

Software RT-Builder for Quality Control of Radiation Processing

User Manual

Software RT-Builder

Software RT-Builder is the tool for calculation and analysis of the summarized absorbed dose in 3D product irradiated by EB, X-ray or gamma ray with various methods, such as multipass, multilevel, multisided and others (See chapter 3.4.).

RT-Builder summarizes the absorbed doses obtained with software ModeStEB, ModeSXR and ModeGR in the 3D product irradiated with EB, X-ray and gamma ray for one pass/side/level irradiation, for two pass/side/level irradiation and so on.

RT-Builder uses the assembling of the script for sequence of multi pass/side/levels irradiation of the product for summation of the absorbed doses calculated with software ModeStEB, ModeSXR and ModeGR for each of multi pass/side/levels.

For example, the task - to calculate the absorbed dose in 3D target with multilayer structure consist of some flat sheets with various sizes and materials which was four sided irradiated with scanned EB on moving conveyer.

The sequence of operations is as follows:

- The software ModeStEB calculates the absorbed dose in multilayer target irradiated with scanned EB from 1st side, 2nd side, 3^d side and 4th side.
- If the multilayer target construction is symmetric from one of sides in direction of thickness, width or length, RT-Builder can calculate the absorbed dose as invert curve for opposite side in direction of symmetry axis.
- The RT-Builder summarizes the absorbed doses obtained in the above operation step for certain interesting layers in multilayer target.

Note. The discrete model is used at calculation by MC method the 3D absorbed dose into target volume irradiated with EB, X-ray or gamma ray. It means that target volume is represented as a 3D grid of volumetric points – voxels, which are defined by 3 indexes along axis X, Y and Z. The indexes number along axis X, Y and Z are defined by splitting $N(x)$ on axis X, - $N(y)$ on axis Y, and - $N(z)$ on axis Z.

For example, the target in form of parallelepiped has Width along axis X, Length along axis Y, and Thickness along axis Z. All values Width, Length, and Thickness are defined in cm. The volume of each voxels will be defined as $V_{\text{vox}} = \Delta X \cdot \Delta Y \cdot \Delta Z$, in cm^3 .

Where $\Delta X = \text{Width} / N(x)$, $\Delta Y = \text{Length} / N(y)$ and $\Delta Z = \text{Thickness} / N(z)$.

Average value of absorbed dose $(D_{\text{vox-av}})_i$ in volume of each voxel $(V_{\text{vox}})_i$ is defined at calculation by MC method the 3D absorbed dose into target volume irradiated with EB, X-ray or gamma ray. Software ModeStEB, ModeSXR and ModeGR transfer the value of calculated absorbed dose into software RT-Builder in discrete form as set of doses $(D_{\text{vox-av}})_i$ from all voxels of irradiated target.

RT-Builder operation

Operation of the Software **RT-Builder** will be demonstrated on example of targets irradiated with gamma ray from flat panoramic ^{60}Co source rack. **Software ModeGR.** See description of the **software ModeGR** operations in **the chapter 4.3.**

Before work with the **software RT-Builder**, user should prepare the files with calculated absorbed doses in the product irradiated with gamma ray for defined pass/side/levels.

- Click the **“File”** in the Main form **of the Software RT-Builder** (See **Fig.1**).

The window for loading files will be appearing.

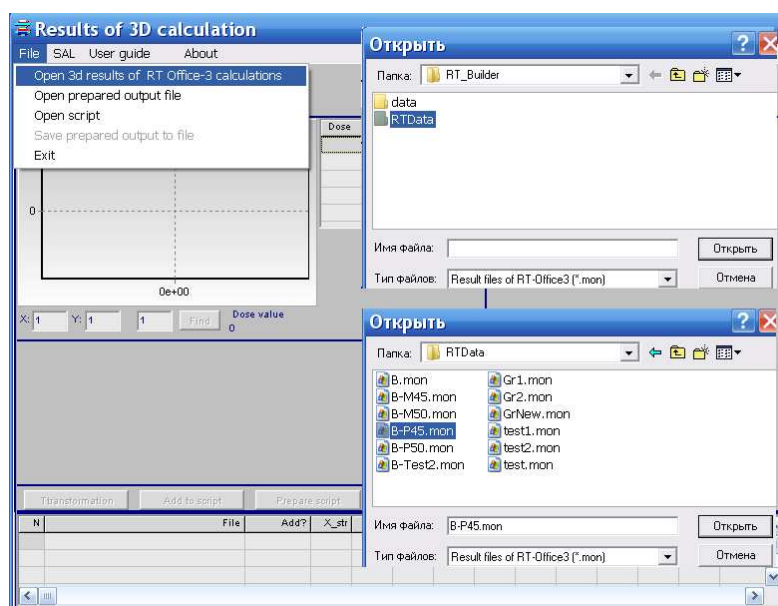


Fig.1. The main form of the Software RT-Builder.

