimation Width [cm], user editable via add/delete icons
27. Output Factor for respective Collimation Width
28. Virtual Source Distance [cm] for respective Collimation Width, 0=no adjustment of VSD
29. TAR Table heading
30. Import icon allows the user to import the TAR table in CSV format (only) for the respective Collimation Type
    a. Row label is Depth [cm]
    b. Column label is:
        i. Width [cm] for Square Collimation Shape
        ii. Diameter [cm] for Circle Collimation Shape

14. Overview of Report Configuration



Top to bottom:

1. Global Templates heading
2. Report Templates DataGrid
3. Active Report Templates CheckBox
4. Add new Report Template
5. Copy current Report Template
6. Delete selected Report Template
7. Import compatible .report file
8. Export selected source to .report file



Top to bottom:

Patient and Plan Properties

9. Logo
10. Patient Name from plan
11. MRN (ID1 from Eclipse API plans
12. ID2, if available
13. Birth date of patient
14. Gender of patient
15. Hospital, if available
16. Eclipse version (API plans only)
17. ClearCalc version
18. User performing ClearCalc calculation
    a. Via the API, the name as it appears of the user logged into Eclipse
    b. Via the Standalone, the user logged into the application
19. ClearCalc Calculation Date/time stamp
20. Brachytherapy Treatment Unit, brachy only
21. Brachy scaling factor for "Nominal with ClearCalc Decay" source/plans, brachy only
22. Brachytherapy source calibration date
    a. Via either ClearCalc Administration or via the API (based on Admin setting)
23. Course ID, if available
24. Plan ID
25. Prescription
26. Plan approval status, if available
27. Current approval user, API only
28. Current approval date/time, API only
29. Planning approved user, API only
30. Planning approved date/time, API only
31. Treatment approved user, API only
32. Treatment approved date/time, API only
33. Last reviewed user, API only
34. Last reviewed date/time, API only
35. ClearCalc Heterogeneity enabled/disabled
36. Photon Calculation Tolerance applied, photon plans only
37. Brachytherapy Treatment Date, brachy only
38. Brachytherapy Source ID, brachy only
39. Results Comment

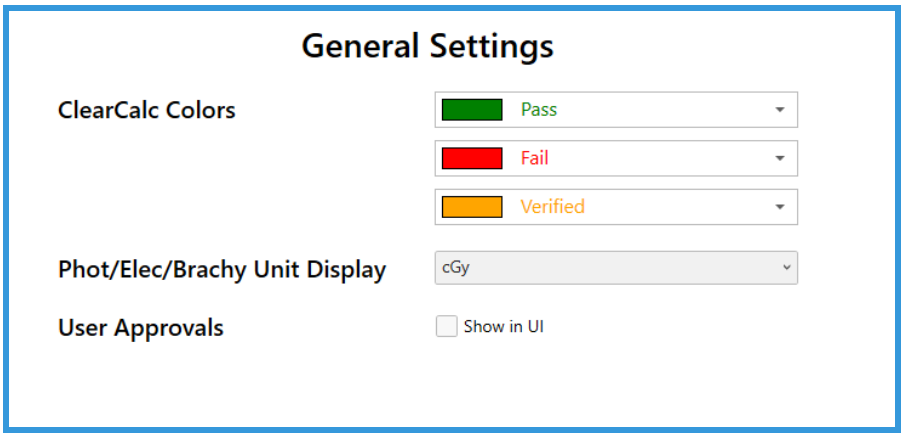
Results

40. MU results table, if applicable
41. Calculation Point Doses Table, if applicable
42. 3D point dose statistics table, if applicable
43. Calculation Parameters table
44. Brachytherapy Treatment Parameters, brachy only
45. Beam's eye views, if applicable
46. Log file analysis results, if applicable

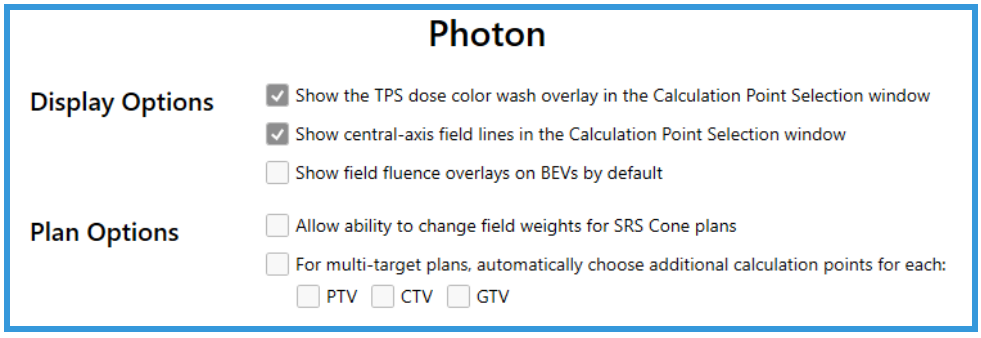
Footer

47. Patient name/MRN/ID2 display in footer
48. Plan ID display in footer
49. ClearCalc Approvals display in footer
50. Page numbers

15. Overview of Settings Sub-menus



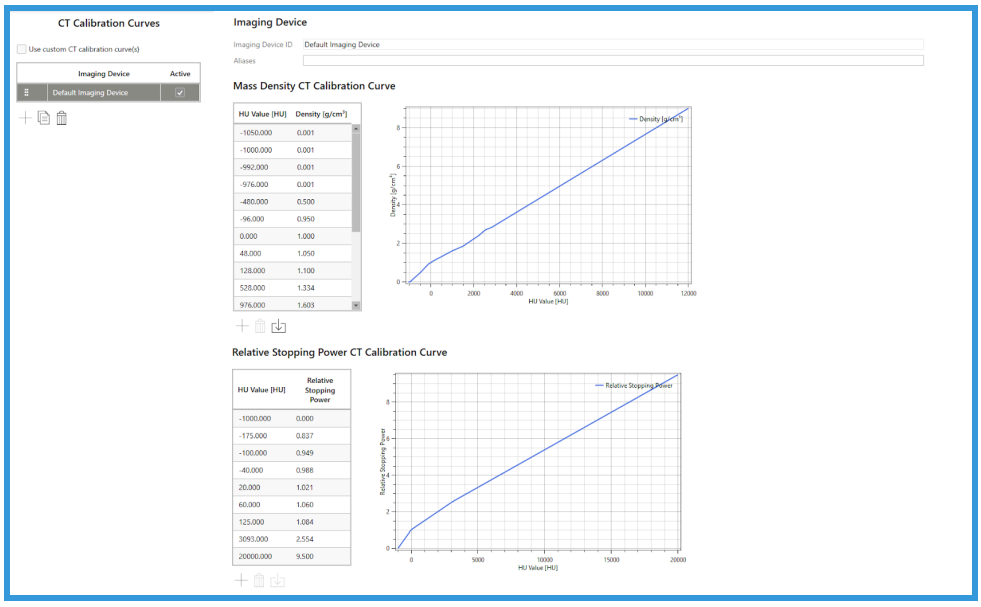
a. General
   i. Choose system Pass, Condition, and Verify colors
   ii. Set ClearCalc system units for Photon/Electron/Brachy plans to cGy or Gy
   iii. Show or Hide User Approval option in Overview Center Window



b. Photon
   i. Option to show dose displayed over CT in Calculation Point Selection window

ii. Option to show central-axis field line displayed over CT in Calculation Point Selection window
iii. Option to display the fluences on the BEVs by default
iv. Option to allow user to change SRS Cone plan field weights
v. Option allow ClearCalc to auto-find a calc point for each PTV/CTV/GTV target structure by default

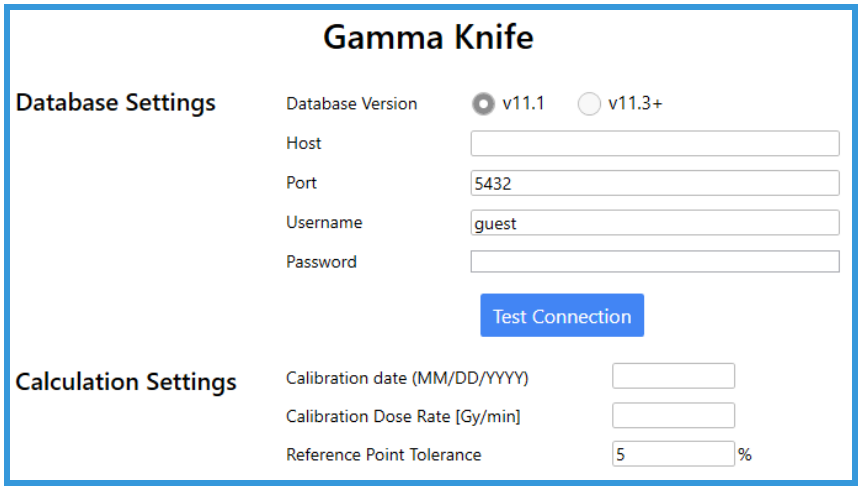
c. Brachytherapy
   i. Option to print brachytherapy plans that contain Treatment Schedules to individual reports (as opposed to one PDF for all treatments)



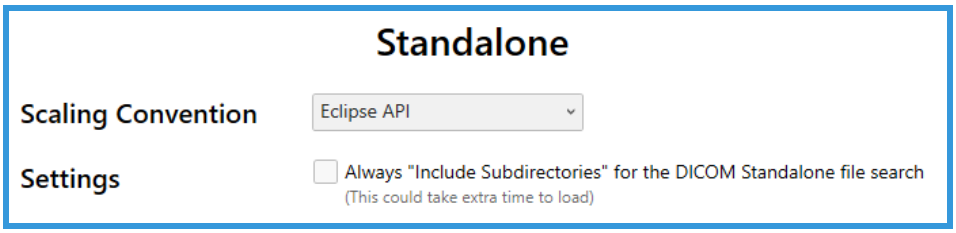
d. CT Calibration Curves (for RadMonteCarlo Calculations)
   i. Left to Right:
      1. CT Calibration Curves heading
         a. User option to use custom CT calibration curves or default ClearCalc CT calibration curves
         b. Imaging devices commissioned in ClearCalc DataGrid
         c. Active devices CheckBox
         d. Add Imaging Device
         e. Copy Imaging Device
         f. Delete Imaging Device
      2. Imaging Devices Heading

a. Imaging Device ID entry
b. Imaging Device Alias entry
c. ClearCalc uses the following logic to match the Imaging Device to the plan:
    i. Via DICOM Standalone:
        1. Alias: Manufacturer Model Name - DICOM (0008,1090) and either Device Serial Number - DICOM (0018,1000) Or Device ID - DICOM (0018,1003). Individual values must be separated by a comma or semicolon.
            a. Additionally, if the user desires to match CT Calibration curves based on scan protocol, the name of the scan protocol can be added to the list of Alias values
            b. If multiple devices are listed that share the same Manufacturer Model Name, Serial Number or Device ID, ClearCalc will look for the device that has a matching scan protocol. If no matching scan protocol is found, among similar units, ClearCalc will choose the unit that appears first in the table.
    ii. Via Eclipse ESAPI:
        1. Imaging Device ID set during treatment planning or
        2. Alias: Imaging Device Manufacturer, Imaging Device Model, Imaging Device Serial Number

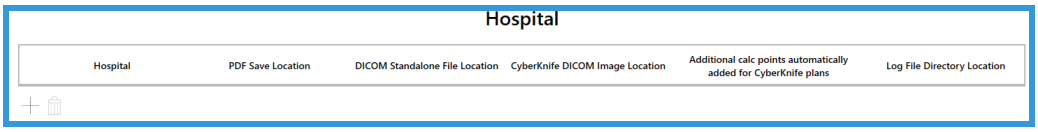
3. Mass Density CT Calibration Curve Heading
    a. HU Value versus Density DataGrid: values may be manually added to table or pasted as a group from a spreadsheet
    b. Add New Row
    c. Remove selected Row
    d. Paste Table Clipboard
    e. Density versus HU Value Graph
4. Relative Stopping Power CT Calibration Curve Heading
    a. HU Value versus Relative Stopping Power DataGrid: values may be manually added to table or pasted as a group from a spreadsheet
    b. Add New Row
    c. Remove selected Row
    d. Paste Table Clipboard
    e. Density versus HU Value Graph



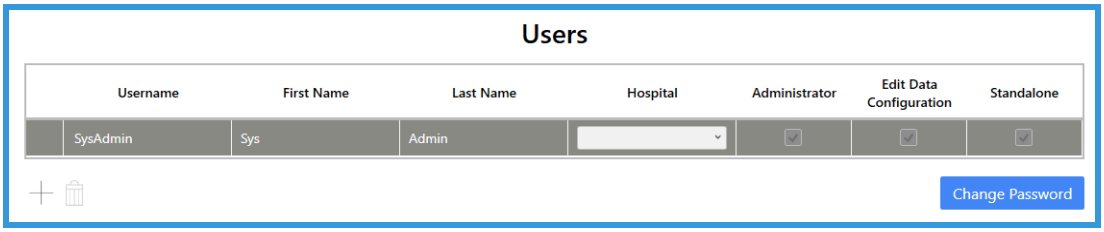
e. Gamma Knife
   i. Gamma Knife Database Settings for querying GammaPlan
      1. Database version: v11.1 or 11.3+
      2. Host IP address
      3. Port (typically 5432)
      4. Username (typically “guest”)
      5. Password for Username account
      6. Test Connection button verifying that the database values entered are synchronizing properly
   ii. Calculation Settings
      1. Calibration Date (MM/DD/YYYY): Optional. If pass/fail color coding is desired, the calibration date may be entered. If this date is entered, the Calibration Dose Rate entered in Administration will be compared to the Calibration Dose Rate from the GammaPlan database plan file and will appear in green font if it matches or red font if the date does not match. The color coding will display in both the calculation results and the report. If this date is left blank, the GammaPlan planned source calibration date will be displayed with black font.
      2. Calibration Dose Rate [Gy/min]: Optional. If pass/fail color coding is desired, the calibration dose rate may be entered. If this dose rate value is entered, the Calibration Dose Rate entered in Administration will be compared to the Calibration Dose Rate from the GammaPlan database plan file and will appear in green font if it matches or red font if the date does not match. The color coding will display in both the calculation results and the report. If this date is left blank, the GammaPlan planned source calibration dose rate will be displayed with black font.
      3. Reference Point Tolerance: percentage difference criteria used to evaluate reference point pass/fail



f. Standalone
   i. Scaling Convention: LINAC Scaling ComboBox allows the user to choose their scaling convention - default is “Eclipse API”
   ii. Settings: User option to default include subdirectories for DICOM standalone plan data file search

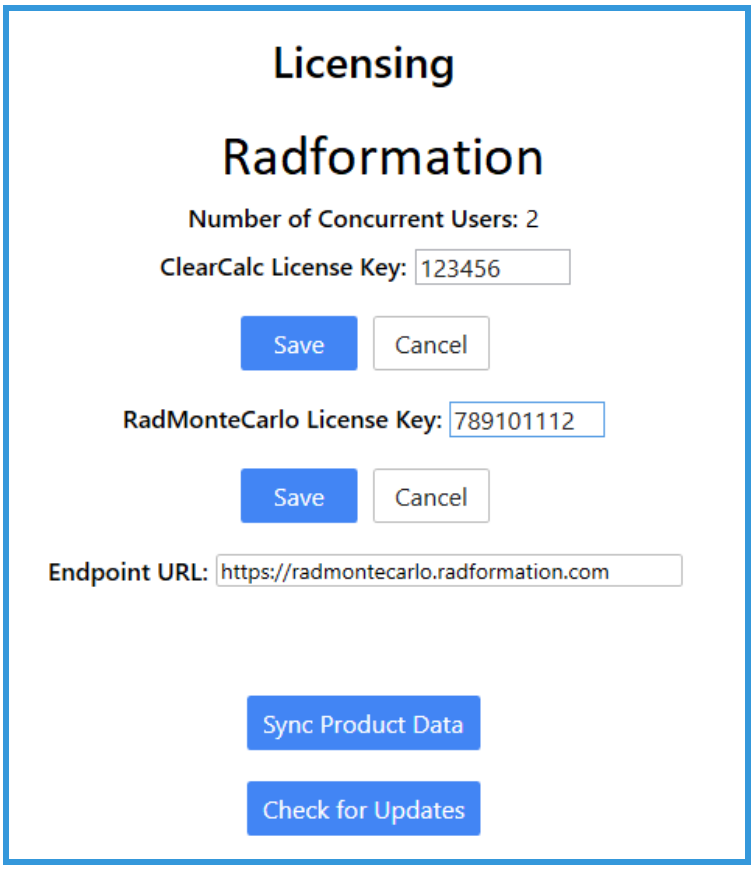


g. Hospital
   i. Hospital Settings DataGrid
   ii. Hospital Name for hospital-specific file settings
   iii. Location for respective hospital’s PDF save
   iv. Location for respective hospital’s DICOM file location for Standalone
   v. Location for respective hospital’s Cyberknife file location for Standalone
   vi. Option allow ClearCalc to auto-find additional calc points for Cyberknife plans based on the user-entered value
   vii. Plus icon to add new hospital to Hospital DataTable
   viii. Trash can icon to remove hospital from Hospital DataTable



h. Users
   i. Set user name
   ii. Set first name
   iii. Set last name
   iv. Add new user
   v. Delete selected user
   vi. User’s assigned Hospital (applies Hospital-related defaults from “Settings” tab

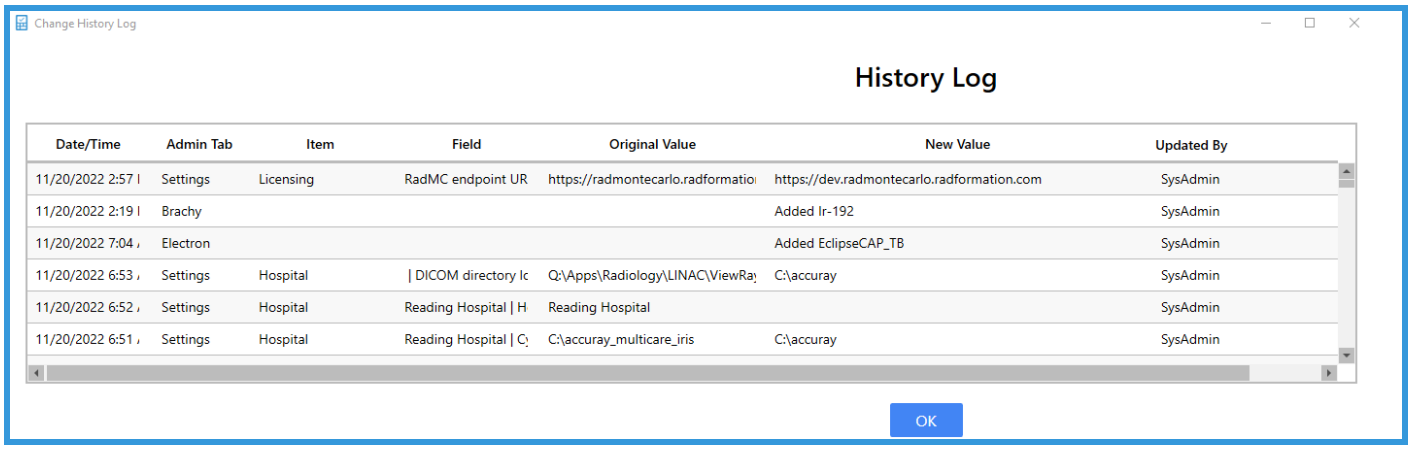
vii. Toggle on/off Administrator: user is allowed to edit user rights and beam configuration (note: when this level is selected, the lower “Edit Data” and “Standalone” levels will also be toggled on)
viii. Toggle on/off Data Configuration: user is allowed to edit machine and source data (note: when this level is selected, the lower “Standalone” level will also be toggled on)
ix. Toggle on/off Standalone: user is only allowed to use the Standalone application and will not be able to enter Administration
x. Change password for highlighted user
xi. Toggle on/off Administrator: user is allowed to edit user rights and beam configuration (note: when this level is selected, the lower “Edit Data” and “Standalone” levels will also be toggled on)
xii. Toggle on/off Data Configuration: user is allowed to edit machine and source data (note: when this level is selected, the lower “Standalone” level will also be toggled on)
xiii. Toggle on/off Standalone: user is only allowed to use the Standalone application and will not be able to enter Administration
xiv. Change password for highlighted user



i. Licensing
    i. Licensing Site Name
    ii. Number of Concurrent Users

iii. ClearCalc License key
iv. Monte Carlo License key
v. Endpoint URL: RadMonteCarlo endpoint for plan data upload and particle simulation
vi. Allows user to synchronize product data for both ClearCalc and RadMonteCarlo with Radformation's web server
vii. Check for Updates for ClearCalc-only users (hides for users that have ClearCheck)

16. Overview of Change History Log



Change History Log DataGrid

1. Date/Time: date/time stamp of Administration change
2. Admin Tab: main menu in which change was made
3. Item: sub-menu in which change was main
4. Field: property that was modified
5. Original value: value prior to change
6. New value: value after change
7. Updated By: user that made change

7. ClearCalc Features

ClearCalc Calculation Point Selection for Photons

Point Selection Logic

ClearCalc has an integrated option to automatically select the be point from the calculated plan. This option may be activated or deactivated via the "Photon" tab on a per-machine basis in ClearCalc Administration.

