VARSKIN+ 2.0
Software Release Note

March 2025

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Revision History

Revision	Description
0	Initial release.

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1.0 Introduction

This document outlines in detail the modifications, additions, and/or removal of features from VARSKIN+ v1.3.1 to VARSKIN+ v2.0.

The change associated with this version of VARSKIN+ is to add the new Extravasation Dosimetry model. No other changes were made to the other modules of VARSKIN+.

All modifications are based on items entered in the RCD software issue tracker as a source for the basis of a change.

2.0 Abbreviations and Definitions

Table 2-1. Abbreviations and definitions.

Term	Definition
CP	change package number (gitlab version identifier)
DLL	dynamic-link library
GUI	graphical user interface

3.0 Base Line Code

The changes identified here have been incorporated into the baseline of VARSKIN+ 2.0. Table 3-1 and Table 3-1 document the attributes of the software product with project dependencies as identified in Table 3-3.

Table 3-1. GIT attributes.

Git Location	Revision ID (Commit SHA)
https://gitlab.com/RCD-1/varskin/-/tags/varskin+v1.1	d2f7c94e0b144f9830f151307078c27f68d63a6e
https://gitlab.com/RCD-1/varskin/-/tags/varskin+v1.2	2295b4ef6963f161fdfa91868ded5419ff602121
https://gitlab.com/RCD-1/varskin/-/tags/varskin+v1.3	137adac8cb4c6ade81d4eb9c70018eeaa7c69fe2
https://gitlab.com/RCD-1/varskin/-/tags/varskin+v1.3.1	777ed573c8841bb9c7fa272cda3e50eab253314c
https://gitlab.com/RCD-1/varskin/-/tags/varskin+v2.0	fefe81be88d14adb393776fc8ddbd5084991d374

Table 3-2. Executable attributes.

Executable Name	V+2.0.exe
MD5sum	4b9631a9f92deedab4f90186ccb9a493
SHA256	49cfe73a84d9a47c6f0a652bc3423d59793e9a72ff273f54b6b87331edaedcfe
SHA512	96cd917bf29343f5e6062459cd97fc347df05d027c9185571792037fa823dfe14c812685c4a48219d191d9792ed5ec3ab3710735e4be3d8a055143e9a4c3bea4

Table 3-3. Dependency attributes.

Software	Version	Git Location / Group ID	Revision ID (Commit SHA)
NRC-Graphing	1.0	https://gitlab.com/RCD-1/nrc-graphing/-/tags/nrcGraphing_v1.0	575af944ddf229c6ba033b4117f90d84117c9f49

Software	Version	Git Location / Group ID	Revision ID (Commit SHA)
RadToolbox	3.0.1	https://gitlab.com/RCD-1/radtoolbox/-/tags/radToolbox_V+v1.3.1	499592ffb31a96862df73d26b00a0d9bad3c46bd
ExtravDose	1.0	https://gitlab.com/RCD-1/extrav/-/tags/v1.0	59e0a5658a705566d4b49e281cff31af0e6285a8
KeyGen	1.0	https://gitlab.com/RCD-1/keygen/-/tags/v1.0	270a0ccb47ca1149e41332af6ace3f92940a114f
files	2.0	https://gitlab.com/RCD-1/utilitiesjava/-/tags/utilities_v2.0	3714305b7dac46253827bc4a0361ae496db588c0
formats	2.0		
language	2.0		
maths	2.0		
JFreeChart	1.5.4	org.jfree	n/a
Intel® Fortran Compiler Classic	2021.11.0	n/a	n/a
JDK	21	n/a	n/a

4.0 Changes

The following sub-sections outline the changes made from VARSKIN+ version 1.3.1 to VARSKIN+ version 2.0. A summary of changes is provided in Table 4-1.

Table 4-1. Summary of versions and resolved issues.

Version	Issue #	Description	Section(s)
1.3.1 (CP55)	99	Major Release.	-
1.3.2 (CP53)	108	Major Release. Addition of Extravasation Dosimetry model.	4.1

4.1. Issue 108: Addition of Extravasation Dosimetry Module

Extravasation Dose (ed.) is a module in VARSKIN+ (V+) 2.0 for calculating local tissue dose from radiopharmaceutical extravasation during medical administration. Extravasation occurs when a radiopharmaceutical intended for the bloodstream leaks into surrounding tissue. It is a temporary condition in which radioactive material within the patient irradiates tissues near the site of administration for longer periods of time than if extravasation did not occur.

The developed extravasation dosimetry module is a time-dependent, multi-dimensional, and multi-physics code that breaks the region into mesh/voxel volumes for analysis. It simulates the injection of a fluid with a defined activity concentration that is then transported throughout a region while accounting for mixing (i.e., concentration changes). With the transport of the concentrated fluid, a subsequent calculation of the spatial dependent dose rates and accumulated doses to tissue resulting from the fluid transport is determined. Models have been developed with the goal of focusing on ease of use for the end user in terms of the minimal number of required inputs while ensuring a reliable solution is obtained to help inform the decision-making process.

The fluid flow model is written generically to account for the various mechanisms and forces that impact the net flow spatially (e.g., diffusion, advection, gravity, etc.). With time-dependent numeric solutions comes limitations on the size of the time steps taken while “marching” toward the end of the problem. This control has been handled internally by the model to ensure appropriate time steps are taken for the rate of change of the physical processes occurring.

The dose model accounts for doses received from alpha particles, electrons, and photons. The model considers dose to source and target voxels in the modeled region of interest (ROI). Dose rates for each time step are calculated in addition to accumulated dose for the analysis time-period.

Users have two levels of input options depending on needs. Users can perform:

- quick approximations based on a minimal set of basic inputs (Basic mode) or
- in-depth assessments utilizing advanced modeling features with an expanded set of input parameters (Advanced mode).