There are the following load files for selection:

1. **Select file “Open 3d results of RT Office-3 calculations”** - the file with previously calculated absorbed doses in the product irradiated with EB, X-ray and gamma ray for certain pass/side/levels will be open. (See [Fig.2](#)).

As example, the files type - “**ND1.mon**” – with results of MC simulation of absorbed doses for gamma ray processing are presented in [Fig.2](#) and [Fig.4](#).

Simultaneously user can load some files with previously calculated absorbed doses in the irradiated product for certain pass/side/levels. (See [Fig.4](#)).

In this form the built-in tools for output data analyzing and processing are as follows:

- Tools for **dose volume histogram (DVH) analysis**.
- Tools for **3D absorbed dose analysis with spokes method**.

In this option user can perform the following operations:

- **to select the files with calculated absorbed doses** in the product irradiated with EB, X-ray and gamma ray for defined pass/side/levels;
- **to carry out the detailed DVH and spokes methods analysis** for 3D absorbed dose distribution in 3D irradiated product for one pass/side/level irradiation in the whole product volume or any selected part of product volume, (See [Fig.3](#));
- **to invert the curve of absorbed dose distribution** in an irradiated product in directions of symmetry of construction product;
- **to change scale for whole curve of absorbed dose distribution** in an irradiated product by multiplication on corresponding coefficient;
- **to develop script file** for summation of the absorbed doses calculated with software **ModeStEB**, **ModeSXR** and **ModeGR** in accordance with sequence of multi pass/side/levels product irradiation.

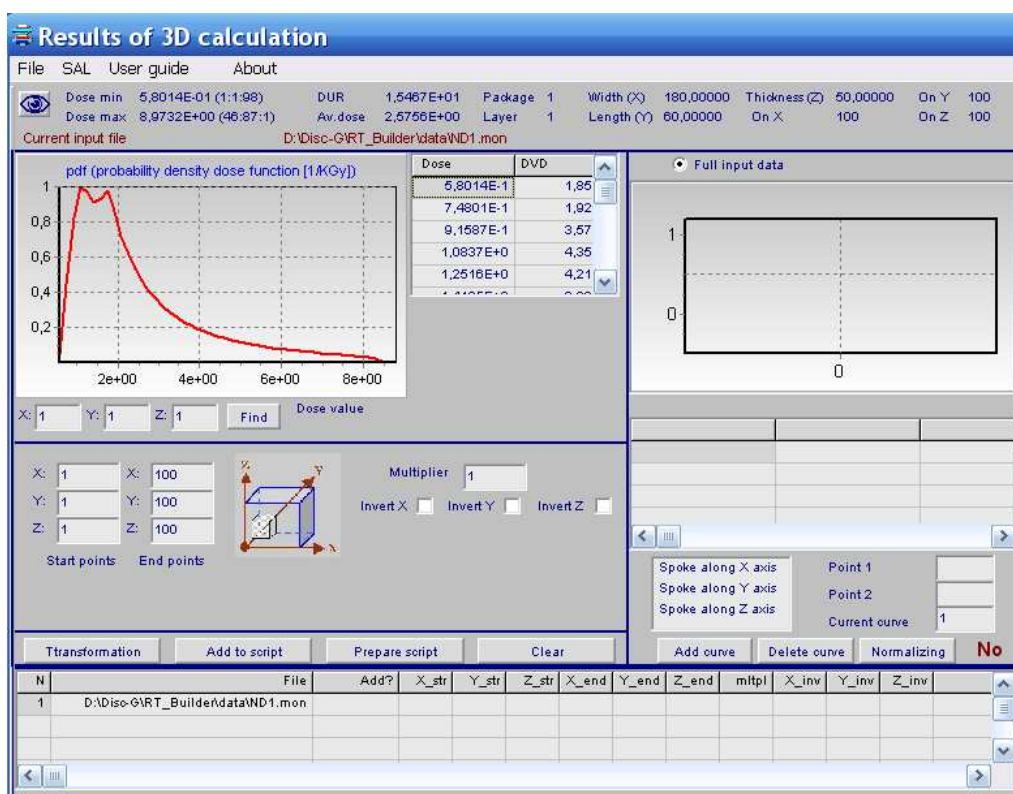


Fig.2. Frame “Open prepared output file” with loaded file ND1.mon.