The ClearCalc point selection logic uses the following:

- First, ClearCalc checks all of the Reference Points contained in the plan to determine if every field in the plan passes utilizing those points. If all of the fields pass within the user-set tolerance for this point, ClearCalc will display the utilized Reference Point as the Calculation Point. If this is not satisfied, then...
- Next, ClearCalc will check the plan isocenter location to determine if the MU and dose for all fields to that point pass. If all of the fields pass within the user-set tolerance for this point, ClearCalc will display the Isocenter as the Calculation Point. If this is not satisfied, then…
- If enabled, ClearCalc will then move to its automated, internal Calculation Point Selection algorithm. Criteria for points created by the ClearCalc Point Selection is: ≥3mm from tissue transitions, ≥1 cm from all field edges, within the 90% Prescribed dose region (sometimes loosened to 70%), and exposed by the field (or all field-in-field segments). If ClearCalc is unable to find a single point for all fields, then...
- ClearCalc then follows the same point logic to find the least amount points, giving priority to the plan points, to get as many fields as possible to pass MU and dose within the user-set tolerance.

Manually Changing the Calculation Point or Adding Additional Calculation Points

To further customize the ClearCalc calculation point, the “Calculation Point Selection” window may be launched via the “View/Edit Calculation Points” button in the main results page. Here, users may optionally add (or remove) additional points to the Calculation Point Doses table. A description of the display and available operations of the Calculation Point Selection Window may be found in Overview of Photon Calculation Point Selection Window for Photon Plans (not available for cone SRS plans due to TMR-based calculation).

ClearCalc 3D Point Dose Comparison

ClearCalc will perform a 3D point dose comparison on all structures that are designated by the user. By default, ClearCalc populates all target structures (GTV, CTV, PTV, ITV) within the treatment plan. Users may add/remove structures from the list as desired. For the default population, once a target has been identified, ClearCalc will find up to ~250 points for evaluation within the target on an approximately 5 mm dose grid. When targets are smaller, the dose grid size is decreased so the maximum number of points may be found for comparison, still trying to find up to 250 (though for very small targets, this number will be less). Only voxels between -300 to 150 HU are checked for inclusion.

Each point within the target is then compared to the plan value using a relative dose difference only. The Pass/Fail criteria is set in ClearCalc Administration on the Photon tab, and is machine-specific. Each point will be evaluated based on the Reference Point Tolerance for the machine first. Then, the total number of passing points relative to the total number of evaluated points is reported via a Passing Percentage so show the overall relative dose point performance within the target. This is set using the “3D Point Dose Tolerance'' in Administration.

In addition to the point evaluation, ClearCalc will also display the mean dose to the target from both the TPS and ClearCalc (along with a standard deviation) for dose coverage evaluation and comparison.

Additionally, the mean relative and absolute dose difference determined from all evaluated points will also be reported (along with their respective standard deviations).

ClearCalc Photon Tolerances

ClearCalc will auto-assign tolerance settings from ClearCalc Administration based on the plan properties. For instance, if only the General Tolerance is set, and the IMRT/VMAT and SRS Tolerances are set to 0, ClearCalc will only use a single tolerance for all plans - the General Tolerance. If all 3 tolerances are set, then ClearCalc will look at the plan properties to auto-assign the Tolerance. For instance, if a plan contains 4 static MLC fields, ClearCalc will identify the plan as a 3D plan and choose the General Tolerance. If ClearCalc detects modulation with arc rotation in the plan, ClearCalc will identify the plan as VMAT and will assign the IMRT/VMAT Tolerance to the plan. Should the auto-assigned tolerances not be the desired settings, the user may use the Tolerances ComboBox in the Results UI to select a different tolerance. Custom Tolerances are also available for manual selection, but do not auto-assign. Once a new Tolerance is chosen, ClearCalc will automatically recalculate the plan results based on the newly selected tolerance.

ClearCalc Diodes

ClearCalc allows the user to configure diodes for clinical comparison to doses from photon and electron treatment plans. Note that diodes are not available on VMAT, arc, or SRS cone plans. Configuration begins in the ClearCalc Administration application and requires a user who has administrative access to the application to begin diode setup.

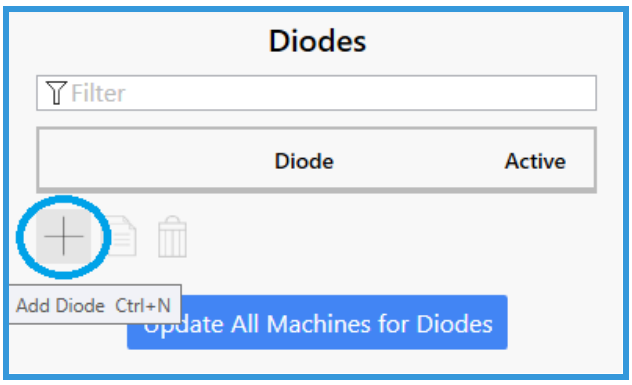
ClearCalc performs a calculation using the modified FSPB algorithm for the field on a flat water phantom at d_{max} for each field. This is an independent calculation of expected dose at the d_{max} depth for the field (as entered in ClearCalc admin for the machine/energy/diode combination on the Diode tab) and utilizes: the field geometry, applicable beam data for the field parameters as entered in ClearCalc Administration, ca.

When calculating the Expected Diode range, the ClearCalc d_{max} dose value is converted to a diode reading to find the ideal diode reading for the field using the Dose Calibration Factor and Correction Factor as entered by the user in ClearCalc Administration. This ideal reading is then used to find a range for the expected diode reading using the Tolerance set by the user in ClearCalc Administration. The ideal diode reading then accounts for the Tolerance percentage in both the positive and negative directions. For example, if ClearCalc determines that the ideal diode reading for Field 1 should be 65.5 and the Tolerance set in ClearCalc Administration is 5%, the Expected Diode Range will be 62.4 - 68.9.

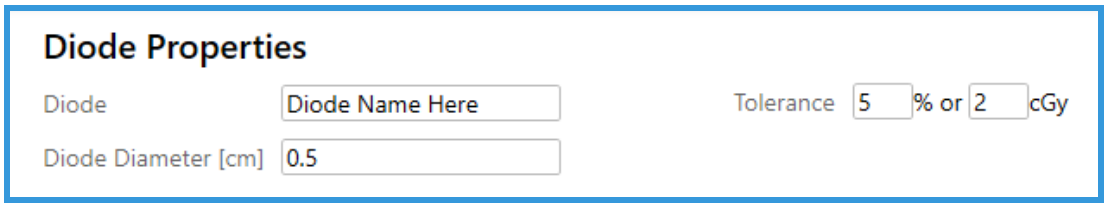
Diode Configuration

1. Launch the ClearCalc Administration application and login using Admin credentials.
2. Ensure that all photon and electron machines you wish to utilize with diodes are already configured in the Photon and Electron tabs.
3. Proceed to the Diode tab.

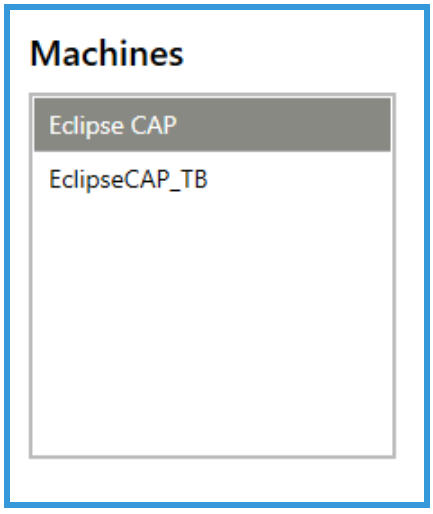
4. In the left sidebar, underneath the Diodes heading, choose the "+" sign (or use the shortcut CTRL + N) to add a new Diode.



5. In the center window, enter the diode properties (Diode name, Diode diameter, Diode tolerances).

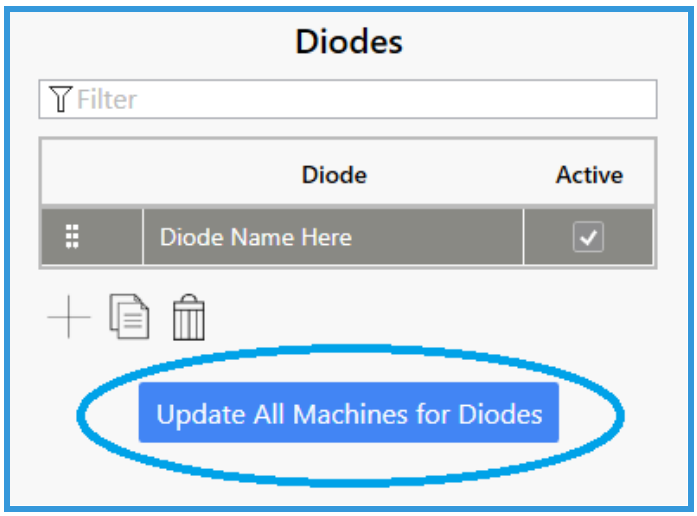


6. Under the Machines heading, ensure all configured and Active ClearCalc machines are displayed.



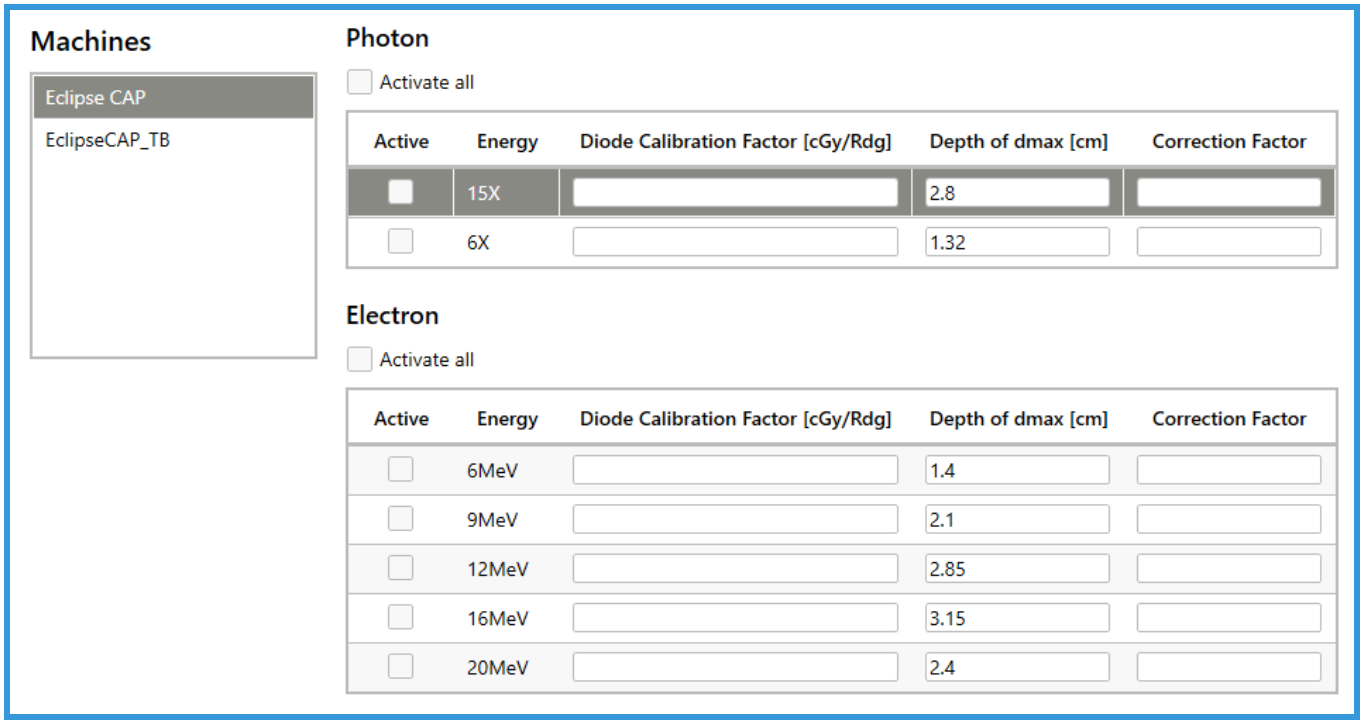
   a. Clicking the "+" sign when creating a new diode will automatically synchronize all ACTIVE photon and electron machines with the newly added diode.

b. If machines are not correct, click the blue button on the left sidebar titled “Update All Machines for Diodes” - this will automatically synchronize all Active photon and electron machines and energies with all listed diodes.



c. You may also use this button if you update your configured ClearCalc machines, as this will add/remove machines as needed.

7. Highlight a machine in the Machines table to begin configuration.
   a. All available modalities and energies for the selected machine will be listed to the right of the Machines table.

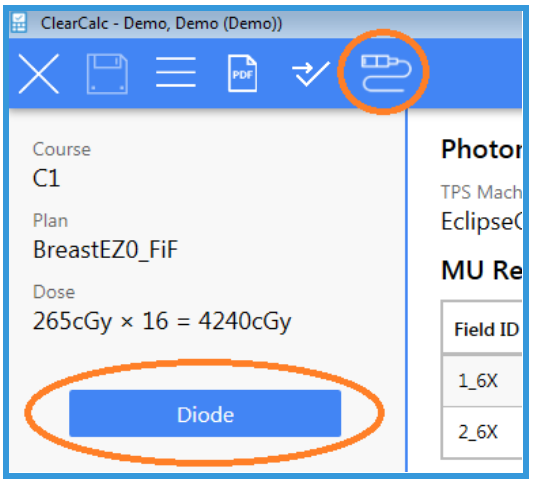


8. Activate the desired photon and electron energies by using the check box to the left of the energy value in each subtable.
    a. You may also quickly activate all energies for a modality (i.e. all photon energies) by using the "Active all" check box directly below the heading

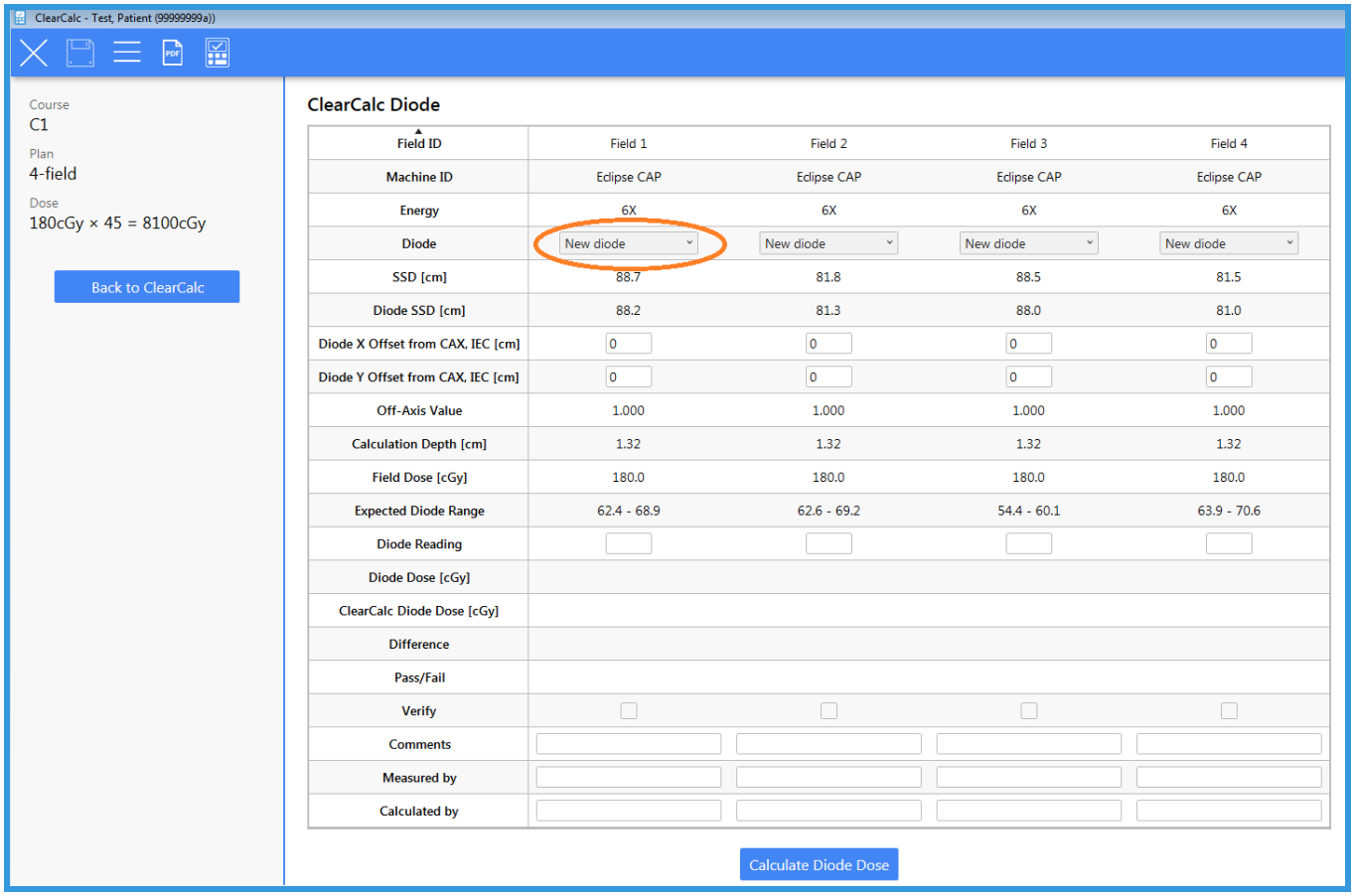
9. For all active energies, ClearCalc requires 3 pieces of data:
    a. Diode Calibration Factor [cGy/Rdg]: this is the diode calibration for the selected energy. This is obtained by taking a measurement at the machine to determine the cGy/Rdg conversion for that diode with the specified energy. For more information on how to obtain this value, please refer to your diode documentation.
    b. Depth of d_{max} [cm]: this is automatically populated by ClearCalc for each energy based on the data in the ClearCalc Administration application. While this data may be edited in the Diodes tab, note that any changes will deviate from the data for the respective energy as it exists in ClearCalc and is utilized for plan calculations.
    c. Correction Factor: This allows the user to adjust for any diode related correction factors that may not be accounted for in the Depth of d_{max} and Dose Calibration Factor. For no correction factor, set this value to 1.0.
10. Once the data entry is completed, click the Save icon or use CTRL + S to save the diode data. Your diode may now be used on applicable plans in ClearCalc.

Diode Use

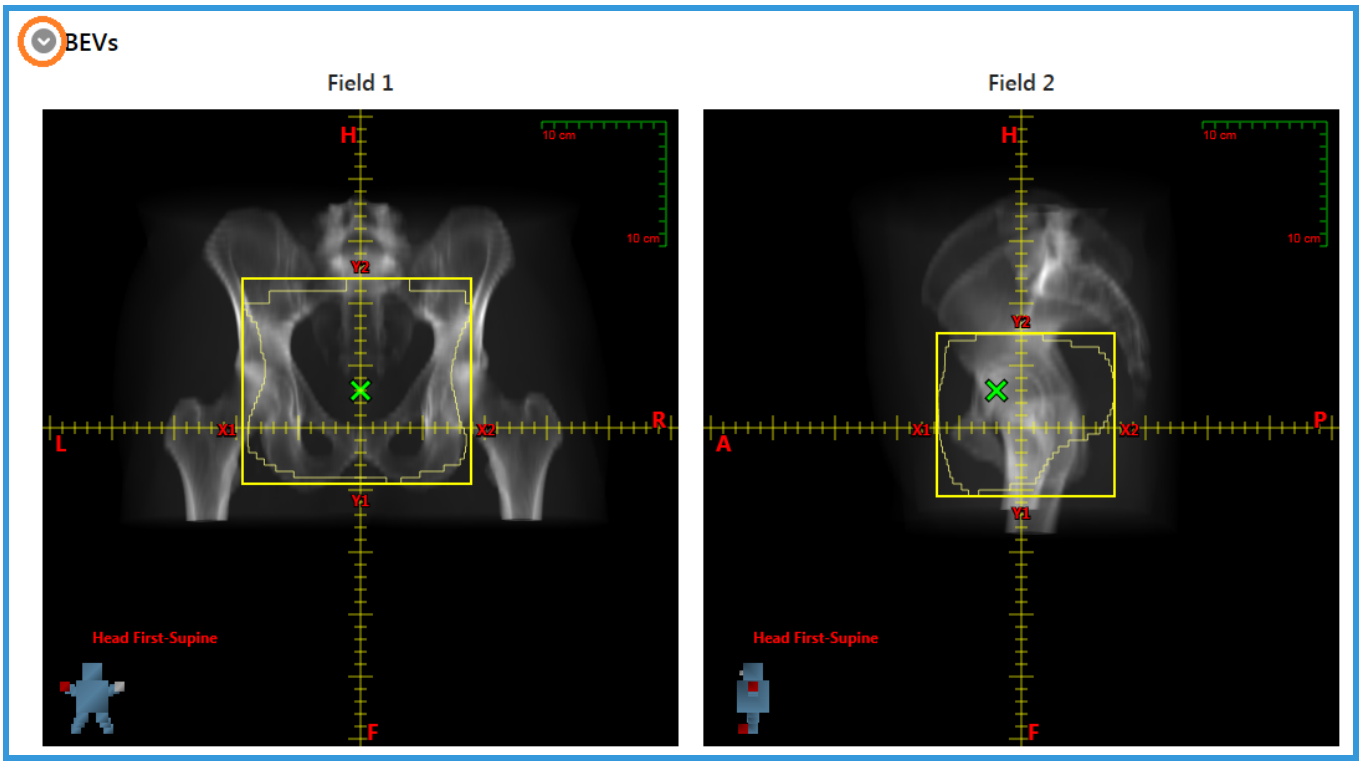
1. Load a plan for evaluation (either via Eclipse or the ClearCalc Standalone application).
    a. Note that the Diode module will not activate for VMAT, plans with arcs, or SRS cone plans.
2. If the machine and energy are configured for any diode in ClearCalc Administration, the Diode module buttons will populate. Choose either the Diode button or the diode icon in the toolbar to access the Diode module.



