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Multiple Dosimetry Calculational Tool (MDCT) Software Application Document

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Pacific Northwest NATIONAL LABORATORY

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Hanford External Dosimetry Program (HEDP)

MULTIPLE DOSIMETRY CALCULATIONAL TOOL (MDCT): Software Application Document

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ABSTRACT

This document reports the quality assurance documentation for the Multiple Dosimetry Calculational Tool (MDCT), which is implemented as a spreadsheet. This includes software functional requirements, software design description, software project management, user documentation, software test plan and report, and user training requirements for this spreadsheet tool.

KEY WORDS: multiple dosimetry, multiple dosimeters, multi-pack, multi-pak, spreadsheet, software QA.

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ACRONYMS AND ABBREVIATIONS

CHPRC	CH2MHill Plateau Remediation Contract
HDI	How Do I?
HID	Hanford Identification Number
HPDAC	Hanford Personnel Dosimetry Advisory Committee
HCND	Hanford Combination Neutron Dosimeter
HSD	Hanford Standard Dosimeter
MDCT	Multiple Dosimetry Calculational Tool
PII	Personally identifiable information
PNNL	Pacific Northwest National Laboratory
R&HT	Radiation and Health Technology
REX	Radiation Exposure database
SS	Spreadsheet
V&V	Validation and Verification
WCH	Washington Closure Hanford

1.0 INTRODUCTION

1.1 Purpose

This report serves to document the software functional requirements, software design description and project management, requirements specification, user documentation, software test plan, test plan report, and training requirements for the *Multiple Dosimetry Calculational Tool (MDCT).*

This document was developed to meet the requirements for safety software as described in the How Do I (HDI) Subject Area: *Safety Software* and the R&HT PNL-MA-870 Procedure AP-15, *R&HT Software Configuration Management Plan (SCMP).* The sub-sections below identify the software management and planning implemented for the MDCT spreadsheet application. Project management planning for the project that utilizes the software is contained in the R&HT Project Management Plan.

1.2 Scope

With the adoption of the ICRP 60 methodology in the 2007 revision to 10 CFR 835 came changes that have a direct affect on the compartmentalization method used to calculate the effective dose from multiple dosimeters. The compartmentalization method was described in the 1997 ANSI/HPS N13.41 standard and is the method used at Hanford. The ANSI/HPS N13.41 standard committee is in the process of updating the standard, but the changes to the standard have not yet been approved. And, the drafts of the revision of the standard tend to align more with ICRP 60 than with the changes specified in the 2007 revision to 10 CFR 835. Therefore, a revised method for calculating effective dose from non-uniform external irradiation using a compartmental method was developed using the tissue weighting factors and remainder organs specified in 10 CFR 835 (2007).

The intended use of the *Multiple Dosimetry Calculational Tool (MDCT)* Spreadsheet Tool is for dosimetry staff of Hanford contractors to perform calculations of effective dose and equivalent doses from multiple dosimeters worn together in the field, also called a multi-pack, using the newly developed methodology. The calculations used in the spreadsheet tool are based on the technical information provided in PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010, and Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09," Hill (2009).

1.3 SOFTWARE PACKAGE DESCRIPTION

The MDCT spreadsheet is used to calculate the following for multiple dosimeters worn at one time:

- Effective dose for beta-gamma dose reported on dosimeters (represents 'deep' dose in REX)
- Effective dose for neutron dose reported on dosimeters (represents 'neutron' dose in REX)
- Maximum equivalent dose to the skin (represents 'shallow' dose in REX)
- Maximum equivalent dose to the eye (represents 'eye' dose in REX)
- Maximum equivalent dose to the extremities (represents 'ring' dose in REX).

The spreadsheet workbook provides the following worksheets:

- Cover page and MDCT revision history
- Multi-pack spreadsheet tool
- Instructions on use of the spreadsheet tool
- Diagrams of dosimeter placement on the body including the single letter body location designation.

The user input boxes in the MDCT worksheet are shown with light green shading. All other cells of the spreadsheet are locked with password protection to prevent change by the user.

The user inputs are:

- Employee name
- Payroll number or HID
- Contractor Code
- Form number
- Date
- HPT office
- Area
- Phone
- Location of Job
- Name of Job

- Beginning wear date
- End wear date
- For all body locations, the inputs are:
    - Dosimeter type (selection from a set listing)
    - Dosimeter number
    - Special Sheet number
    - Shallow dose
    - Deep dose
    - Neutron dose
    - Eye dose.