The frame (See Fig.2) comprises the following information:

- the name of current input file with results calculation of gamma ray absorbed dose in certain layer, that was calculated by the program ModeGR;
- the layer geometrical parameters such as Width(x), Length(y) and Thickness (z) in cm;
- the values of splitting number $N(x) = 100$ along axis X, $-N(y) = 100$ along axis Y, and $-N(z) = 100$ along axis Z;
- the graph of probability density dose function for the layer (red curve);
- the values of $Dose_{min}$, $Dose_{max}$, $Dose_{av}$ – Average dose and DUR-dose uniformity ratio in the layer, the indexes of X, Y and Z for location of $Dose_{min}$ and $Dose_{max}$ (See upper part of the frame);
- configuration data for calculation gamma ray absorbed dose distribution in the selected layer by the program ModeGR.

To see configuration data, click the button “Eye” (See Fig.2, upper part of the frame). The Table “Configuration data for calculation by ModeGR” with all input data for calculation the gamma ray absorbed dose distribution in the selected layer will be opened (See Fig.3).

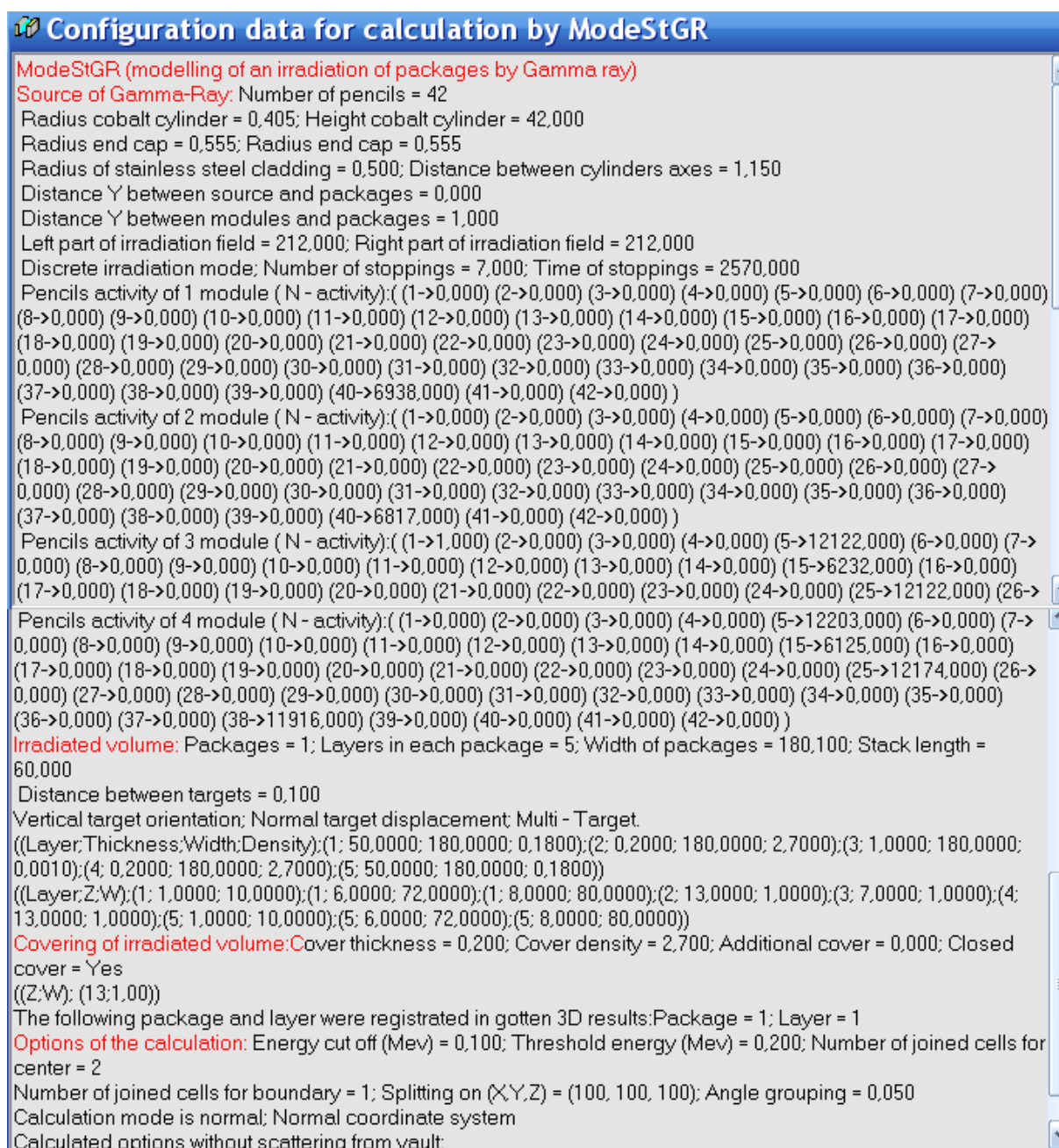


Fig.3. The Table “Configuration data”.