3. Once in the Diode interface, select the diode for each field in the "Diode" row combo boxes. ClearCalc will only populate diodes that are compatible for the machine/energy in the field.



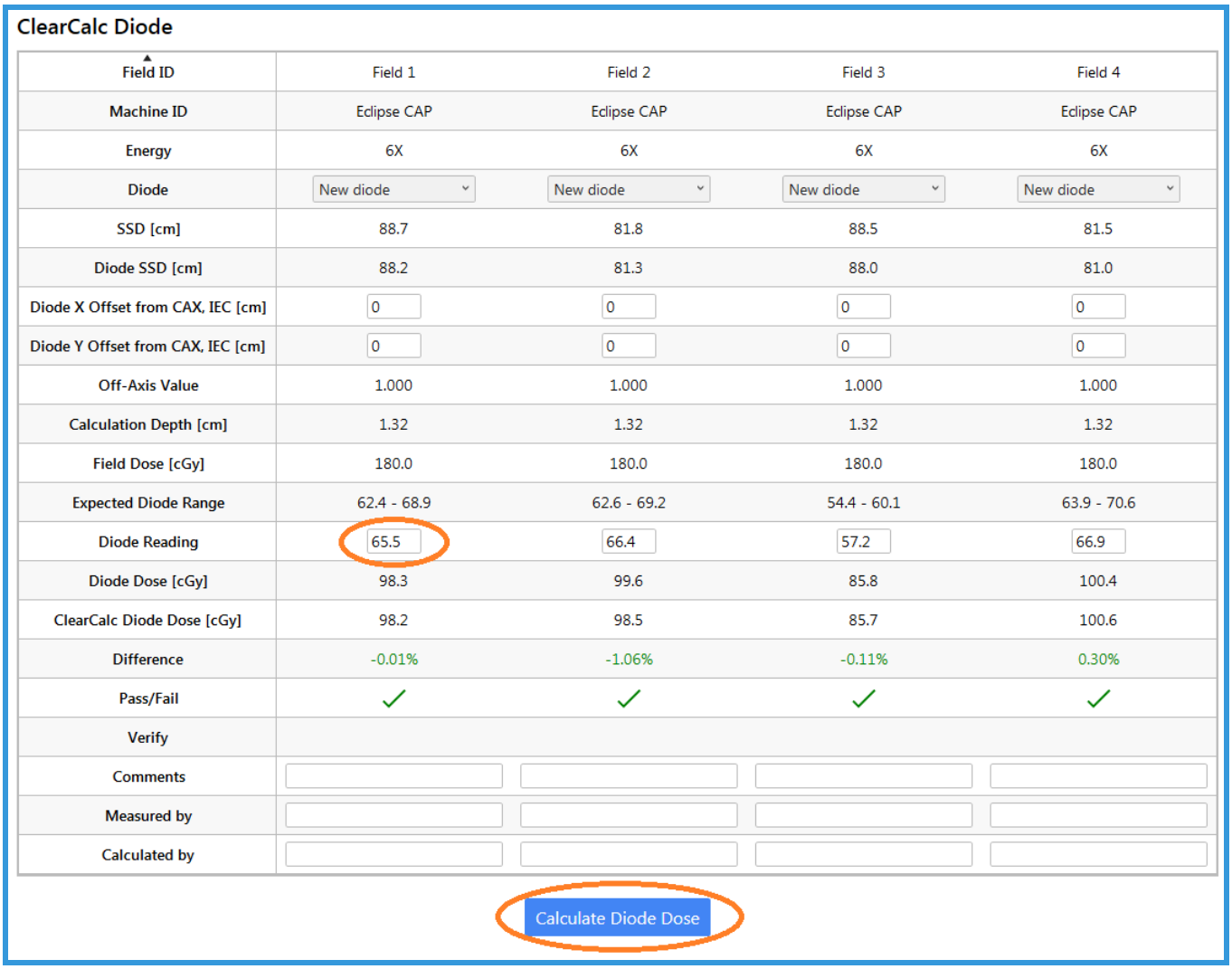
4. Next, enter any X- and Y- offsets for the diode location in the table for each field. If there are no offsets, leave the value at zero.
    a. Offset direction are user-view oriented:
        i. Up and right are positive.
        ii. Down and left are negative.
    b. If offsets are entered for photon plans, off-axis values will also display for user verification.
        i. These are based on the profiles that are entered into ClearCalc Administration for the field size, depth,and energy utilized in the plan. This is to account for any off-axis effects in the measurements.
5. The diode measurement location, including any entered offsets, will display on the Beam's Eye Views for each field.
    a. To toggle the Beam's Eye Views on and off, click the expand arrow next to the BEVs heading below the data table. This will display the Beam's Eye View as well as the location of the diode placement via the green "X" overlay on each BEV.
    b. To close the BEVs, click the arrow again to collapse the view.



6. The "Expected Diode Range" is now populated for the diode measurement parameters entered. This value may be used for documentation on the expected reading (not final dose) on the patient at the machine with the selected plan.
    a. Note that the range provided corresponds to the Tolerance set for the diode in ClearCalc Administration. ClearCalc determines the ideal final dose for the respective field, converts the value back to an ideal diode reading, and then accounts for the tolerance to that value in both the positive and negative directions to find the expected range. For example, if ClearCalc

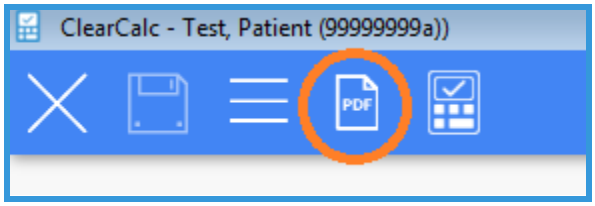
determines that the ideal diode reading for Field 1 should be 65.5 and the Tolerance set in ClearCalc Administration is 5%, the Expected Diode Range will be 62.4 - 68.9.

7. Once the diode measurements have been taken at the treatment machine for the same patient and plan under the expected measurement conditions, the Diode Reading may be entered into the table for final evaluation.
8. Once all readings are entered, select the Calculate Diode Dose button to finalize the comparison.
    a. ClearCalc Diode Doses are calculated by simulating the same field on a flat water phantom and calculating the dose the d_{max} for the field utilizing the same ClearCalc calculation method (Photons: Modified FSPB algorithm; Electrons: TG-71 calculation) that the patient plan is utilizing.

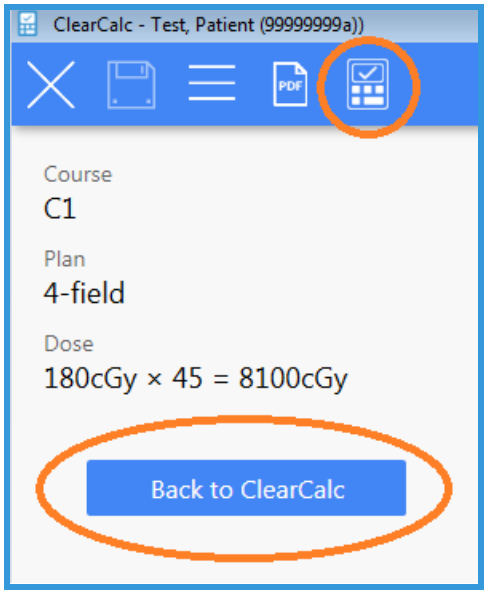


9. The dose from the diode will be calculated, along with the ClearCalc determined Diode Dose, the difference between the two values, and a Pass/Fail icon will display.
10. Entries for Comments, Measured By, and Calculated By may be input if desired, but are not required.

11. The results may then be printed to PDF using the PDF icon in the Toolbar along the top of the interface.



12. To return to the ClearCalc results, choose the "Back to ClearCalc" button or the ClearCalc icon in the menu bar.



Diode results, in addition to being entered into the main results UI, may also be entered via the Standalone application. For information on Standalone results entry, refer to the ClearCalc Diode Entry Standalone section.

ClearCalc Log File Analysis

ClearCalc is able to analyze log files that correspond to the loaded treatment plan and calculate the dose resulting from the delivery. Only recorded machine parameters are utilized to reproduce the delivery. Physics beam modifiers, such as a physical wedge, are not recorded in the log files and will not be accounted for in the calculation.

Fluences are accumulated in the maximum dose plane. A comparison is made between the fluence accumulation for each field from the TPS versus the machine delivery fluence to calculate the fluence difference. Once the machine delivery fluence is accumulated, the 3D Point Dose Statistics are also calculated for the selected structures using the generated fluence from the machine delivery files.

NOTE! Log files utilized for routine patient QA should only be utilized with a robust machine QA program. The accuracy of the log files should be verified using QA plans. Additionally, dynalog files, specifically, do not record absolute MU delivered and this parameter must be verified in the Record and Verify system.

Log File Generation

Typically, machines are already configured to output log files. Should a machine need to be configured, it is recommended to refer to your manufacturer for assistance with configuration. Some suggestions for proper log file generation are noted here.

On the MLC Controller computer or the 4DITC, open a Windows File Explorer and navigate to C:\Program Files\Varian\Oncology\MLC\Controller\Exec. In this folder, *startup.** file(s) should exist. These should be opened with a text editor and verify that "diogAutoDynalogs 1" exists in the file (or "diagAutoDynalogs 2,1" for MLC Controllers on v6+). Note that this line may already exist and just need to be uncommented. If this line does not exist, it should be added. Save the file and reboot the MLC computer for the changes to take. Once generated, log files typically save to C:\Program Files\Varian\Oncology\MLC\Controller\Exec\dynalogs, though each installation may be unique. Check with your manufacturer for further instruction.

Log File Matching

Log files are paired based on a proprietary matching algorithm using the patient ID, field ID, and plan information. The log files acquired at the machine must match the same plan that is loaded for analysis in ClearCalc - for example, creating a QA plan for a plan and acquiring the log files for the QA plan will NOT match the patient plan. When more than 1 set of log files is detected, ClearCalc will populate a list of the available log file sets and their corresponding delivery time frame(s). The user may then select the log files to use for calculation. Impartial/incomplete delivery log files cannot be analyzed - only fully delivered log files may be used for analysis.

Log File Results

Once the log files are matched and loaded, ClearCalc re-creates the delivery using the file parameters and calculates the resulting delivered dose. For more detailed information on the Results UI display, refer to the Overview of Log File Analysis for Photons Plans with Supported Log Files section of the User Manual.

Tolerances for the log file analysis module may be set on a per-machine basis on the Photon tab in ClearCalc Administration under the IMRT/VMAT Tolerance heading. Values may be set for the Log File 3D Point Dose Statistics table as well as for the Log File Fluence Difference. Tolerance settings may only be edited in the Administration application and may not be adjusted on a per-analysis basis.

The 3D Point Dose Statistics table in the Log File Analysis module is very similar to the 3D Point Dose Statistics in the main Results UI - the difference being that the points are analyzed in the dose calculated from the delivery files machine parameters in lieu of the TPS plan parameters. Using the 3D, fully recalculated delivery dose, ClearCalc analyzes the same structures that are active in the main Results UI. Users may also toggle structures on/off from the table if they should be hidden for Log File analysis. In

addition to showing the TPS-to-Delivered dose comparison, ClearCalc will also display the ClearCalc-to-Delivered dose comparison - allowing the user to ascertain the differences between the TPS algorithm and the ClearCalc algorithm. This information is critical in determining if a difference is due to the delivery files themselves (a true delivery error) or if it could be contributed to the algorithm differences between the TPS and ClearCalc (not a delivery error). The Reference Point Tolerance [%/cGy] setting is used to determine if a point analyzed is pass/fail. From there, of the point analyzed, the Log File 3D Point Dose Tolerance set for the Log File Analysis module in ClearCalc Administration is used to ensure that the passing percentage is reached. For example, if the Reference Point Tolerance is set to 5%/5cGy, each point that ClearCalc calculated in 3D space within the selected structure will be analyzed to determine if the dose from the TPS to that same point matches within 5% or 5cGy. If the point is within that range, it is a Pass. If not, the point is considered a Fail. Of all of the 250+ points analyzed within the structure, ClearCalc will ensure that at least 95% of those points pass within the range.

The Fluence comparison section utilizes the 3D dose from the Treatment Plan and creates a 2D planar fluence for each individual field at the maximum dose plane. A 2D fluence plane is created in the same respective location using the ClearCalc 3D calculated dose using the delivery log file machine parameters. The two fluence planes are then compared to each other using the relative intensity and the Log File Fluence Tolerance setting and a Fluence Difference image is displayed.

Log File Transfer from the Machine

The log files must be transferred from the machine to a network location that is accessible by ClearCalc. Varian machines typically have PeerSync installed or configured on the MLC controller computer. PeerSync is a software that can be used to easily transfer files from the controller to the network destination. The Log File Directory Location (the location that PeerSync is configured to export to) should be configured for each machine on the Settings tab of ClearCalc Administration.

Configuring PeerSync (optional)

PeerSync installation and use is at the discretion of the user and is one option for moving log files - it is not required for log file transfer. Treatment consoles that are not behind the Varian firewall do not require the use of PeerSync. PeerSync is not distributed by Radformation and is not required for file transfer. Other methods of file transfer may be used. This information is provided for informational purposes in cases where the software is already licensed to/installed for the user. The log file transfer may already occur to a network drive. Check with the machine installer to verify.

If it is installed/configured, PeerSync should be installed according to the manufacturer's instructions. It is recommended to use the PeerSync Profiler Interface install. Specific setting suggestions are noted below:

- Choose the Intermediate Profile Description
- Add New Job
- Rename the Folder Selection to Log Files
- Choose the Source Folder by browsing to the location of the log files on the controller computer
- Choose the Target Folder by browsing to the network folder location where the log files should be copied - use Normal mode for network folders
- Select Automation from the left sidebar and check "Scan job once at start" and "Use real-time monitoring."

- Select Real Time Options and select both “Use standard real-time monitoring” and “Source File/Folder Change” and click OK
- Choose File Options in the left sidebar and check “Standard,” “Add,” and “Update,” while ensuring that “Replicate” and “Moved deleted files” are unchecked.
- Select Automation from the left sidebar and choose “Exclude open files (allow read access to source file during transfer)”
- Select Exceptions from the left sidebar and
    - For C-series linacs, input “*.dlg” (without quotes) into the Include Files box
    - For TrueBeam machines, input “*.bin;*.txt” (without quotes) into the Include Files box
    - For any machine type, input “~;*.tmp” (without quotes) into the Exclude Files box
- Select Startup/Service from the left sidebar and choose the desired startup option - this is optional
- To begin the PeerSync Service, select Run/View from the left sidebar and choose Launch Current Profile

For ARIA users who run the PeerSync Install Shield, the installation process can overwrite 2 .dlls in C:\Windows\system32\ to an out-dated version of the .dlls. To restore the files to the correct version, the two correct file versions must be copied to the correct location. Perform the following 2 file copy/pastes:

- C:\ProgramFiles\Varian\ProductLine\Syslogd\DartSnmp.dll to C:\Windows\system32
- C:\ProgramFiles\Varian\ProductLine\Syslogd\DartSock.dll to C:\Windows\system32

8. ClearCalc Algorithms and Calculations

Photon: FSPB

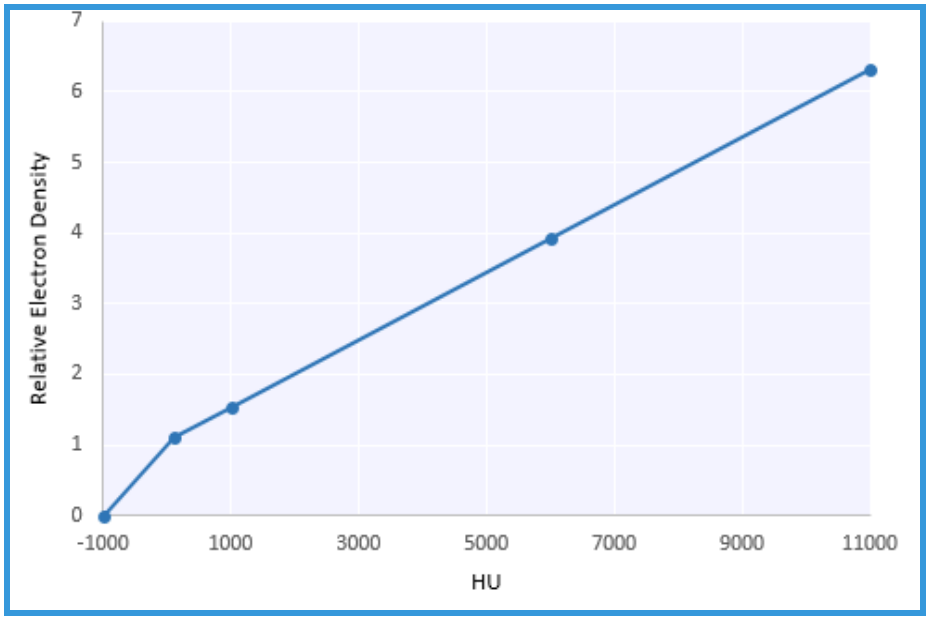
ClearCalc’s MU and Dose calculation supports a modified Finite-Size Pencil Beam calculation algorithm for photons. Calculations are performed as dose-to-water. This algorithm models individual “beamlets” of a field with a pencil-beam kernel whose parameters have been fitted based on a variety of simple square field geometries to accurately reproduce dose contributions from various parts of a field. Fields are broken up into beamlets and dose is calculated by integrating the dose from each of these beamlets at the calculation point. More information may be found in the ClearCalc White Paper titled “A Novel Modified Finite-size Pencil Beam Algorithm for Independent Photon Treatment Plan Verification,” which is available on the Radformation website.

Heterogeneity Corrections

The actual patient geometry is simulated based on the CT and structure set data and is utilized in the ClearCalc calculation, therefore full heterogeneity effects are taken into account. Depths and corresponding equivalent depths utilized in the ClearCalc calculation are determined independently of the values sent from the TPS. This is true for both conventional photon plans as well as for CyberKnife plans. ClearCalc’s heterogeneity correction is applied in a per-beamlet fashion, thus ClearCalc algorithm is able to accurately model the interplay between the patient body geometry and the different parts of the

beam. ClearCalc's method of heterogeneity correction for a given calculation point involves two components for each beamlet contribution:

1. The radiologically equivalent depth is calculated independently by stepping through the HU values in the patient within the EXTERNAL structure to the plane of the calculation point and incrementing the equivalent depth based on our conversion of HU ⇒ Relative electron density ⇒ Radiologically equivalent depth. The CT-to-density table ClearCalc uses for FSPB is a standardized HU to Relative Electron Density conversion:

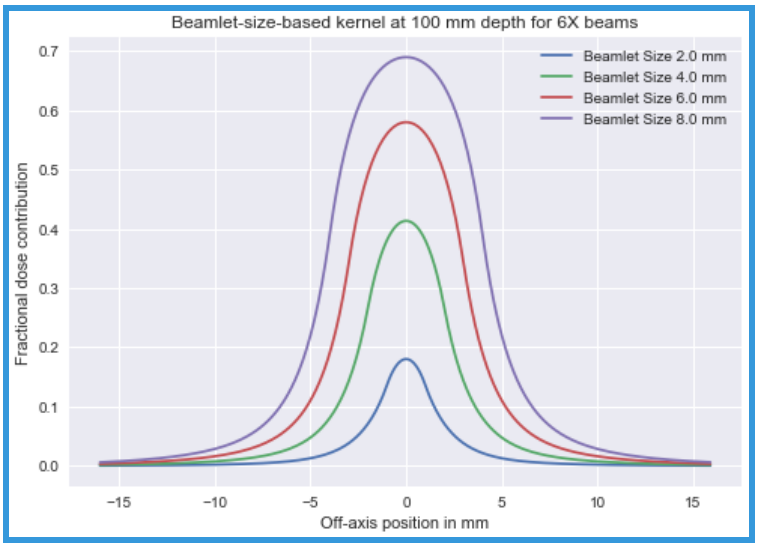


ClearCalc's Default CT-to-Relative Electron Density Conversion for Photon FSPB

2. We have fit adjusted fall-off parameters for the finite-sized beamlet kernels for a variety of relative electron densities for the finite-sized pencil beam kernels such that the contribution from any given beamlet to the calculation point is affected. For example, if a beamlet intersects the lung in the same plane as the calculation point, then the different fall-off parameters applied for that beamlet's contribution of dose to the calculation point is different than if it were in water, since one would expect a different amount of scatter from the lung tissue than water.

Scatter Conditions

ClearCalc subdivides each individual field into small beamlets, each of which has a kernel representing both the primary and scatter contributions from that beamlet as well as a scaling factor that accounts for PDD fall-off and off-axis effects. The dose contribution from a given beamlet. Specifically, there are 8 kernel parameters: a, u_{1x}, u_{2x}, u_{1y}, u_{2y}, w , x_0, y_0. With these parameters, beamlets of arbitrary size can be modeled:



The “a” parameter models the PDD of the beamlet for a given depth. The other kernel parameters can be described in a 1-dimensional version (ClearCalc has kernel parameters for both x and y directions to more accurately model fall-off differences that exist between crossline profiles and inline profiles) by this function:

$$P(x, \overrightarrow{w}, \overrightarrow{u}, x_0) = \begin{cases} \sum_{i=1}^{n} w_i \sinh(u_i x_0) \exp(u_i x) & \text{for} \quad x < -x_0 \\ 1 - \sum_{i=1}^{n} w_i \exp(-u_i x_0) \cosh(u_i x) & \text{for} \quad -x_0 \leq x \leq x_0 \\ \sum_{i=1}^{n} w_i \sinh(u_i x_0) \exp(-u_i x) & \text{for} \quad x_0 < x \end{cases}$$

The exponentials in this function model the scatter dose from the beamlet kernel, so the dose to any given calculation point is simply the sum of the contributions from each of the finite-size pencil beams.

ClearCalc specifically calculates the beamlet contributions to the calculation point independently and enables high accuracy, as it makes it possible to account for an irregular surface and heterogeneities.

Calculation Resolution

In order to keep calculation speeds relatively short, ClearCalc up-sample the incoming plan’s resolution - typically to between 5mm and 7mm. For example, if the user has a 2.5mm dose grid in Eclipse, we would drop every other “plane” to resolve to 5mm. If the user has a 2mm dose grid, we would drop every 2 planes

(use one, drop one, drop one, use one) to get to 6mm, if the user has a 0.8mm grid, we would drop every 7 planes to get to 5mm.

Arc Field Calculations

For arc fields, ClearCalc sections the arc into many control points - creating individual fields over the course of the arc - with a resolution of 5 degrees or finer per control point. Depths are then calculated for each control point utilizing the CT data. The control points are then summed to determine the total dose for the arc. The effective depth in the Photon Calculation Parameters table displays the average depth across the arc.

SRS Cone Calculations

For SRS cone calculations, ClearCalc performs a TMR calculation as this is the data that exists and is synchronized via the Eclipse Measured data. The equivalent depth is calculated for the arc and that is used for a look-up calculator with TMR and other required variables. Calculations are performed heterogeneously, but there is now the option to disable heterogeneity at the user's discretion. Arbitrary 3D points in the Calculation Point Selection window are not available for these plan types due to the TMR calculation type.

CyberKnife Calculations

For CyberKnife calculations, ClearCalc supports Fixed, Iris, and MLC Cyberknife plans. ClearCalc is performing the calculation for Fixed and Iris plans using the TPR data and including off-axis corrections. This information is included in the files that ClearCalc utilizes from the CyberKnife TPS. ClearCalc will independently calculate the path length, and not rely on the depth data in the plan, in order to keep the calculation as independent as possible. Heterogeneity corrections are applied by performing the TPR calculation with ClearCalc's base 6X-FFF data and taking a ratio of the homogeneous dose to the heterogeneous dose and applying that correction to the dose calculation. For Fixed and Iris calculations, ClearCalc uses the beam data contained in the plan folder. For MLC calculations, ClearCalc utilizes the 6X-FFF base data beam model for calculation.

CyberKnife plans may only be evaluated with the DICOM Standalone application and launched directly from the Accuray TPS workstation. The plan for evaluation must be open in the Accuray TPS while ClearCalc is being used for ClearCalc to access the necessary files for calculation, since the temporary files used for calculation are only present while the plan is open in the TPS. Additionally, all pertinent plan files may be exported to a network drive if a manual export is preferred. Please contact Radformation Support for the necessary files to export when using this method.

CyberKnife machines utilize default data built into ClearCalc. Optionally, a default machine is provided for CyberKnife plans that may be imported into the ClearCalc Administration application for viewing in the Photon tab. Importing this machine allows users to set custom tolerances for CyberKnife plans.

Elekta Unity Calculations

For Elekta Unity calculations, a new base beam data set was created specifically for the Elekta Unity for 7X-FFF beam and incorporates adjusted a-factors, which correct for the off-axis beam matching for this

machine. ClearCalc also includes a cryostat correction with embedded correction factor values -these may not be adjusted by the user. ClearCalc additionally implements a Lorentz effect correction which applies a convolution kernel that effectively shifts the base kernels a small amount in the lateral direction relative to the central axis in the +X jaw direction to correct for the Lorentz effects from the magnetic field.

WARNING! ClearCalc's FSPB calculation for the Elekta Unity does not model the electron return effect. Doses around interfaces of low density structures will have significant dose discrepancies.

ViewRay MRIdian Calculations

For MRIdian plans, ClearCalc takes the base 6X-FFF data and output factors and adjustments were made to have the ClearCalc FSPB kernels fit the machine performance. Additional a-factor fitting was added for TomoTherapy machines in order to adjust for machine-specific off-axis kernel matching. No corrections were made to adjust for the Lorentz effect due to the strength of the magnet used in the MRIdian machine. A solid MRIdian couch structure with an HU override of -400 is inserted by ClearCalc at the location relative to isocenter specified in the PlanOverview.txt file.

Accuray TomoTherapy Calculations

For TomoTherapy (RadiXact, HiArt, and TomoTherapy), ClearCalc takes the base 6X-FFF data and output factors and adjustments were made to have the ClearCalc FSPB kernels fit the machine performance. The calibration conditions may be adjusted for the machine to match the correct settings at machine calibration in ClearCalc Administration in order to correct for any output differences. Additional a-factor fitting was added for TomoTherapy machines in order to adjust for machine-specific off-axis kernel matching.

Gamma Knife Calculations

For Gamma Knife plans, ClearCalc supports the Icon and Perfexion treatment models. ClearCalc performs a TMR10 calculation. ClearCalc individually calculates the dose from each shot to the specific calculation point. The segmented skull geometry mesh from GammaPlan database is used to determine the skull measurements. ClearCalc independently performs the geometry calculations to recreate the skull and obtains the shot depths from the recreated skull. From there, ClearCalc uses a ray cast to determine the distance from the source to the skull. This is then used to find the depth to the treatment location and we use the TMR10 calculation with this data to obtain the result. TMR10 uses an exponential attenuation computation to the point of interest that is specific to each source location. The attenuation length, i.e. depth of the point of interest in the patient for each source is calculated based on the source focal point, the distance from the focal point to the point of interest, and the distance to the generated skull surface. Beamlets are created at each source position for each shot in each target. The beamlets themselves are then rotated and translated in space according to the shot geometry. ClearCalc has also added in a correction for the gamma angle, allowing accurate calculations when the gamma angle is set to a value other than 90 degrees, by applying a rotational matrix for each beamlet. For these situations, when the beamlets are in their proper geometric position around the skull, the vectors from source to isocenter and

calculation point are ray traces through the patient geometry for the dose computation. Additionally, the collimator output factors are hard-coded to match the manufacturer values.

Electron: TG-71

For electrons, ClearCalc utilizes the American Association of Physicists (AAPM) in Medicine Task Group Report 71 [Report No. 258 - Monitor unit calculations for external photon and electron beams (2014) https://www.aapm.org/pubs/reports/detail.asp?docid=151] guidance and equations to perform an independent MU calculation. Since the user's measured beam data is entered by the user, the data is independent of the data within, and the calculation results from the TPS. The user is able to enter multiple machines, set available energies, identify treatment applicators, as well as enter measured data for cone factors, cutout factors, PDDs, and inverse square corrections (either effective SSD or air gap corrections are available to the user). It is intended that the data entered into the ClearCalc Administration application be the same measured data used to perform the beam modeling within the user's TPS.

Cutout sizes are determined via two methods: Sector integration or User entered. For sector integration, the incoming cutout is divided into 32 wedge sectors - or 11.25 degrees per "pie slice" - and the area of that sector is determined. Each sector is then added and an equivalent square is calculated based on the additive area. Note that this calculation method will lead to the actual area calculated for perfectly circular cutouts to be converted to an equivalent square using the following equation:

$\text{Equivalent square}_{\text{circle}} = r_{\text{circle}} \div 0.558$

As an example, a 3 x 3 cm^2 circle is a 2.69 x 2.69 cm^2 equivalent square.

For further details, the following articles were used as reference in the implementation of sector integration:

> James CL Chow, et al. *A graphical user interface for an electron monitor unit calculator using a sector-integration algorithm and exponential curve-fitting method.* 2006 Med Phys 7 52
>
> David R Choi, et al. *Modified sector-integration method for predicting the output factors of electron beams including extended source to surface distance.* 2000 Phys. Med. Biol. 45 3367

Brachytherapy: TG-43

For brachytherapy plans, ClearCalc utilizes the American Association of Physicists (AAPM) in Medicine Task Group Report 43 [Report No. 084 - Update of AAPM Task Group No. 43 Report: A revised AAPM protocol for brachytherapy dose (2004) https://www.aapm.org/pubs/reports/detail.asp?docid=85] guidance and equations to perform the independent point dose calculation using the Line Source Approximation. The user is able to independently enter the data required for brachytherapy calculations, including source ID, dose rate constant, active length, radial dose values, and the anisotropy information.

$$\dot{D}(r) = S_K \cdot \Lambda \cdot \frac{G_L(r,\theta_0)}{G_L(r_0,\theta_0)} \cdot g_L(r) \cdot \phi_{an}(r)$$

If a point-source approximation should be utilized, the user may enter a single row in the Anisotropy table. This data will trigger ClearCalc to perform a Point Source Approximation calculation based on the following equation from TG-43:

$$\dot{D}(r) = S_K \cdot \Lambda \cdot \left(\frac{r_0}{r}\right)^2 \cdot g_P(r) \cdot \phi_{an}(r)$$

ClearCalc is able to perform an independent decay based on a user-entered Calibration Date and Calibration Strength entered in Administration as well as a Treatment Date entered for the plan in the UI.

When using the standalone DICOM application for Brachytherapy, ensure that an Active Length and Dose Rate Constant are manually entered into the Brachy tab of ClearCalc Administration and that “Use value from Eclipse'' checkboxes are all unchecked, as these values are not reliably available through DICOM. For independent Nominal calculations, Calibration Data and Calibration Strength are also required if ClearCalc is performing a decay calculation.

RadMonteCarlo

ClearCalc may be optionally licensed to utilize its Monte Carlo algorithm, RadMonteCarlo, for calculation of photon, electron, and proton expected doses. All RadMonteCarlo calculations are performed as dose-to-medium calculations for photons and electrons and dose-to-water for protons.

RadMonteCarlo is a dose calculation engine used by ClearCalc that uses treatment planning data obtained from supported Treatment Planning Systems and supported Application Programming Interfaces to perform independent dose calculations with its Monte Carlo-based algorithm. It operates as a cloud-based service-oriented architecture that uses DICOM-compliant CT image and treatment plan data as input to calculate expected doses and/or MU. RadMonteCarlo calculation results are displayed in the ClearCalc user interface.

Monte carlo, in general, is particularly useful in radiotherapy for improved modeling of lateral scatter disequilibrium - particularly for large transitions in tissue densities and small “floating” lung tumor volumes. RadMonteCarlo utilizes the treatment planning CT data as well as pertinent planning parameters to calculate the patient-specific dose.

Basic Algorithm Principles

RadMonteCarlo calculations for photons and electrons are based on the Dose Planning Method (DPM).

The following references were used in the implementation of RadMonteCarlo for photons and electrons:

- Sempau J, Wilderman S, Bielajew *A. DPM, a fast, accurate Monte Carlo code optimized for photon and electron radiotherapy treatment planning dose calculations.* Phys Med Biol. 2000; 45:2263–91.
- Rodriguez M, Sempau J, Bäumer C, et al. *DPM as a radiation transport engine for PRIMO.* Radiat Oncol 13, 256 (2018).

RadMonteCarlo calculations for protons are based on Geant4. Calculations are compatible with modulated scanning treatment techniques only.

The following references were used in the implementation of RadMonteCarlo for protons:

- Fippel M and Soukup M. *A Monte Carlo dose calculation algorithm for proton therapy.* Med Phys 31 2263–73. 2004
- https://geant4-userdoc.web.cern.ch/UsersGuides/PhysicsReferenceManual/html/electromagnetic/energy_loss/enloss.html

Simulations

RadMonteCarlo for photons simulate a minimum of 400,000,000 particles and a maximum of 2,000,000,000 particles per plan, scaling up from 400,000,000 on a linear scale depending on the average area of the jaw opening for the plan between 10,000mm^2 (corresponding to a 10x10cm^2 field size) and 160,000mm^2 (corresponding to a 40x40cm^2 field size).

RadMonteCarlo for electrons shall simulate the number of electrons in the phase space file that most closely matches the user machine's 50% dose depth (R50) value for their specific applicator multiplied by 4 (through rotational splitting that copies each electron in the phase space file to each quadrant). This results in a simulation of ~10-20 million particles for the smallest (6x6cm^2) and ~100-200 million particles for the largest applicator (25x25cm^2). The range is due to the fact that the lower energy electron phase space files have fewer particles in them, though they don't travel as far and so they require fewer particles to achieve low uncertainty.

RadMonteCarlo for protons simulates the number of histories per MU determined in the commissioning process, scaled by a scaling factor of 1/3000 (to ensure the calculation time is not too great).

Photon

ClearCalc utilizes the data contained in the Administration application to commission RadMonteCarlo for each configured machine in the "Machines" list. The photon commissioning process creates virtual source models for each machine and energy. Created virtual source models are specific to the beam data present for each machine. Then, utilizing these virtual source models as well as the CT dataset and treatment planning parameters, photon calculations may be performed with RadMonteCarlo.

Photon Virtual Source Model Commissioning

IMPORTANT! Performing these steps will overwrite ANY existing virtual source models that exist. Ensure that this is the desired intent before proceeding.

Virtual source model commissioning varies depending on user configuration - refer to the appropriate clinical configuration below. The following configurations are currently supported:

1. Current ClearCalc user with Eclipse™ TPS: Current user with previously synced machine data
2. New ClearCalc user with Eclipse™ TPS: New user with no synced machined data
3. Non-Eclipse™ TPS user: Current or new user with

All steps refer to the labels in the images below the configurations.

Current ClearCalc User with Eclipse™ TPS

1. Open ClearCalc Administration and navigate to the Photon tab
2. In the lower left corner, click the Monte Carlo Commissioning button
3. In the top right corner of the RadMC Beam Data Import and Commissioning window (A), click the Import Output Factors From Eclipse button - this will synchronize the new/additional data required for RadMonteCarlo (versus FSPB)
4. Enter the Eclipse™ domain name where beam data is stored (G)
    a. If necessary, use the browse option to manually navigate to the beam data folder(G)
5. In the 3rd drop-down menu, select the algorithm containing the required to beam data (G)
6. Select OK
    a. The software will attempt to synchronize beam data for all energies and modifiers with an “Approved” status for the selected machine for the chosen algorithm
7. Repeat steps 4-6 for all treatment units and their respective algorithms within the RadMC Beam Data Import and Commissioning window
8. When beam data synchronization is complete, each energies’ output factors and diagonal profiles’ status in the Beam Data table will display a green checkmark
    a. If a red X appears, please revisit the above steps to ensure that the required data is correctly synchronized (D)
9. Once all necessary machine and energy combinations have been properly synchronized, in the left hand Machines to Commission table (B), activate each desired treatment unit for RadMonteCarlo commissioning by checking the Commission checkbox
10. Click the Begin RadMC Commissioning button to begin the virtual source model commissioning process with the machines selected in Step 9
    a. Virtual source model commissioning requires a Monte Carlo particle simulations and may take 5-10 minutes per typical machine (i.e. C-arm linac with five photon energies)

New ClearCalc User with Eclipse™ TPS

Starting in ClearCalc v2.2, the beam data synchronization automatically imports all data required for FSPB and RadMC, therefore new users will utilize the standard import method.

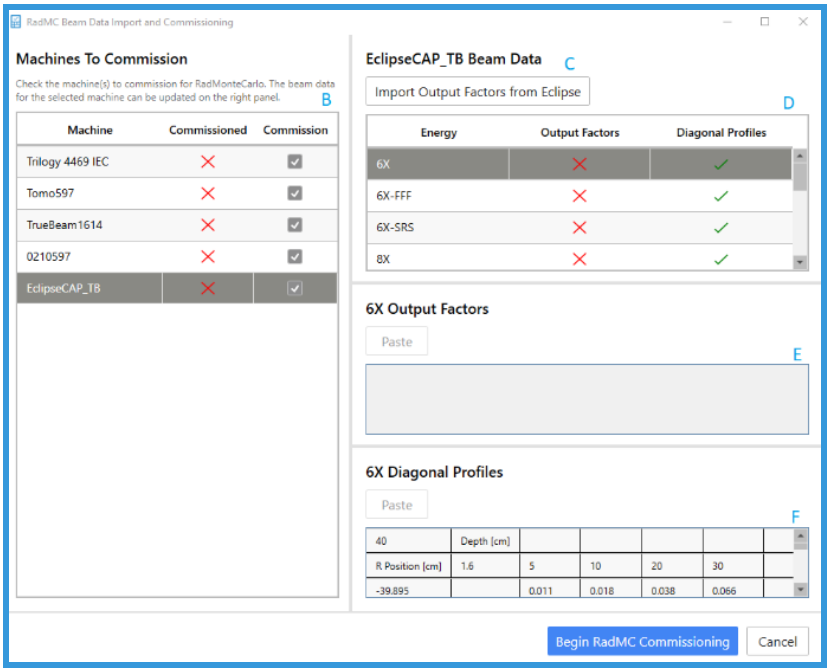
1. Open ClearCalc Administration and navigate to the Photon tab
2. Select theSync button in the Toolbar
3. In the Sync Eclipse Beam Data window, enter the Eclipse™ domain name where beam data is stored (G)
    a. If necessary, use the browse option to manually navigate to the beam data folder(G)
4. In the 3rd drop-down menu, select the algorithm containing the required to beam data (G)
5. Select OK
6. In the lower left corner, click the Monte Carlo Commissioning button
7. When beam data synchronization is complete, each energies' output factors and diagonal profiles' status in the Beam Data table will display a green checkmark
    a. If a red X appears, please revisit the above steps to ensure that the required data is correctly synchronized (D)
8. Once all necessary machine and energy combinations have been properly synchronized, in the left hand Machines to Commission table (B), activate each desired treatment unit for RadMonteCarlo commissioning by checking the Commission checkbox
9. Click the Begin RadMC Commissioning button to begin the virtual source model commissioning process with the machines selected in Step 9
    a. Virtual source model commissioning requires a Monte Carlo particle simulations and may take 5-10 minutes per typical machine (i.e. C-arm linac with 5 photon energies)

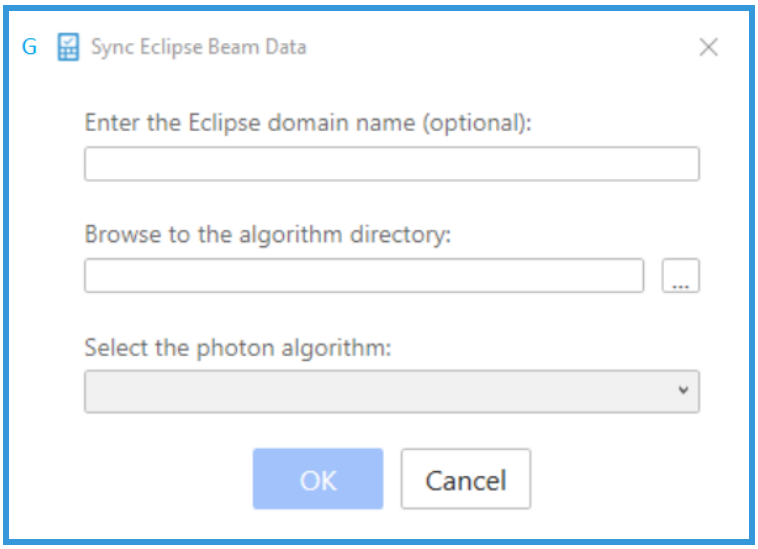
New or Current ClearCalc User with non-Eclipse™ TPS

Typical machine builds for non-Eclipse™ users do not include rectangular field output factors or diagonal profiles, as neither is required for FSPB beam modeling. However, additional data is required to commission virtual source models for RadMonteCarlo.