Additional user can made the detailed DVH analysis for each volumetric part in the selected layer of the selected package.

For this purpose, Select indexes of interesting volumetric part of the layer.

The frame for selection the indexes of interesting volumetric part in form of tables “Start points” and “End points” are located in the left down part of the frame “Results of 3D calculation”. (See Fig.4)

- **Enter the indexes of X, Y and Z in the table “Start points”.**
- **Enter the indexes of X, Y and Z in the table “End points”.**
- **Click the button “Transformation”.**

The values of $Dose_{min}$, $Dose_{max}$, $Dose_{av}$ and DUR in the selected volumetric part of the layer, the indexes of X , Y and Z for location of $Dose_{min}$ and $Dose_{max}$ will be appeared in the frame (See left middle part of the frame in the Fig.4).

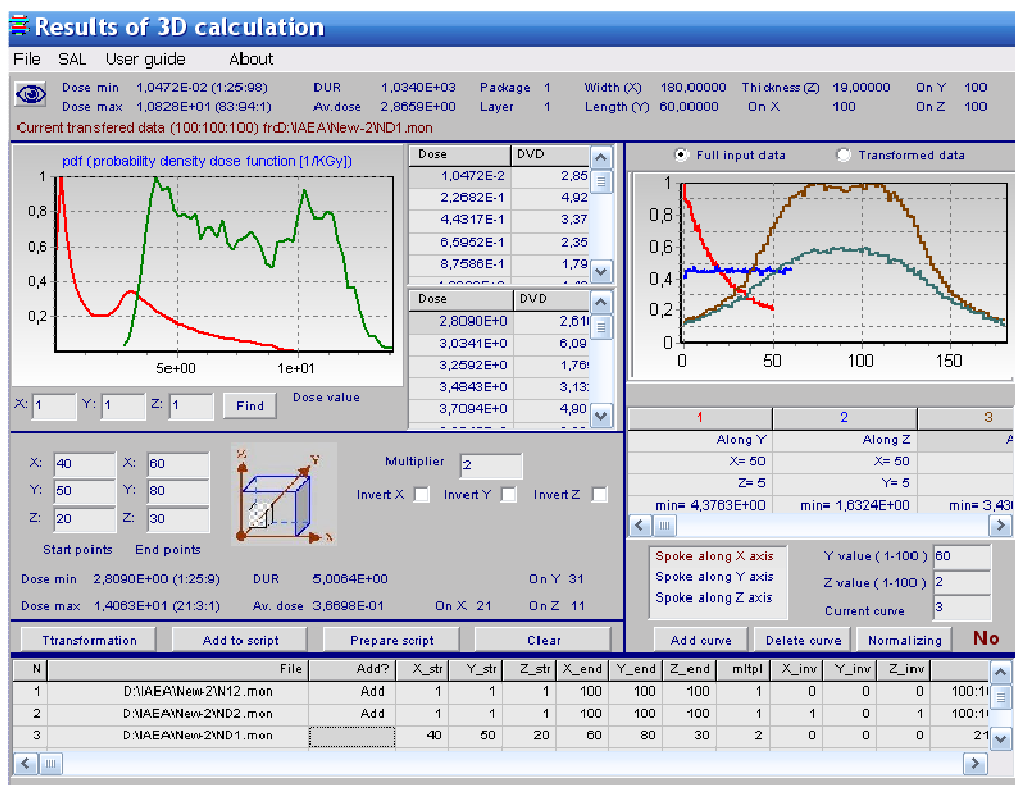


Fig.4. Frame “Open prepared output file” with DVH and spokes methods analysis of files “ND12.mon”, “ND2.mon” and “ND1.mon”.

2. Select file “Open prepared output file” – the previously prepared by RT-Builder files with the summarized absorbed dose in the product irradiated by EB, X-ray and gamma ray with various methods, such as multipass, multilevel, multisided and others (See Fig.5).

Files type - “.sum”.