1. Using the provided spreadsheet located in /radformationfiledata/clearcalc/machines:
    a. Enter output factors at each field size as listed in the table. Note that output factors are required at the treatment units reference calibration conditions (for example only: 100SSD, at dmax, calibration field size of 10x10cm)
    b. Enter diagonal profile data for the largest square field size at the five depths listed in the spreadsheet. The distance extends from the negative to the positive radial direction for a complete profile. Half-scan profiles must be mirrored.
2. Once all necessary data is entered into the spreadsheet, launch ClearCalc Administration
3. Navigate to the Photon tab
4. In the lower left corner, click the Monte Carlo Commissioning button
5. In the Machines to Commission table (B) of the RadMC Beam Data Import and Commissioning window, highlight the machine for which supplemental beam data will be added
6. In the Beam Data status table, highlight the first energy row to prepare for beam data import (D)

7. Once the energy is selected, the lower Output Factor table is now activated in preparation for beam data entry
8. In the beam data spreadsheet generated in Step 1, highlight the cells containing the output factor data *with field sizes included* and press CTRL + C to copy the data
9. Returning to the RadMC Beam Data Import and Commissioning window, click the Paste icon below the Output Factors table heading
10. Verify that the output factor data pastes accurately into the table (E)
11. In the beam data spreadsheet generated in Step 1, highlight the cells containing the diagonal profiles data *with field sizes included* and press CTRL + C to copy the data
12. Returning to the RadMC Beam Data Import and Commissioning window, click the Paste icon below the Diagonal Profiles table heading
13. Verify that the diagonal profile data pastes accurately into the table (E)
14. Repeat steps 6-13 for each energy for the highlighted machine for which virtual source model commissioning needs to be performed
15. Repeat steps 5-14 for each treatment unit for which virtual source model commissioning needs to be performed
16. When beam data synchronization is complete, each energies' output factors and diagonal profiles' status in the Beam Data table will display a green checkmark
    a. If a red X appears, please revisit the above steps to ensure that the required data is correctly synchronized (D)
17. Once all necessary machine and energy combinations have been properly synchronized, in the left hand Machines to Commission table (B), activate each desired treatment unit for RadMonteCarlo commissioning by checking the Commission checkbox
18. Click the Begin RadMC Commissioning button to begin the virtual source model commissioning process with the machines selected in Step 9
    a. Virtual source model commissioning requires a Monte Carlo particle simulations and may take 5-10 minutes per typical machine (i.e. C-arm linac with 5 photon energies)





The RadMonteCarlo commissioning process is estimated to take 10-30 minutes *on average* (perhaps longer) and is dependent upon numerous factors including the number of machines/energies being commissioned as well as user network speed.

IMPORTANT! Exiting the commissioning dialog prior to its completion could lead to incomplete virtual source model creation and calculation issues, therefore it is recommended the window not be closed while the commissioning is processing.

Electron

ClearCalc uses stored electron phase space files as well as the R50 value from the data stored in ClearCalc Administration to perform RadMonteCarlo electron calculations. Utilizing these stored phase space files as well as the CT dataset and treatment planning parameters, electron calculations may be performed with RadMonteCarlo.

Electron Commissioning

There's no commissioning process required for electron calculations with RadMonteCarlo. Phase space files that are required for particle simulation are pre-generated and stored in the cloud. At the time of simulation, optimal phase space files are matched to each treatment field in the plan. The optimal phase space file is chosen based on the PDD-R50 value and applicator factor from the commissioning data stored in ClearCalc Administration.

Proton

ClearCalc utilizes proton machine data to commission RadMonteCarlo for each necessary machine. The proton commissioning process creates virtual source models for each needed machine and energy. Created virtual source models are specific to the beam data for each machine - namely the Bragg Peaks and spot sizes. Then, utilizing these virtual source models as well as the CT dataset and treatment planning parameters, proton calculations may be performed with RadMonteCarlo. ClearCalc will use the

HU values of the incoming CT dataset and convert to mass density based on embedded stopping powers. The calculation itself will treat everything as water.

Proton Commissioning

Commissioning for protons will be performed using Bragg Peak and spot size proton beam data. Once the data is provided, virtual source models will be created. Those virtual source models will be utilized in the proton calculation. Please reach out to Radformation Support for commissioning assistance.

Cloud-based Architecture

The RadMonteCarlo algorithm operates as a cloud-based service-oriented architecture that allows multiple clients to send calculation requests to its dose calculation engine. That calculation engine uses DICOM-compliant CT image and treatment plan data as input to calculate MU and/or expected doses.

RadMonteCarlo consists of 2 main components:

1. A supported local User Interface - ClearCalc UI - that is configured to send data to, receive data from, and display results from the RadMonteCarlo dose calculation engine.
2. A cloud-based Monte Carlo dose calculation engine - RadMonteCarlo - that calculates MU and/or expected doses.

Operational Overview

RadMonteCarlo is a job-based service. Local clients submit job requests and then retrieve job results.

There are currently 3 job types supported by RadMonteCarlo:

- Fitting - Virtual Source Model Fitting
- Commissioning - Commissioning
- DPM Simulation - Dose Planning Method Simulation

Before ClearCalc (or any client) can run any photon or proton Monte Carlo simulations, a virtual source model (VSM) needs to be created. A VSM is essentially a stand-in for the real machine in the simulation. The VSM attempts to accurately capture how the real machine behaves in terms of dose delivered to a water phantom. After the VSM is created, subsequent dose planning method (DPM) simulations can be run.

Generating a VSM is a complicated one-time process that involves submitting multiple Fitting and Commissioning jobs. A VSM consists of a geometric particle source model (for photon this is a concentric rings model + ring energy histograms) and corrected with an absolute dose conversion factor and scatter factor. Collectively, all of these form the VSM and allow accurate emulation of a real machine.

For electrons, embedded phase space files are used so virtual source model fitting is not necessary.

Fitting Job

The purpose of the fitting job is for the client to obtain ring energy histograms for a given machine/energy source. The local client provides the required data according to the particle type to the fitting job and in response RadMonteCarlo returns ring energy histograms.

The client must submit multiple fitting jobs (one per machine,energy pair) in order to collect all of the ring energy histograms needed to build complete VSMs for all of a clinic's machines.

Commissioning Job

The purpose of the commissioning job is to calculate an accurate absolute dose conversion factor and scatter factor. The local client provides the geometric particle source model (concentric ring model + ring energy histograms) and absolute dose calibration measurements.

RadMonteCarlo first runs a simulation to determine the absolute dose conversion factor (the scalar value that converts simulation eV units to cGy units) by comparing a parameter-constrained simulation to the provided absolute dose calibration values measured under the same parameter constraints at the clinic.

Next, RadMonteCarlo runs multiple Monte Carlo simulations under different collimator configurations in order to build a collection of scatter-free dosage profiles. The difference between the scatter-free dosage profiles and actual measured dosage profiles is then used to calculate a scatter factor (a scalar value for converting scatter-free dosage to real dosage incorporating scatter). This step is the most time consuming of all VSM-related steps.

Once commissioning is finished, the local client has everything it needs for a complete VSM.

DPM Simulation Job

The purpose of the DPM simulation job is to calculate a plan dose. This is the "bread and butter" type of Monte Carlo simulation job that most clinics are interested in running. The local client provides the VSM as well as the plan and DICOM representation of the patient. RadMonteCarlo runs the simulation and returns the dose matrix.

RadMonteCarlo Results

The incoming RadMonteCarlo results are resampled to a 3mm dose grid resolution by default. If the initially calculated statistical uncertainty is low, voxel sampling will be rescaled to 1.5mm to improve the resolution of DVH calculated structures. Users may further adjust voxel sampling on-the-fly by editing the value in the RadMonteCarlo options in the left sidebar of the results.

3D Gamma Analysis

When performing the 3D gamma analysis, the TPS dose is used as the reference data, on the resolution of the TPS dose grid. The user-set dose threshold, set in ClearCalc Administration, is first applied to all voxels of both the TPS and RadMonteCarlo dose grids. Any voxels with relative dose below the set threshold are

ignored for analysis, relative to the ClearCalc reference dose When performing the 3D gamma analysis, ClearCalc generates an evaluation point grid around the center of each TPS voxel using a 0.5mm resolution. Points in this evaluation grid are analyzed to the user's selected distance to agreement, designated in ClearCalc Administration (also adjustable on-the-fly in the results). Once the evaluation grid is generated, the center of the voxel is checked for agreement to the RadMonteCarlo dose first. If agreement is not found in the center voxel, then the evaluation point grid is subsequently checked for a point passing within the set 3D gamma analysis setting beginning from the top plane of points and moving downwards through the voxel center. The 3D gamma analysis for each point is then calculated according to the technical reference from Low, et al. entitled "*A technique for the quantitative analysis of dose distributions.*" [Med Phys 25 (5); May 1998:656-661.]. In the instance where the distance to agreement or percent difference criteria are set to zero, the ratio for that criteria will be omitted from gamma index analysis. The gamma index will only evaluate on the remaining non-zero criteria. Results are displayed relative to the TPS dose grid resolution on a per-fraction basis to keep in line with applicable MU and Point Dose results tables. In the Gamma Index Pass/Fail Colorwash view in the CT Viewer, voxels shown as green have passed the 3D gamma analysis with the selected settings. Voxels shown as red are "hotter than" and voxels shown as blue are "colder than" the TPS reference value for the 3D gamma analysis settings.

CT Viewer

The CT view allows the user to toggle between different results:

- Gamma Index Pass/Fail Colorwash
- Relative Dose Colorwash
- TPS Dose Colorwash
- RadMC Dose Colorwash

Dose Volume Histogram

The RadMonteCarlo Dose Volume Histogram (DVH) result overlays the TPS dose results for each structure contained in the treatment plan (i.e. via Eclipse ESAPI). When DVH values are not directly provided by the TPS dose files (i.e. for DICOM), the structures are resampled. Partial voxels are not considered and a structure voxel is entirely inside or entirely outside of a structure only. Note that this may lead to slight differences in DVHs when compared to TPSs that account for partial voxels.

9. ClearCalc Administration Beam and Source Data

Default ClearCalc Administration Data

Preliminary photon, electron, and brachytherapy data is included with ClearCalc so that the user may begin working with the software immediately. All data must be verified for accuracy prior to clinical use. Refer to the ClearCalc Commissioning section for details on the recommended commissioning process.

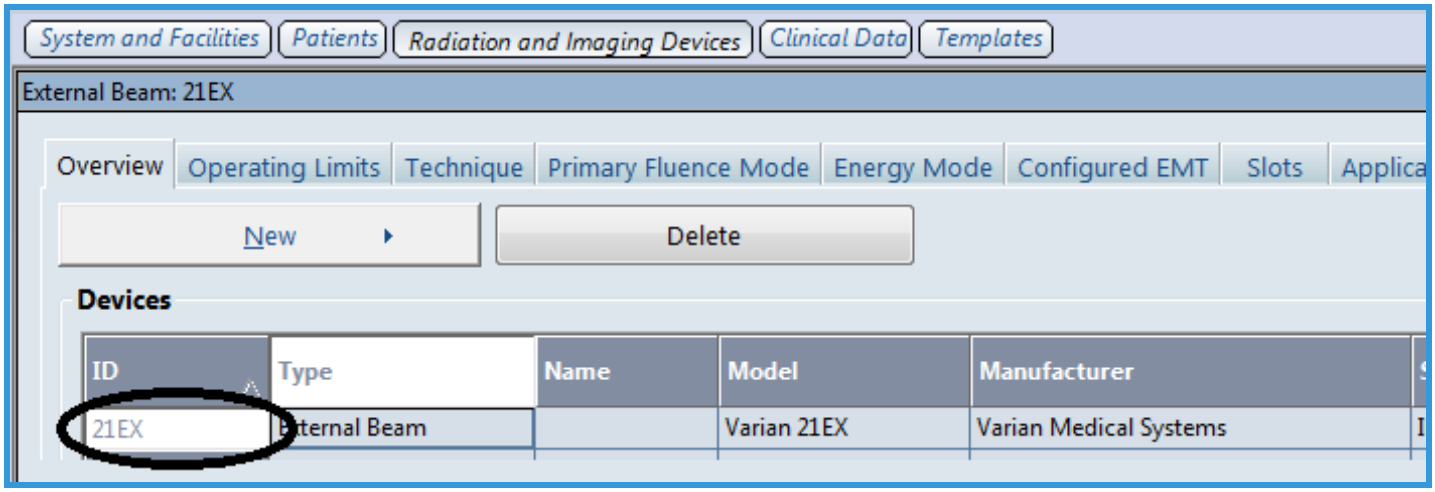
Not all machines, energies, and sources are included in the stock data and those not included should be configured by the user. Radformation is not responsible for data entry.

Certain reference values are displayed in a set unit for the following:

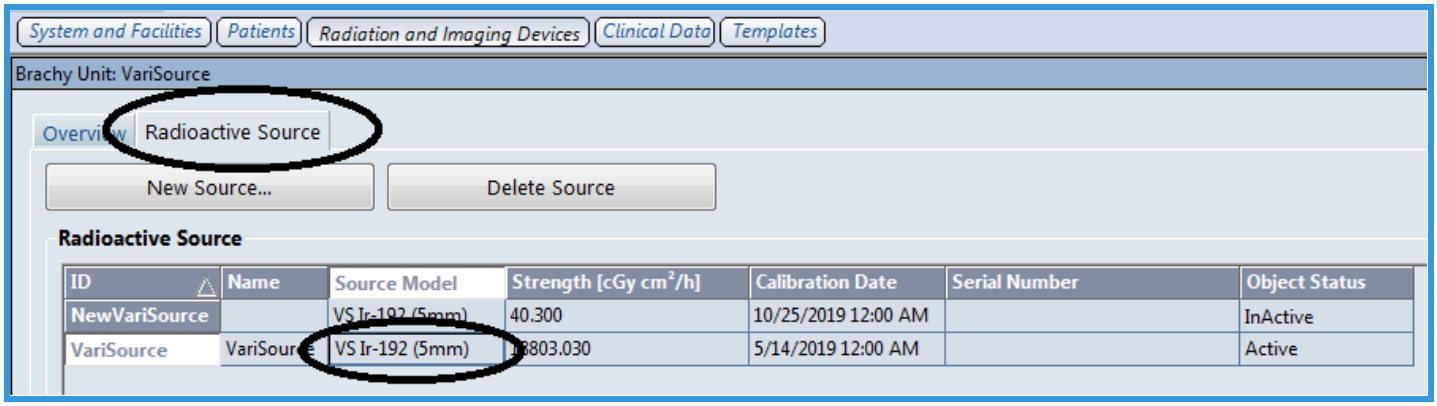
- Photon: Reference dose at calibration depth in [Gy]
- Electron: Calibration in reference conditions in [cGy/MU]
- Brachytherapy: Dose rate constant in [cGy/hU]

ClearCalc Machine and Source Matching

Photon and electron machines to be used with ClearCalc are required to exactly match the machine name from the Treatment Planning System. These can be changed in ClearCalc Administration on the respective modality tab. For machines utilized from Eclipse, this will be the "Device ID" found in RTAdmin under the Radiation and Imaging Devices section (see image below). For DICOM standalone photon and electron machines, ClearCalc utilizes the (300a,00b2) Treatment Machine Name DICOM tag.



Brachytherapy sources to be used with ClearCalc are required to exactly match the source name from the Treatment Planning System. These can be changed in ClearCalc Administration on the Brachytherapy tab. For sources utilized from Eclipse, this will be the "Source Model" found within the HDR treatment machine in RTAdmin under Radiation and Imaging Devices | Radioactive Sources (see image below). For DICOM standalone sources, ClearCalc utilizes the (300a,0226) Source Isotope Name DICOM tag.



Photon Beam Data

The photon module is designed to be easily commissioned, by fitting the beamlet kernel parameters, PDD, and scaling factors to calculated dose matrices for a variety of square field sizes provided from a treatment planning system base data, such as Eclipse™.

Clinics will have measured PDD, output factors, and point-check data confirming that the treatment planning system (TPS) very accurately models the dose for those square field sizes and therefore the PDDs in the dose matrices generated in the treatment planning system are traceable to clinical measurements. After fitting the finite-size beamlet fall-off parameters and scaling factors to these dose matrices, ClearCalc and the treatment planning system have been found to agree very closely (within <0.5%) inside of the square field. If the treatment planning system models square field sizes in water accurately, then the user can be confident in the accuracy of the PDDs and other parameters utilized to commission ClearCalc.

Photon Data and Compatibility

Default photon data is provided in the ClearCalc Administration application, providing the base beam data for the Finite Sized Pencil Beam algorithm to calculate secondary plan analyses. Measured data for user machines will be fitted to this base data and is compatible for conventional linear accelerators. This includes typical beam modifiers (MLCs, wedges, SRS Cones) for the machines as well. The default data is customized by uploading the user's measured data from Eclipse (see instructions below).

Data fitting for CyberKnife machines is not required, as the calculation information is included for each plan in the applicable CyberKnife files utilized by ClearCalc and is fitted with ClearCalc's based 6X-FFF beam data. As such, CyberKnife machines will not be listed in ClearCalc Administration be default, though a machine file may be manually added by the user from the "CyberKnife" file located in radformationfiledata/clearcalc/filedata/machines.

Electron Beam Data

Electron Data and Compatibility

Default electron data is provided in the ClearCalc Administration application for the following energies: 6Mev, 9Mev, 12MeV, 16MeV, 20MeV. The default data is clinically measured data for a Varian 21EX machine. This data may be used if desired, but the data should first be validated by qualified personnel. For other machines and energies not listed above, or for energies wishing to use clinic-specific measured data, the data should be entered into Admin as needed by the user. Upon initial machine synchronization, the user will have the option to populate the default data for available energies or to leave the data blank.

Photon, SRS Cone, and Electron Beam Data Synchronization

Importing Initial Measured Photon, SRS Cones, and/or Electron Data from Eclipse

ClearCalc provides the user with the option to automatically import available measured data from the Eclipse TPS. Note that, when syncing data, ClearCalc synchronizes the measured data. Therefore, if you use the same measured data for more than one algorithm, it is not necessary to sync all active algorithms

if the measured data is identical.

To import the measured Eclipse data required by ClearCalc to begin the data fitting process, follow these steps:

1. After logging in to ClearCalc Administration, click the Sync icon in the upper left of the Administration menu bar.
2. A Synchronization Window will appear prompting the user for the location of available measured data.
    a. Enter the Eclipse server name into the top box
        i. For Full-Scale servers, this is the IP of your Eclipse server hosting the va_data$ partition
        ii. For typical installations, this is the name of the Eclipse image server hosting the va_data$ partition
        iii. Typically these folders are saved on your client server: \\<your client server>\DCF$\client\BeamData\<your algorithm name>
            1. e.g. \\ECLIPSEV155\DCF$\client\BeamData\AAA_15511
            2. To easily find data location, open Beam Configuration in Eclipse and expand the Machine, Energy, and Algorithm you are wishing to Commission in ClearCalc by using the collapsed arrows. Once located, you will see the directory mapping to the right of the algorithm name.
    b. Once the server is properly entered, all available algorithms will appear in the drop down menus. Select the correct algorithms for each modality for which data should be synchronized: photon, SRS cone, and/or electron.
        i. You may choose to sync 1, 2, or all 3 modalities - for those for which synchronization is not needed, do not select a folder in the drop down and ClearCalc will skip synchronization.
        ii. Photon: In the drop down, select the algorithm folder containing the photon data from which ClearCalc should pull your clinically measured data.
            1. If you use more than one algorithm for different photon energies, you may repeat this process for the other algorithm once the first synchronization is completed. See note at the beginning of this section regarding multiple algorithms for the same modality.
        iii. SRS Cone: In the drop down, select the algorithm folder containing the SRS cone data from which ClearCalc should pull your clinically measured data.
            1. If you use more than one algorithm for different SRS cones, you may repeat this process for the other algorithm once the first synchronization is completed. See note at the beginning of this section regarding multiple algorithms for the same modality.
        iv. Electron: In the drop down, select the algorithm folder containing the electron data from which ClearCalc should pull your clinically measured data.
            1. If you use more than one algorithm for different electron energies, you may repeat this process for the other algorithm once the first synchronization is completed. See note at the beginning of this section regarding multiple algorithms for the same modality.
        v. Once all algorithms have been selected, click “OK” to begin data synchronization
3. Syncing will automatically populate all “Approved” status machines and energies. Each

modality automatically populates the following data:
    a. Photon Data
        i. Machine ID, Machine Energies, Wedges (if any), Calibration data, Output factors, PDDs, Profiles
    b. SRS Cones Data
        i. Links to the photon machine above with the same Machine ID and adds to the "Wedges or SRS Cones" section of the machine, also independently syncing Calibration Data, SRS Cone Output Factors, SRS Cone Diameters, TMRs
    c. Electron Cone Data
        i. Machine ID, Machine Energies, Applicator IDs and sizes, PDDs
4. IMPORTANT!! After all machines are synchronized, any data unable to be synchronized automatically should be entered:
    a. Photons
        i. The DLG Correction Factors and MLC Transmission values must be manually entered "per-machine, per-energy" via the "Enter DLG and MLC Data" button in the left sidebar
        ii. Data can be found in Eclipse RT Administration:
            1. Highlight the machine in Overview
            2. Navigate to the MLC tab
            3. The necessary data is in the "Dosimetric Properties for Material 'MLC'" table
    b. Electrons
        i. Small field cutout radius, Cone Factors, Cutout Factors, and Inverse Square Corrections are populated with base data from a Varian 21EX-series machine. These may be edited to match clinical data. For energies besides 6, 9, 12, 16, and 20 MeV, the base data will be interpolated/extrapolated for those energies.
5. Once a machine is synchronized and all necessary data is entered where required by the user, the machine will be available for use with photon plans in ClearCalc.

Data that is automatically synchronized is read-only.

To compare or review Profile or PDD numerical data, choose the "Copy Measured Data" or "Copy ClearCalc FSPB Data" buttons below the respective graph. This will export the respective data into a delimited format that may be reviewed in a spreadsheet or similar program. If new data needs to be imported, the Import icon next to each heading may be utilized to import the respective data. See note on file formatting above.

Importing Photon Beam Data for Non-Eclipse Sites

Electron and brachytherapy data may be manually entered for sites that do not have Eclipse. For photon data entry for non-Eclipse sites, a custom globals.db file will need to be created by Radformation Support with applicable beam data. Please contact Radformation Support for more information.

NOTE: All data must be reviewed for accuracy prior to using ClearCalc clinically. If you find that the fitted data is not matching well after initial data fitting, please contact Radformation Support for assistance.

Electron Synchronized Applicator Factors

When applicator factors are synchronized via the auto-synchronization method, corrections need to be taken into account for measurements not taken at the depth of maximum dose for the applicator (as it varies with applicator size over energy slightly). As such, auto-synchronized applicator factors will be determined using the following equation:

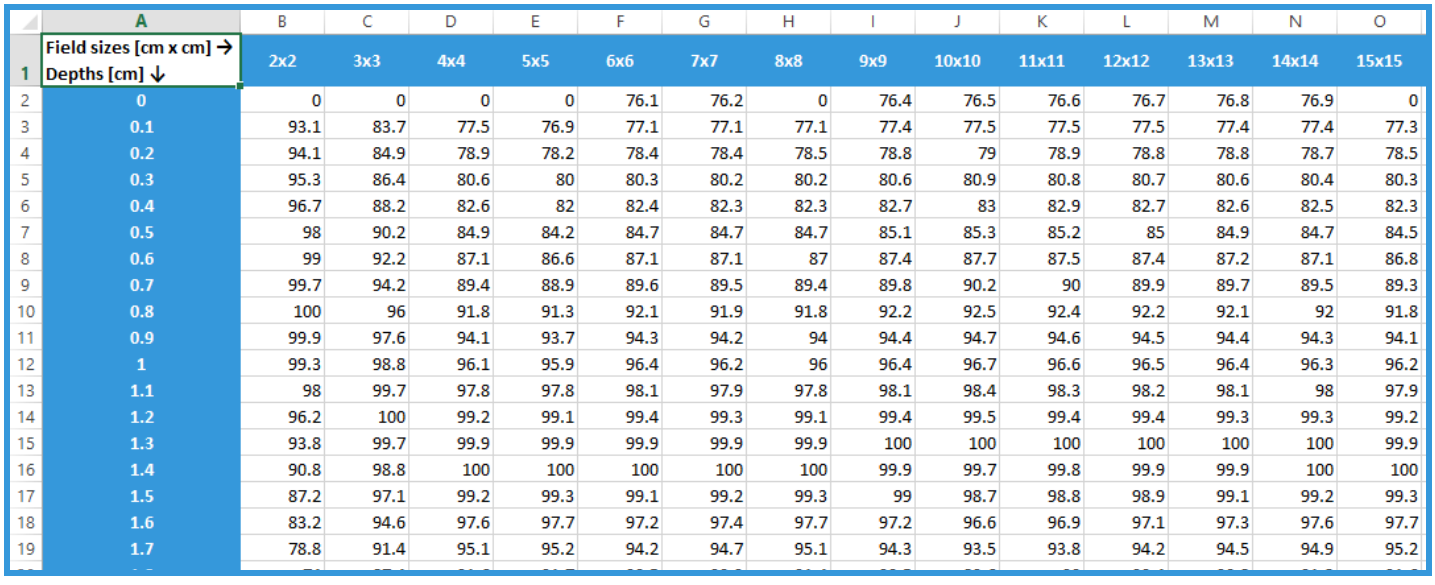
$$\text{ClearCalc Cone Factor} = \frac{\text{Maximum PDD value for Applicator}}{\text{Calibration Depth PDD value for Applicator}} * \text{cGy per MU at Calibration Point for Applicator}$$

When compared to your clinical applicator factors, note that there may be a difference due to this normalization if applicator factors are taken at one depth for all applicators (open) or if applicator factors are averaged. This is due to the nature of the data entry into Eclipse that is utilized by the auto-synchronization. This normalization is required to obtain accurate results in ClearCalc, as PDDs are obtained on a per-applicator basis. For informational purposes, this equation may also be found when hovering over the "Applicator Factors" heading in ClearCalc Administration.

Electron PDD Table Import (optional)

If automatic synchronization for electrons is not used, an optional path for PDD import for electrons exists. When in the PDD table, data may be imported via the "Import" icon next to the PDD Table heading. The Import feature for PDDs accepts files in .csv or .asc format and must be imported on a per-energy basis. PDD data, once imported, is in read-only text format. The following formats are supported.

- The CSV data should have the field sizes across the first row (<number> x <number> format in [cm x cm]) and the depths down the first column in [cm]. Data in any other format will not be properly read into the software. A sample is shown in the image below. The values should already be in PDD format (relative to 100). If values are entered in decimal format (relative to 1), ClearCalc will prompt the user that we will automatically scale the numbers by 100 to convert to PDD (and will prompt the user if doing so). Note that the value shown in cell A1 in this example is for demonstrative purposes only and when importing, this cell should be left blank.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Field sizes [cm x cm] → Depths [cm] ↓	2x2	3x3	4x4	5x5	6x6	7x7	8x8	9x9	10x10	11x11	12x12	13x13	14x14	15x15
2	0	0	0	0	0	76.1	76.2	0	76.4	76.5	76.6	76.7	76.8	76.9	0
3	0.1	93.1	83.7	77.5	76.9	77.1	77.1	77.1	77.4	77.5	77.5	77.5	77.4	77.4	77.3
4	0.2	94.1	84.9	78.9	78.2	78.4	78.4	78.5	78.8	79	78.9	78.8	78.8	78.7	78.5
5	0.3	95.3	86.4	80.6	80	80.3	80.2	80.2	80.6	80.9	80.8	80.7	80.6	80.4	80.3
6	0.4	96.7	88.2	82.6	82	82.4	82.3	82.3	82.7	83	82.9	82.7	82.6	82.5	82.3
7	0.5	98	90.2	84.9	84.2	84.7	84.7	84.7	85.1	85.3	85.2	85	84.9	84.7	84.5
8	0.6	99	92.2	87.1	86.6	87.1	87.1	87	87.4	87.7	87.5	87.4	87.2	87.1	86.8
9	0.7	99.7	94.2	89.4	88.9	89.6	89.5	89.4	89.8	90.2	90	89.9	89.7	89.5	89.3
10	0.8	100	96	91.8	91.3	92.1	91.9	91.8	92.2	92.5	92.4	92.2	92.1	92	91.8
11	0.9	99.9	97.6	94.1	93.7	94.3	94.2	94	94.4	94.7	94.6	94.5	94.4	94.3	94.1
12	1	99.3	98.8	96.1	95.9	96.4	96.2	96	96.4	96.7	96.6	96.5	96.4	96.3	96.2
13	1.1	98	99.7	97.8	97.8	98.1	97.9	97.8	98.1	98.4	98.3	98.2	98.1	98	97.9
14	1.2	96.2	100	99.2	99.1	99.4	99.3	99.1	99.4	99.5	99.4	99.4	99.3	99.3	99.2
15	1.3	93.8	99.7	99.9	99.9	99.9	99.9	99.9	100	100	100	100	100	100	99.9
16	1.4	90.8	98.8	100	100	100	100	100	99.9	99.7	99.8	99.9	99.9	100	100
17	1.5	87.2	97.1	99.2	99.3	99.1	99.2	99.3	99	98.7	98.8	98.9	99.1	99.2	99.3
18	1.6	83.2	94.6	97.6	97.7	97.2	97.4	97.7	97.2	96.6	96.9	97.1	97.3	97.6	97.7
19	1.7	78.8	91.4	95.1	95.2	94.2	94.7	95.1	94.3	93.5	93.8	94.2	94.5	94.9	95.2

- The ASCII data should be imported in a format similar to the file below. This format should be possible from a scanning system.

```
:MSR    6    # No. of measurement in file
:SYS BDS 0 # Beam Data Scanner System
#
# RFA300 ASCII Measurement Dump ( BDS format )
#
# Measurement number    1
#
%VNR 1.0
%MOD    RAT
%TYP    SCN
%SCN    DPT
%FLD    ION
%DAT    12-07-2007
%TIM    17:26:13
%FSZ    60  60
%BMT    ELE     6.0
%SSD    1000
%BUP    0
%BRD    1000
%FSH    -1
%ASC    0
%WEG    0
%GPO    0
%CPO    0
%MEA    1
%PRD    0
%PTS    60
%STS        0.0     0.0     0.8 # Start Scan values in mm ( X , Y , Z )
%EDS        0.0     0.0    60.0 # End Scan values in mm ( X , Y , Z )
#
#     X      Y      Z     Dose
#
=       0.0     0.0     0.8    78.3
=       0.0     0.0     1.9    79.6
=       0.0     0.0     2.7    80.1
=       0.0     0.0     3.8    81.4
=       0.0     0.0     4.8    83.0
=       0.0     0.0     5.8    85.0
```

Electron Data Extrapolation

Regarding data use, all values outside of the highest and lowest entered data are copied beyond the entered range. ClearCalc does not extrapolate outside of the entered data range - the last exact data point will be used. Data within the provided range is interpolated when necessary to match the treatment plan values.

Brachytherapy Source Data Customization

Default brachytherapy source data for TG-43 based calculations is provided as a courtesy for the following sources:

- Bard I-125 STM1251
- Best I-125 Model 2301
- Best Pd-103 Model 2335
- Bravos Ir-192 HDR
- CivaTech Pd-103 CS10
- Cs-137 67-6500
- E&Z Bebig HDR Ir-192 Ir2.A85-2

- E&Z Bebig HDR Ir-192 Model GI192M11
- Elekta Oncura I-125 Model 9011
- GammaMed Ir-192 HDR 12i
- GammaMed Ir-192 HDR Plus
- GammaMed PDR Ir-192 PDR 12i
- IsoAid Advantage I-125 IAI-125A
- IsoAid Advantage I-125 IAI-125A (CLRP v2)
- IsoAid Advantage Pd-103 IAPd-103A
- IsoRay Proxcelan Cs-131 CS-1 Rev2
- Nucletron Ir-192 HDR Flexisource
- Nucletron Ir-192 mHDR-v1
- Nucletron Ir-192 mHDR-v2
- Nucletron Ir-192 mHDR-v2r
- Nucletron Ir-192 mHDR-v2r (From Nucletron TPS)
- Theragenics I-125 AgX100
- Theragenics Theraseed Pd-103 Model 200
- VariSource 5 mm source
- Varian Ir-192 HDR VariSource (2000)
- Varian Ir-192 HDR VS2000 (2012)
- Xoft

Data for these sources are taken from the latest published data. All brachytherapy source data should be verified for accuracy prior to clinical use. The literature references are provided in ClearCalc Administration for each source. If another publication is desired for use, the user is responsible for data entry.

10. ClearCalc Standalone

The ClearCalc Standalone application performs ClearCalc calculations on DICOM plans and their related files, when applicable. Additionally, Monitor Unit hand calculations can be performed for photons and electrons with simple field geometries and are calculated on a water phantom.

Launching the Standalone Application

To launch the Standalone, navigate to the location of the ClearCalc installation. Run the ClearCalc.exe program. The standalone will require a user login. The default username/password is SysAdmin/SysAdmin. Users may be configured via the Users tab in ClearCalc Administration. Rights settings may also be A shortcut may be added to the desktop for access ease as well.

ClearCalc DICOM Standalone

The ClearCalc DICOM module imports DICOM data for use for ClearCalc calculations. This allows clinics not utilizing the Eclipse Treatment Planning System (or those running other TPSs in addition to Eclipse, such as those for Low Dose Rate Brachytherapy) to perform calculations with ClearCalc.

The DICOM interface functionality mirrors the features discussed in Section 7.4. The standalone will determine the incoming plan type and populate the proper calculation accordingly. Note that DICOM files do not always contain the same data that is available across the Eclipse API. To determine if data is missing from the DICOM header, it is recommended to utilize a DICOM Editor to read the file data.

Specific plan files are required to calculate via the ClearCalc Standalone application.

Photon and Electron Plan File Requirements

For photons and electrons, the DICOM files required are: RTPlan, RTStruct, RTDose, and all RTImage files. DICOM plans should be exported with "Field/Beam Dose" and not "Plan Dose." If field dose is not available, the plan should contain a reference point that provides per-field doses if field dose evaluation is desired. For Acuros plan-only dose calculated plans, the per-field MU results will not display. For users wanting to see per-field comparisons for Acuros plans, the per-field doses must be calculated.

There are also machine-specific requirements for non-conventional treatment machines. The file requirements for those machines are outlined below:

Accuray CyberKnife

CyberKnife plans must be evaluated with the DICOM Standalone application from the Accuray TPS workstation. The plan for evaluation must be open in the Accuray TPS while ClearCalc is being used for the plan to be able to access the necessary files for calculation. While a plan is open, the Accuray TPS creates a \tmp folder that ClearCalc reads to obtain the necessary files to perform an independent calculation for the plan. The files within the temporary folder are only present when the plan is open within the TPS. The temporary files contain the needed files for ClearCalc to perform its independent calculation.

Accuray TomoTherapy

TomoTherapy plans must be evaluated with the DICOM Standalone application with data exported from the TPS. ClearCalc requires the following to be exported from the TPS: the CT images, RTPlan, RTDose, and RTStruct files. It is recommended that these files be exported simultaneously for UID matching.

ViewRay MRIdian

MRIdian plans must be evaluated with the DICOM Standalone application with data exported from the ViewRay TPS. ClearCalc requires the following to be exported from the TPS: MR images, the CT images, the corresponding Registration Output, the RTPlan, RTDose, RTStruct, and the corresponding PlanOverview.txt. The PlanOverview.txt file is critical, as it contains the CT-to-MR link for the plan analysis. ClearCalc then uses this to pull the correct deformed CT image set. This image set is what

ClearCalc uses for its calculation. Also note that both the MR and CT are needed for proper calculation. All files must be exported at the same time for the UIDs to properly match as well.

Elekta Unity

Unity plans must be evaluated with the DICOM Standalone application from the Monaco® TPS workstation. ClearCalc requires the following to be exported from the TPS: the CT images, RTPlan, RTDose, and RTStruct files. It is recommended that these files be exported simultaneously for UID matching.

HDR and LDR Brachytherapy

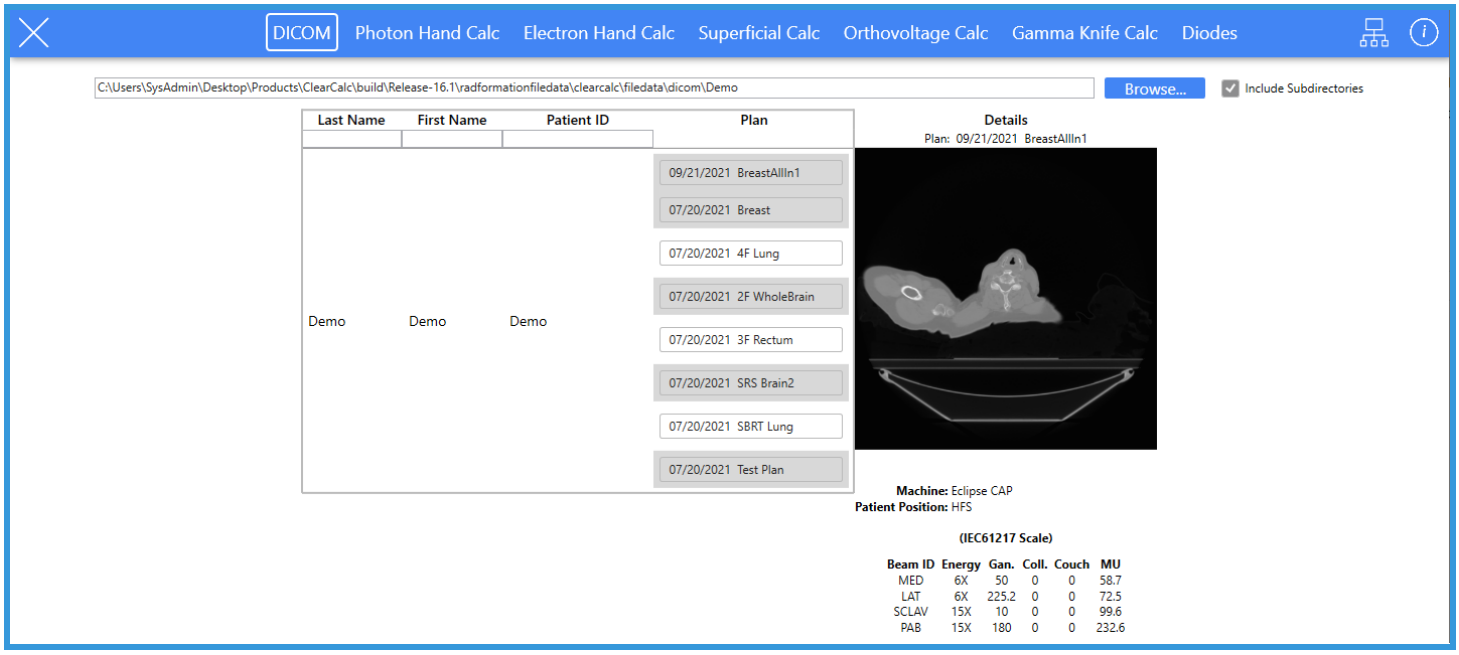
For brachytherapy, only the RTPlan file is required (from BrachyVision/Eclipse or Oncentra) unless the TPS does not export the dose information in the RTPlan file, such as for Varian VariSeed™, in which case the RTDose file is also required. The DICOM header from this, and similar, TPSs does not contain a reference point dose and a matrix dose calculation is therefore performed, evaluating multiple dose levels relative to the Prescription dose.

As with the Plugin application, there is required ClearCalc Administration data needed to use the Standalone application for photon, electron, and brachytherapy plans. For DICOM users, data may be configured for the following:

- For Brachytherapy sources and Electron Machines, data may be manually configured through the ClearCalc Administration application. Data entry must be completed and verified to perform accurate calculations.
- For Photon Machines that are not available through Eclipse, Radformation will need to assist in personally customizing the photon data for machines outside of Eclipse so they may be utilized with the DICOM Standalone - please contact support@radformation.com for assistance and determining if compatibility is possible. Please note that machine compatibility is still required.

Selecting a Plan for Calculation

Once the ClearCalc executable launches, the standalone application will open to the DICOM tab and a list of available DICOM files will appear. ClearCalc will display Last Name, First Name, Patient ID, Date/Time, and Plan ID if the DICOM tags are available. ClearCalc is only able to display values that are present in the correct DICOM tags within the DICOM headers and relies on these tag links to correctly associate files. ClearCalc assumes that the TPS from which the files originate are conforming to the DICOM Standard. It is the user's responsibility to verify the accuracy.



If desired, a default DICOM file directory may be set in ClearCalc Administration by first adding the user to the application via the User tab and then associating a Hospital to the user. A Hospital default directory is set up via the Settings tab. If no default Hospital/Directory location is set for a user, ClearCalc will use the default DICOM folder \\<installation location>\radformationfiledata\clearcalc\dicom.

Note that subfolders may be read by the DICOM Standalone by checking the "Include Subfolder'' check box. To change the search directory, choose the "Browse" option in the upper right of the screen. Additionally, this may be set as the default option in ClearCalc Administration. If this option is set as the default, not that the patient list could take additional time to load.

To select a plan for evaluation, find the patient and plan to evaluate in the list or use the patient search options to locate the patient and plan. Click on the plan name to change the button to a Lunch button as well as to view the plan details to the right of the DICOM search list. Once a plan is clicked, pertinent plan details will display, such as plan date, Machine ID, Field information, CT scan (including the ability to scroll through the CT), and patient position. Once confirmed that the Details match the plan to load, click the newly changed Launch button to begin the ClearCalc Analysis.

Once the plan is loaded, ClearCalc will determine which type of calculation should be completed based on the DICOM header information and launch the appropriate module (photon, electron, or brachytherapy). The results will display for analysis and approval (if necessary).

Printing Results

Results for the DICOM standalone may only be printed to PDF using the PDF icon in the upper left of the menu bar. A default save location may be set on a per-Hospital basis in the Settings tab of ClearCalc Administration. For plans evaluated in the DICOM tab, the custom Report Templates may be used for printing. For all other tabs, reports formats may not be customized. All data displayed will print to PDF, including relevant header information.

ClearCalc Hand Calculations Standalone

Hand Calculation modules of the ClearCalc Standalone allows users to calculate field MU for simple photon and electron static-field geometries in a square water phantom. These calculations require user-entry of treatment field parameters.

The photon and electron hand calculation modules allow the Patient ID, Patient MRN, Course ID, Plan Name, Dose Prescription, and Field ID to be entered on an optional basis - this information is not required for the calculation and does not affect the result. Photon and Electron calculations individually have other optional parameters that will be denoted with a "(optional)" notation. These boxes do not need to contain values for a calculation to complete.