In this option user can perform the **DVH and spokes** methods analysis of summarized 3D absorbed dose distribution in product for defined sequence of multi pass/side/level irradiation of the whole product volume.

3. Select file “Open script” – one of the previously prepared by RT-Builder script files can be selected and open for correction (See Fig.6).

Script file comprise:

- the set of files with calculated absorbed doses in the product irradiated with EB, X-ray and gamma ray for user-defined one pass/side/levels,
- the sequence of operation with the files to summarize the absorbed doses in accordance with multi pass/side/levels irradiation of the product.

Files type - “.sco”.

In this option, user can perform the correction and modification of the script files.

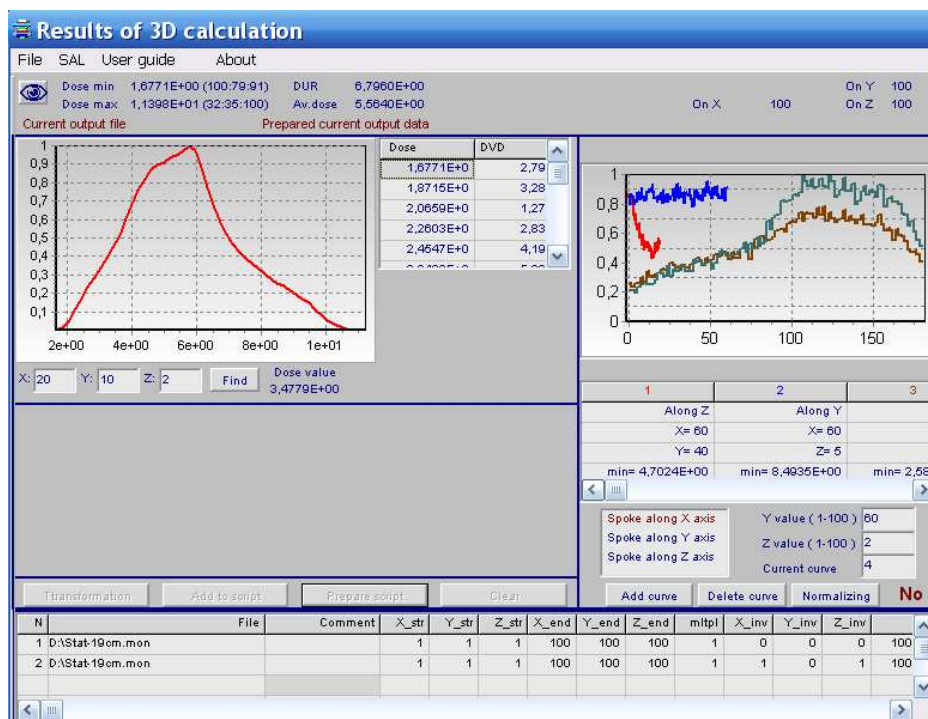


Fig.5. Frame “Prepared output data”.

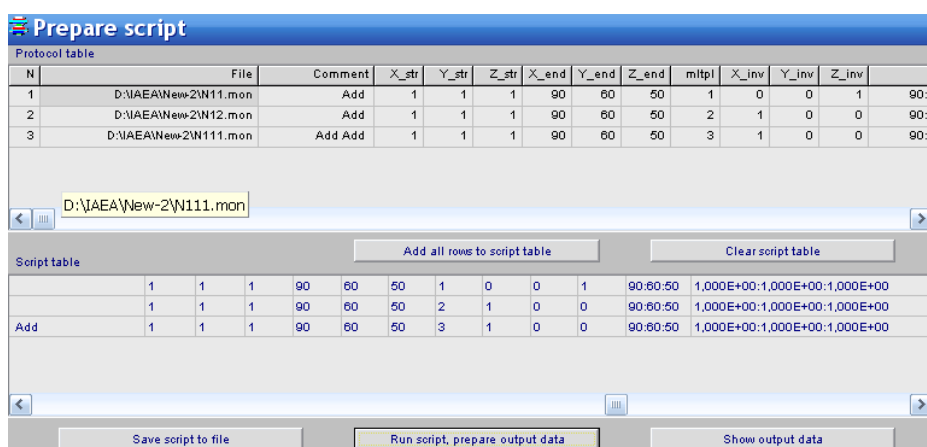


Fig.6. Frame “Prepare script”.

4. Select option “Save prepared output to file” – save prepared output data to file. Files type - “.sum”.

The file contain the result with summarized absorbed dose in product irradiated by EB, X-ray or gamma ray in accordance with user-defined sequence of product irradiation (multi pass/side/levels) included into script file.