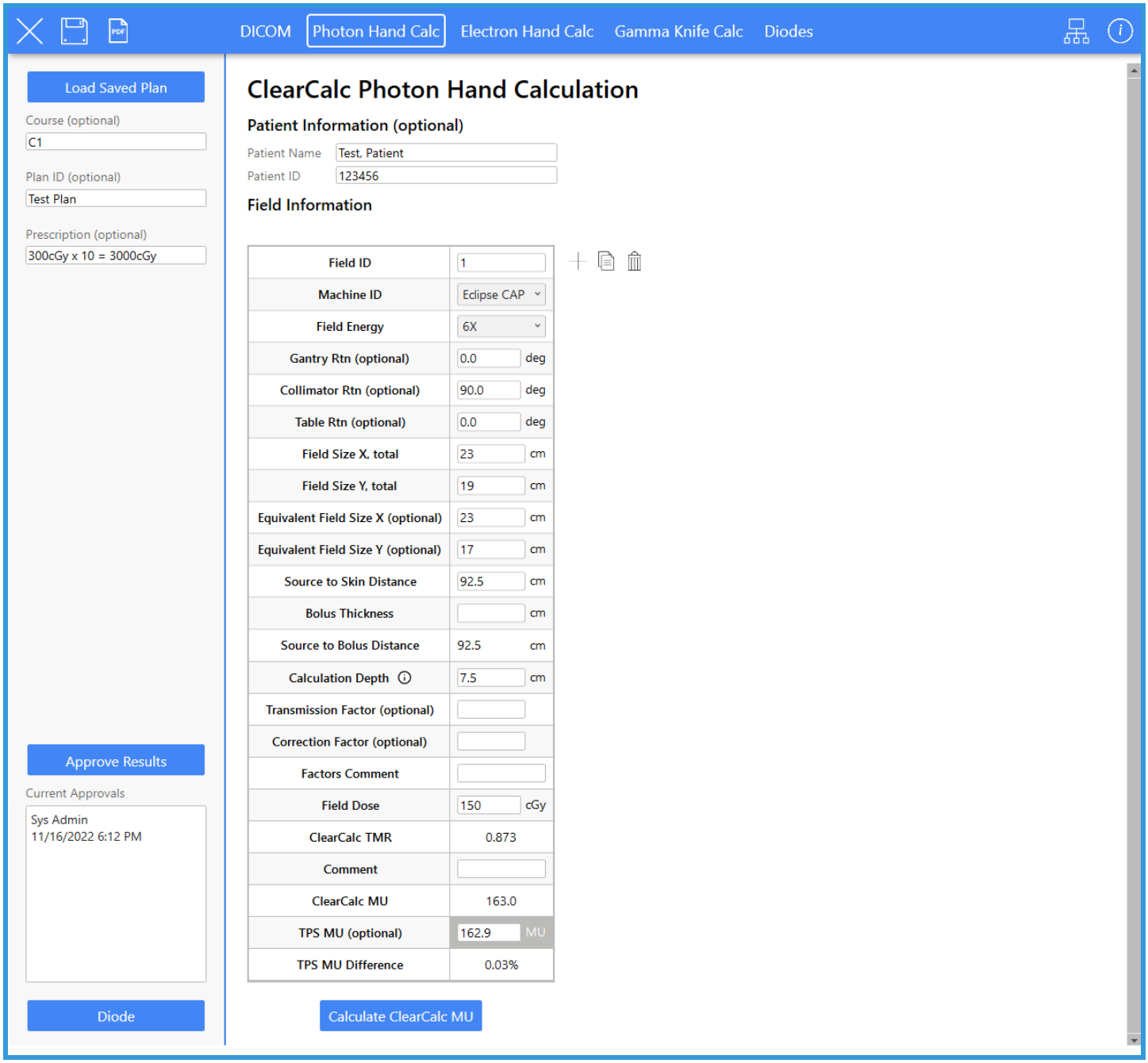
Photon Hand Calculations

A photon hand calculation may be started by selecting the "Photon Hand Calc" tab from the Standalone window. Fields are calculated using a square water phantom and the ClearCalc FSPB calculation algorithm.

To perform a photon calculation, begin by selecting the treatment machine from available photon machines (displayed machines are those available in ClearCalc Admin).

Once the machine is chosen, the available energies for that machine will then populate in the subsequent drop down. Choose the desired energy. Next, the total Field Size for X and Y should be entered. ClearCalc assumes jaws are symmetric, so the total width of the jaw direction should be entered, e.g. X1 = 5cm and X2 = 5cm → Field Size X, Total = 10cm. An option is added to allow the user to enter an Equivalent field size in the X and/or Y direction if it is known - this is an optional value and does not need to be entered. Equivalent field sizes cannot be larger than the total field size in the same direction.

Finally, the SSD (source to surface distance), Calculation depth (depth from the surface to the point of calculation), and Field Dose (for the single beam) should be entered in the noted units. Optionally, a bolus thickness or applicable correction factor may be entered.
Once all required values are populated, the "Calculate ClearCalc MU" button will activate and may be used to determine the resulting Monitor Units for the entered field parameters.

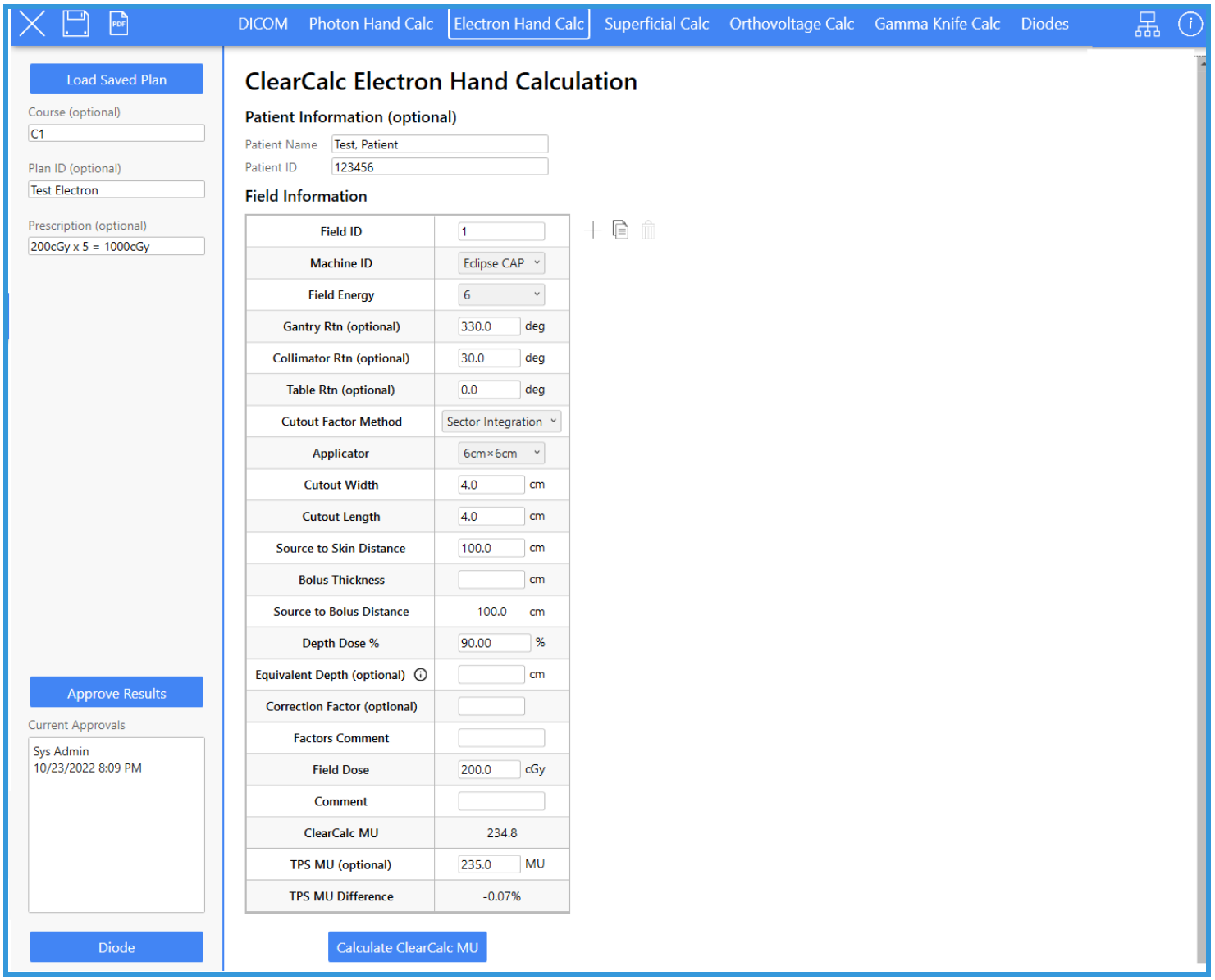


If any parameters of the field are changed, the ClearCalc MU will clear and need to be recalculated. Additionally, any approvals will also reset. Additional fields may be added, the currently selected field may be copied, or the currently selected field may be deleted using the icons to the right of the Field Information table. Note that only one machine may be used for all fields of a multi-field calculation - to change machines, a new calculation should be started.

Electron Hand Calculations

An electron hand calculation may be started by selecting the “Electron Hand Calc” tab from the Standalone window. Fields are calculated using a square water phantom and the ClearCalc electron formalism discussed in the Electron section.

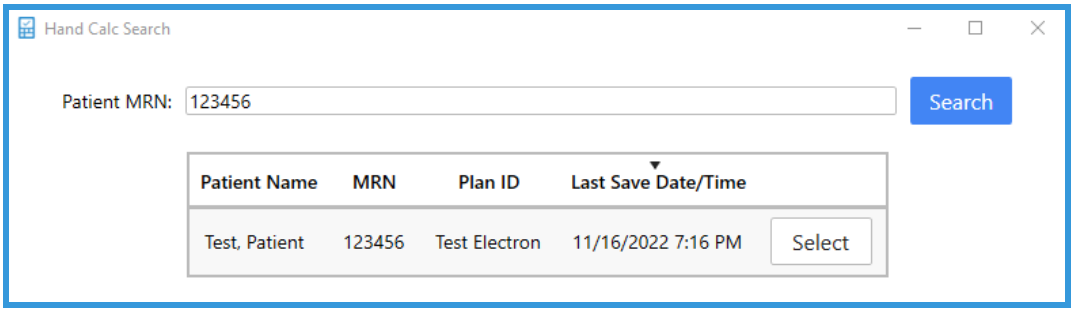
To perform an electron calculation, begin by selecting the treatment machine from available electron machines (displayed machines are those available in ClearCalc Admin). Once the machine is chosen, the available energies for that machine will then populate in the subsequent drop down. Choose the desired energy. Next, a drop down of available applicators for the corresponding machine will display and the desired applicator should be selected. The Cutout Width and Cutout Length should then be entered. ClearCalc assumes cutouts are rectangular and centered symmetrically on the central axis (CAX). The Length and Width sides do not matter as a result of these assumptions. An option is added to allow the user to enter a Cutout Factor if it is known - this is an optional value and does not need to be entered. If the value is left blank, ClearCalc will utilize the Cutout Factor table data in ClearCalc Admin to determine the cutout factor. Finally, the SSD (source to surface distance), Depth Dose % (or Equivalent Depth alternative - optional), and Field Dose should be entered. Optionally, the user may choose to enter a bolus thickness or correction factor. Once all required values are populated, the “Calculate ClearCalc MU'' button will activate and may be used to determine the resulting Monitor Units for the entered field parameters.



If any parameters of the field are changed, the ClearCalc MU will reset. Additionally, any approvals will reset. At any time, additional fields may be added, the currently selected field may be copied, or the currently selected field may be deleted using the icons to the right of the Field Information Table. Note that only one machine may be used for all fields of a multi-field calculation - to change machines, a new calculation should be started.

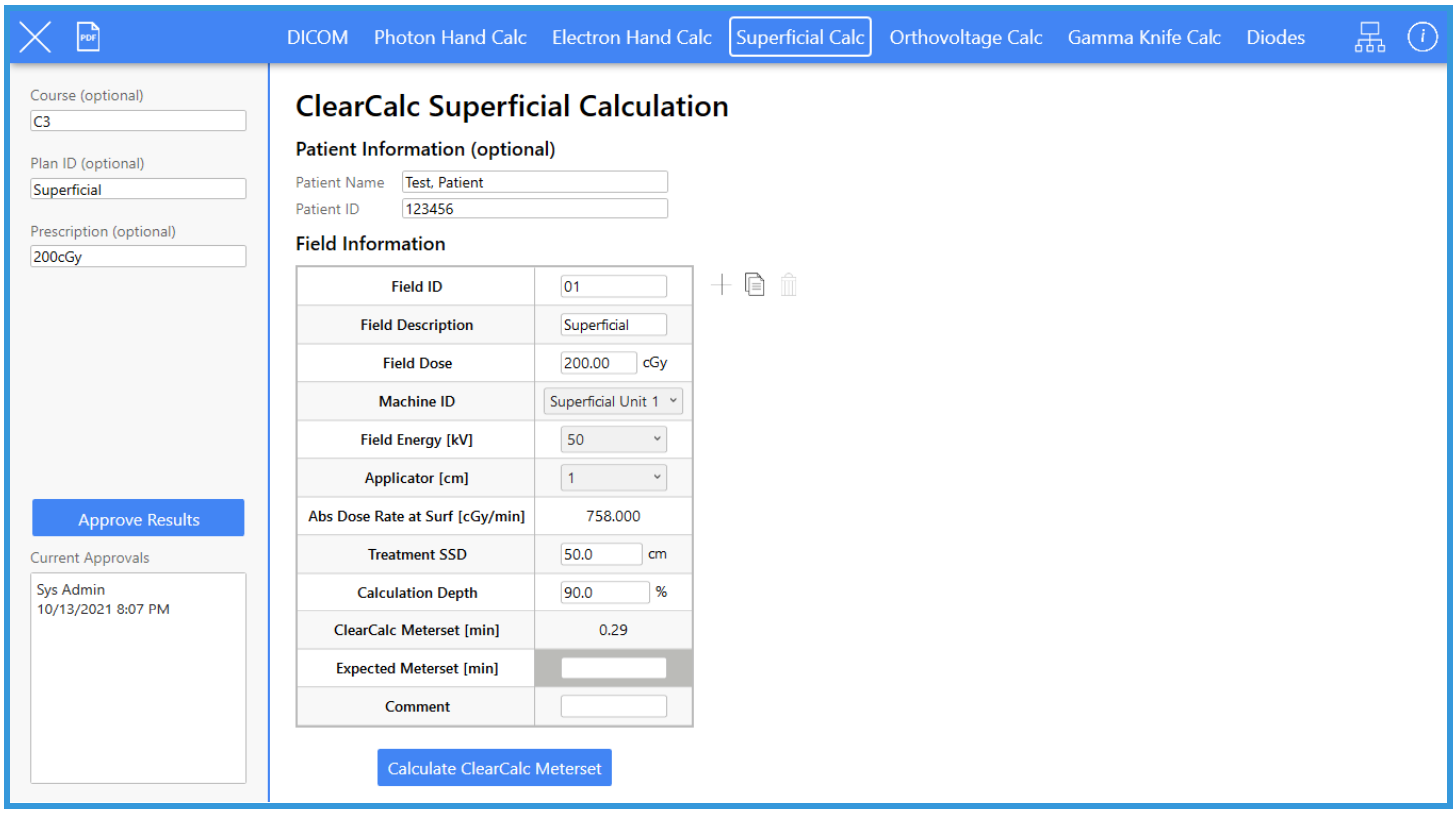
Saving and Retrieving Photon and Electron Hand Calculations

Photon and electron hand calculation results may be saved and retrieved utilizing the Load Saved Plan button (left sidebar) in their respective hand calculation tabs. When selected, a Hand Calc Search window will pop-up. Search by patient MRN to load previously saved results.



Superficial Calculations

A superficial calculation may be started by selecting the “Superficial Calc” tab from the Standalone window. This tab will only be active if sufficient information is entered into ClearCalc Administration. Fields are calculated via a typical hand calculation method.

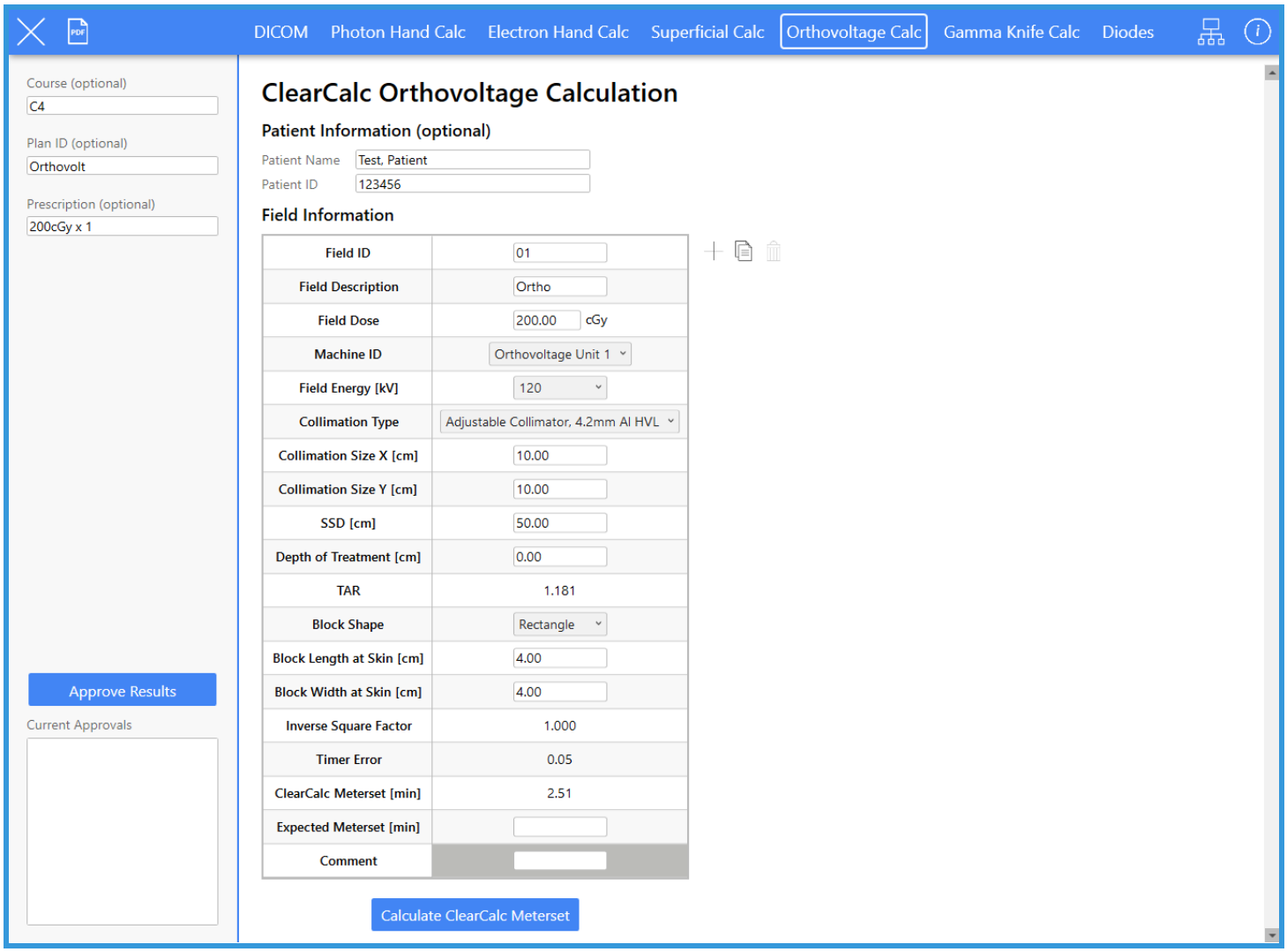


To perform a superficial calculation, begin by entering a field dose selecting the treatment machine from available superficial machines (displayed machines are those available in ClearCalc Admin). Once the machine is chosen, the available energies for that machine will then populate in the subsequent drop down. Choose the desired energy. Next, a drop down of available applicators for the corresponding machine/energy combination will display and the desired applicator should be selected. Finally, the SSD (source to surface distance) and treatment depth percentage should be entered. Optionally, the user may choose to enter a Field ID and description as well as Expected Meterset value, or Comment. Once all required values are populated, the “Calculate ClearCalc Meterset'' button will activate and may be used to determine the resulting Meterset for the entered field parameters.

If any parameters of the field are changed, the ClearCalc Meterset will reset. Additionally, any approvals will reset. At any time, additional fields may be added, the currently selected field may be copied, or the currently selected field may be deleted using the icons to the right of the Field Information Table. Note that only one machine may be used for all fields of a multi-field calculation - to change machines, a new calculation should be started.

Orthovoltage Calculations

An orthovoltage calculation may be started by selecting the “Orthovoltage Calc” tab from the Standalone window. This tab will only be active if sufficient information is entered into ClearCalc Administration. Fields are calculated via a typical hand calculation method.

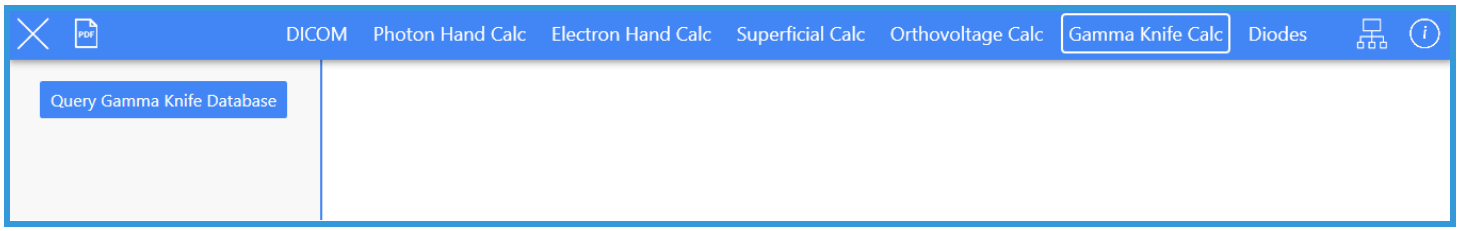


To perform an orthovoltage calculation, begin by entering a field dose selecting the treatment machine from available superficial machines (displayed machines are those available in ClearCalc Admin). Once the machine is chosen, the available energies for that machine will then populate in the subsequent drop down. Choose the desired energy. Next, a drop down of available Collimation Types for the corresponding machine/energy combination will display and the desired collimation should be selected. If the Collimation Size is required, the values should be entered, along with the appropriate block information and shape. Finally, the SSD (source to surface distance) and treatment depth should be entered. Optionally, the user may choose to enter a Field ID and description as well as Expected Meterset value or Comment. Once all required values are populated, the “Calculate ClearCalc Meterset'' button will activate and may be used to determine the resulting Meterset for the entered field parameters.

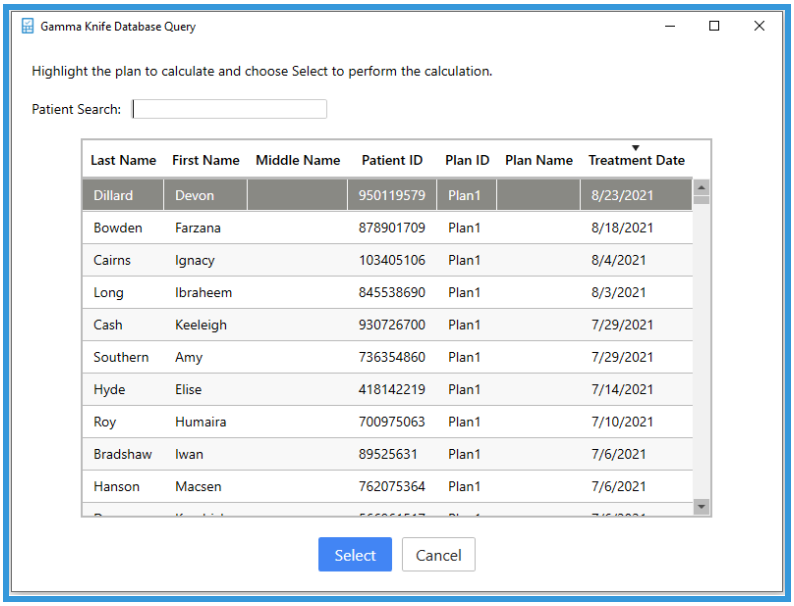
If any parameters of the field are changed, the ClearCalc MU will reset. Additionally, any approvals will reset. At any time, additional fields may be added, the currently selected field may be copied, or the currently selected field may be deleted using the icons to the right of the Field Information Table. Note that only one machine may be used for all fields of a multi-field calculation - to change machines, a new calculation should be started.

ClearCalc Gamma Knife Calculations Standalone

A Gamma Knife calculation may be initiated by proceeding to the “Gamma Knife Calc” tab. The Query Gamma Knife Database button will ping the GammaPlan database using the configuration set up on the Settings tab of ClearCalc Administration.



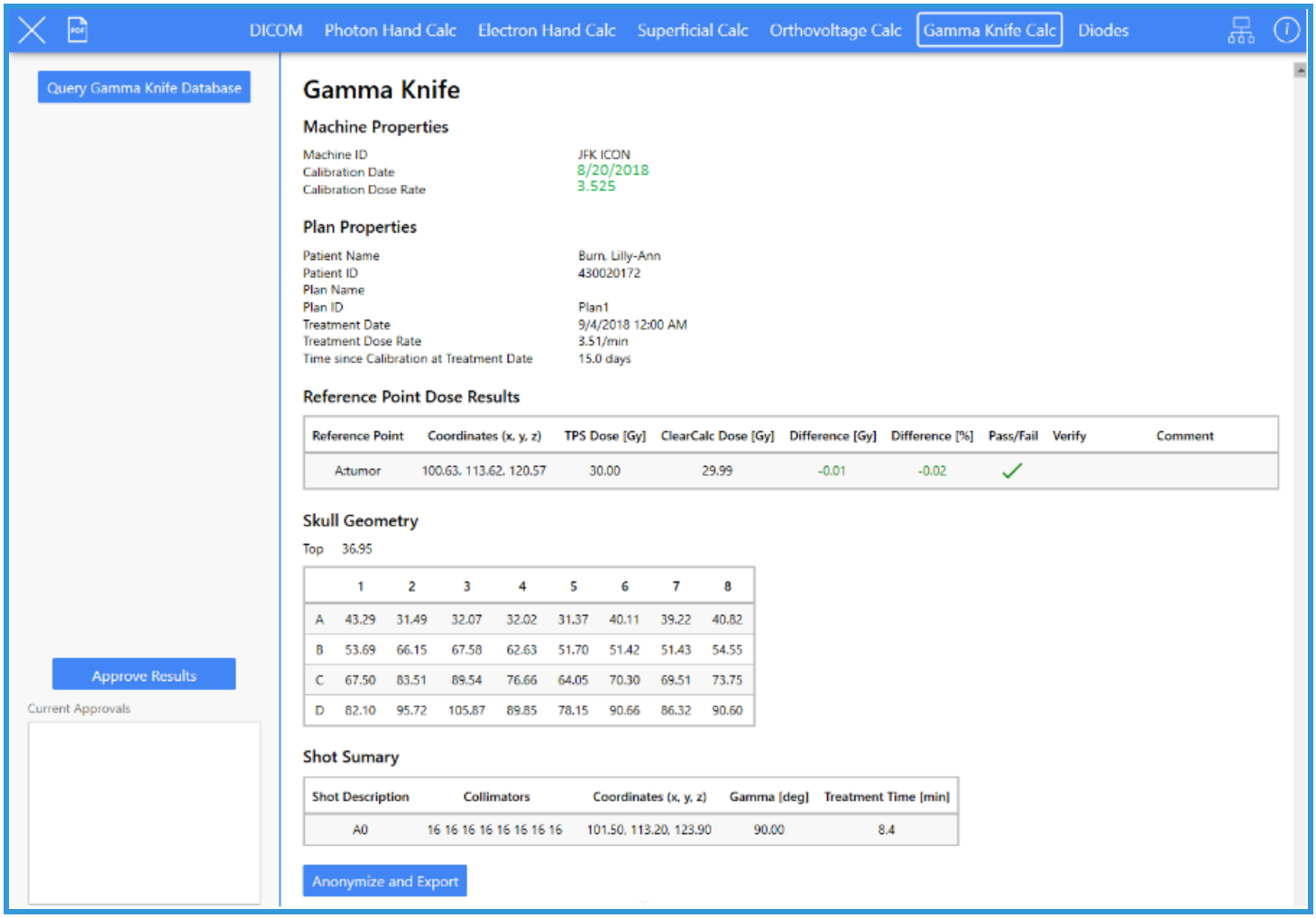
Once the database is queried, the Patient Selection window will populate, listing the available patients and plans from the GammaPlan database. Patients/Plans are listed in Descending date order. Each row will display the patient's Last name, FIrst name, Middle name, Patient ID, Plan ID, Plan Name, and Treatment Date. Users may also use the Patient Search option to search from these patient properties.



Once the patient and plan combination has been located, the row may be highlighted and the OK button will begin the Gamma Knife calculation. The results from the independent calculation will be displayed in the center window. The planning source calibration date and dose rate are compared with the values entered in ClearCalc Administration. In the calculation results and plan report, Calibration Date and Dose

Rate will display in: green font if matching, red if not matching, and black if the calibration date and dose rate are left empty in ClearCalc Administration.

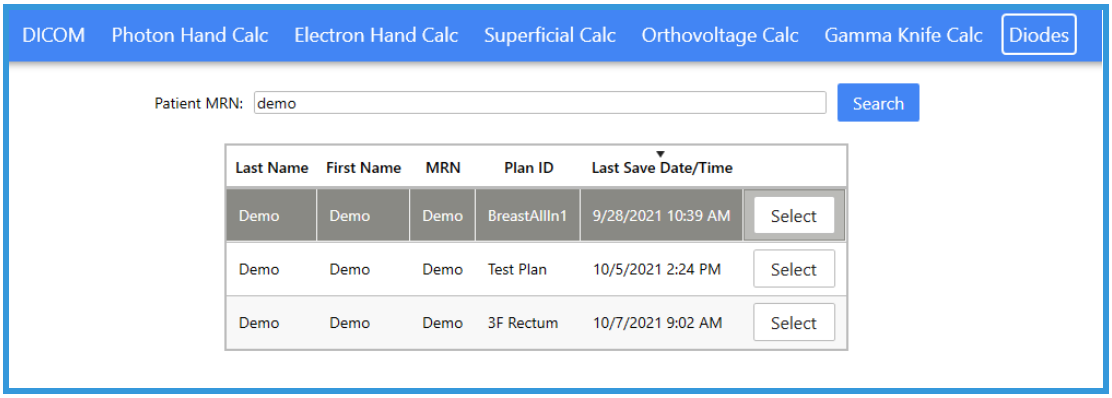
Calculations may be approved if User Approvals is active (in ClearCalc Administration | Settings). Additionally, the user may Anonymize and Export the GammaPlan to file if export and/or anonymization is needed.



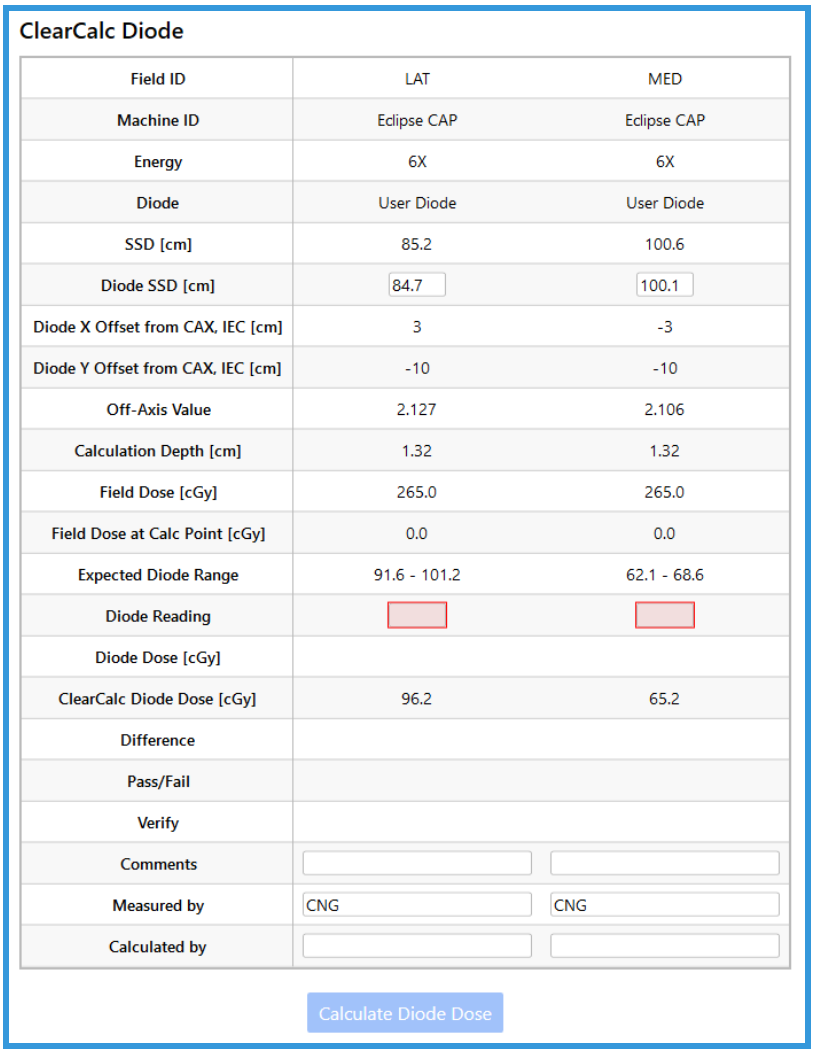
ClearCalc Diode Entry Standalone

Users have the option to enter Diodes results via the Standalone application. The Diode configuration for the plan/fields must still be completed in the Results UI. Thus, once the secondary check has been completed, the user must enter the Diode module from within this result and configure the Diode Offset and Field Dose at Calc Point (if any), as these values are not editable in the Diodes Standalone module.

Once the Standalone application is launched, the user may proceed to the Diodes tab. The Patient MRN box may be used to search for any saved Diode configurations. Choosing “Select” will launch the saved Diode configuration.



In the Standalone entry module, only the Diode SSD and Diode Reading values may be edited - along with the free-text Comments and Measured/Calculated By user information. As extended or retracted SSD values are entered by the user, Expected Diode Reading Range values will automatically recalculate for inverse square corrections.



After results are entered and saved in the Diodes module, results may be printed to PDF directly from within this module for ease. All saved results from the DICOM Standalone entry may also be viewed in the main Results UI as well.

11. ClearCalc Acceptance and Commissioning

ClearCalc acceptance requires the user to download and verify dose on a known phantom geometry to ensure the software is functioning as expected. The ClearCalc Verification patient plan should be imported into Eclipse. If results do not pass, contact Radformation Support.

After Acceptance, and prior to clinical use, ClearCalc should be properly commissioned by qualified personnel to ensure the most accurate match to measured clinical data and ensure ClearCalc is performing as expected.

A suggested procedure is outlined in Appendix A for each modality, but this is intended as a general guide. Ultimately, the needs of the clinic and pre-clinical testing are at the discretion of the qualified personnel commissioning ClearCalc. Overall, the target MU and/or dose tolerances are set anywhere from 3-5%, depending on verification complexity. Stricter tolerances may be needed for specific machine/source setup and should be determined based on clinic-specific needs. For clinics treating SRS and SBRT, additional smaller field sizes should be added for evaluation (e.g. down to 1x1 cm^2).

Note that ClearCalc is a fully-independent TPS-quality algorithm. It is not unlikely that differences will be noted, even on simple phantom plans, as a result. This is similar to the concept of calculating the same plan in two different, commercially-available TPSs, as algorithm differences are anticipated.

12. Troubleshooting the Software

Eclipse™ won't close

- If you are using the Eclipse scripting integration option, ensure that all ClearCalc windows are closed before trying to close Eclipse™. Eclipse™ will not close with ClearCalc windows still open.
- Close Eclipse™.

Can't log in to ClearCalc Administration

- Have your system administrator check your rights in the ClearCalc Administration Application.
- Make sure the user has rights to edit global templates.

Forgot Password

- Have your system administrator reset your password in the ClearCalc Administration Application.

Results Troubleshooting

Some basic troubleshooting tips for ClearCalc results are:

- Calculate the plan with a finer dose grid resolution
- Override the BODY structure to uniform tissue to check for heterogeneity differences
- Recalculate the plan on a solid water phantom to check for possible body contour issues
- Verify beam data for accuracy
- Recalculate the plan with another machine to check for machine differences/possible data mismatches/changes
- Calculate the plan with a different algorithm to test for algorithm differences
- Re-synchronize your beam data, if possible

13. Support

If you need support while using the software, please contact us:

Radformation, Inc
https://www.radformation.com/
support@radformation.com
Phone: 1-844-RADFOR5 extension 2
(1-844-723-3675)

14. Regulatory and Safety Notices

1. **Injury Hazard**
   - **a.** If the software is used in a manner not specified by Radformation, Inc. or is altered or modified in any way, the protection provided by the equipment may be void.
   - **b.** All repairs or service should only be performed by qualified personnel. Please contact Radformation, Inc. at +1-844-723-3675 or support@radformation.com.

2. **FDA 21 CFR 820**
   - **a.** Radformation's products are designed and manufactured in accordance with this regulation.

3. **CE Notice (European Union)**
   - **a.** Marking by the symbol CE indicates compliance of ClearCalc as a Class I Medical Device. The software complies with:
     - **i.** MDD 93/42/EEC (Amended by 2007/47/EC)
   - b. Radformation, Inc. has appointed an Authorized Representative in the European Union, with the following contact information:

EC REP

Emergo Europe
Prinsessegracht 20
2514 AP The Hague
The Netherlands

   - c. A Declaration of Conformity (DoC) has been made and is on file. Contact Radformation, Inc. at +1-844-723-3675 or support@radformation.com for more information.

4. **Australia Sponsor**
   - a. Radformation, Inc. has appointed an Authorized Representative in Australia, with the following contact information:

Emergo Australia
Level 20, Tower II
Darling Park
201 Sussex Street
Sydney, NSW 2000

(01)00860001672725(8012)2.1

Appendix A: ClearCalc Suggested Commissioning

ClearCalc Photon Commissioning

Machine Name	
Photon Energy [MV]	

Initial Beam Data Verification

Verify the accuracy of the data in ClearCalc Administration Photon *tab*

Parameter	Pass/Fail	Pass Criteria	Notes
Machine ID in ClearCalc matches Eclipse ID		Accurate	
Reference conditions parameters		Accurate	
MLC Transmission		Accurate	
DLG Correction Factor		Accurate	
Output Factors		Accurate	
Profiles graphical overlay comparison		Within 5%	
PDD graphical overlay comparison		Within 5%	

Open Field Plan Verification

Create open field plans on a solid water phantom and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
100MU, 90cm SSD, 5x5		Within 3%	
100MU, 90cm SSD, 10x10		Within 3%	
100MU, 90cm SSD, 20x20		Within 3%	
100MU, 90cm SSD, 30x30		Within 3%	
100MU, 90cm SSD, 40x40		Within 3%	
100MU, 90cm SSD, 15deg hard wedge, max field size		Within 3%	
100MU, 90cm SSD, 30deg hard wedge, max field size		Within 3%	
100MU, 90cm SSD, 60deg hard wedge, max field size		Within 3%	
100MU, 90cm SSD, 10deg virtual wedge, max field size		Within 3%	
100MU, 90cm SSD, 60deg virtual wedge, max field size		Within 3%	

ClearCalc Photon Commissioning, Page 2

Basic Plan Verification

Create 10 basic geometry plans on a solid water phantom and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
Field-in-field Breast (sample)		Within 5%	
4-field Pelvis (sample)		Within 5%	
AP-PA Spine (sample)		Within 5%	
Wedge Pair Larynx (sample)		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	

Complex Plan Verification

Create 10 complex geometry plans on a solid water phantom and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
VMAT Prostate (sample)		Within 5%	
9-field IMRT Head & Neck (sample)		Within 5%	
Lung SBRT (sample)		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	

ClearCalc Electron Commissioning

Machine Name	
Electron Energy [MeV]	

Initial Beam Data Verification

Verify the accuracy of the data in ClearCalc Administration Electron *tab*

Parameter	Pass/Fail	Pass Criteria	Notes
Machine ID in ClearCalc matches Eclipse ID		Accurate	
Calibration in reference conditions [Dose/MU]		Accurate	
Applicators		Accurate	
Cone Factors		Accurate	
Cutout Factors		Accurate	
Percent Depth Dose Values		Accurate	
Inverse Square Correction		Accurate	

Open Field Plan Verification

Create open field plans on a solid water phantom and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
100MU, 100cm SSD, 6x6 open cone		Within 3%	
100MU, 100cm SSD, 10x10 open cone		Within 3%	
100MU, 100cm SSD, 15x15 open cone		Within 3%	
100MU, 100cm SSD, 20x20 open cone		Within 3%	
100MU, 100cm SSD, 25x25 open cone		Within 3%	
100MU, 95cm SSD, 6x6 open cone		Within 3%	
100MU, 95cm SSD, 15x15 open cone		Within 3%	
100MU, 95cm SSD, 25x25 open cone		Within 3%	
100MU, 105cm SSD, 6x6 open cone		Within 3%	
100MU, 105cm SSD, 15x15 open cone		Within 3%	
100MU, 105cm SSD, 25x25 cone		Within 3%	

ClearCalc Electron Commissioning (continued)

Basic Plan Verification

Create 5-10 basic geometry plans on a solid water phantom and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
Breast Tumor Bed Boost (sample)		Within 5%	
Pelvis Inguinal Node Boost (sample)		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	
		Within 5%	

ClearCalc Brachytherapy Commissioning

Source Name	

Initial Source Data Verification

Verify the accuracy of the data in ClearCalc Administration Brachy *tab*

Parameter	Pass/Fail	Pass Criteria	Notes
Source ID in ClearCalc matches Eclipse ID		Accurate	
Dose Rate Constant		Accurate	
Active length		Accurate	
Cutout Factors		Accurate	
Percent Depth Dose Values		Accurate	
Inverse Square Correction		Accurate	

Plan Verification

Create basic brachytherapy plans and compare to ClearCalc value

Plan Setup	Pass/Fail	Pass Criteria	Notes
1 channel, 1 source		Within 5%	
1 channel, 2 sources		Within 5%	
1 channel, 5 sources		Within 5%	
1 channel, 10 sources		Within 5%	
2 channels, 1 source each		Within 5%	
2 channels, 5 sources each		Within 5%	
2 channels, 10 sources each		Within 5%	
3 channels, 1 source each		Within 5%	
3 channels, 5 sources each		Within 5%	
3 channels, 10 sources each		Within 5%	