2.0 SOFTWARE FUNCTIONAL REQUIREMENTS

2.1 Objectives

The intended use of the *Multiple Dosimetry Calculational Tool (MDCT)* spreadsheet is for dosimetry staff of Hanford contractors to perform calculations of effective dose and equivalent doses from multiple dosimeters worn together in the field. The calculations used in the spreadsheet tool are based on the technical information provided in PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010, and Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09."

2.1.1 Customer

The MDCT spreadsheet tool is intended to be used dosimetry staff of Hanford contractors to calculation effective dose and equivalent doses from multi-packs worn in the field. At this time, the intended users are expected to be primarily from PNNL Dosimetry Operations. However, other Hanford contractors, such as CHPRC Dosimetry Operations and WCH Dosimetry, may also use the tool.

2.1.2 Project

The MDCT spreadsheet tool is a new revision to and replaces the Multiple Dosimetry Temporary Dosimeter Issue form, dated August 2006. The former form required manual input of data and manual calculation of the doses to be added to the multi-pack chest dosimeter results or ring dosimeter results.

The MDCT spreadsheet tool allows manual input to the data mentioned in Section 1.3 above and automates the calculation of the various effective and equivalent doses from the multi-pack. The resulting effective and equivalent doses represent the shallow, deep, neutron, eye, and ring doses associated with use of the multi-pack. The calculational process has changed from the former method where the chest dosimeter data was revised based on the multi-pack calculations.

2.2 Product Perspective

The MDCT spreadsheet tool is intended to be used dosimetry staff of Hanford contractors to calculation effective dose and equivalent doses from multi-packs worn in the field. The alternative to using the spreadsheet tool is to perform numerous hand calculations for each sample.

2.3 Product Functions and Design Goals

The primary functions of the spreadsheet are:

- Calculate effective dose for beta-gamma dose reported on dosimeters (represents ‘deep’ dose in REX)
- Calculate effective dose for neutron dose reported on dosimeters (represents ‘neutron’ dose in REX)
- Calculate equivalent dose to the skin (represents ‘shallow’ dose in REX)
- Calculate equivalent dose to the eye (represents ‘eye’ dose in REX)
- Calculate equivalent dose to the extremities (represents ‘ring’ dose in REX).

The spreadsheet tool design includes the following attributes:

- Microsoft Excel® is the software of choice.
- Simple interface for end users requiring minimal inputs in a non-confusing manner.
- Certain input parameter will have defined ranges.
- Certain input parameters will have default values given.
- The main output values will be in standard units of mrem.
- The spreadsheet tool has undergone software quality assurance validation and verification according to the criteria specified in Section 4.0.
- The spreadsheet tool will be protected from unintentional or unapproved modification.

- Calculations, assumptions, and constants should be protected from the user change to ensure a clean user interface.
- The configuration control of the spreadsheet tool version will be maintained.
- Notes, comments, and help fields will be used, where needed, to assist the end user in making decisions on input values in clear language.
- Instructions on use of each worksheet will be given as a worksheet in the MDCT workbook.
- The basis for all calculations and assumptions to be used is provided in PNL-MA-842.
- The spreadsheet tool should produce a printout with all inputs and outputs clearly shown.

The spreadsheet tool will be designed to perform basic calculations necessary to analyzing dose from multiple dosimeters worn from a multi-pack. The calculational formulae are described in more detail in Appendix A.

2.4 Business Functions

Business functions impacted are those applicable to Hanford dosimetry staff that perform data analysis of multiple dosimeters worn from a multi-pack. The spreadsheet tool will improve the efficiency of performing the calculations and the documentation of the analyses done.

2.5 User Characteristics

The primary users of this software will be qualified dosimetry staff familiar with the use of multiple dosimetry at Hanford. Instructions on the use of the MDCT spreadsheet tool are included as a worksheet in the tool. As discussed under Section 2.6, “General Constraints” below, attention to detail is required when using the MDCT spreadsheet tool.

2.6 General Constraints

As with any computer program or calculational spreadsheet, the user is more important than the software. It is essential that the user decide whether the application is proper and that they understand the results sufficiently to ensure they are within reasonably expected bounds.

The user must objectively be satisfied that the results of the spreadsheet tool calculations are reasonable. The user should always keep in mind that uncertainties to

within 10% of the true situation are due to mathematical rounding and are considered to be very good.

Input is allowed only in the light green shaded cells. For the input parameters listed below, the choices are constrained to those that are given. No constraints are given for other input parameters.

Input parameter constraints will be as follows:

- For "Dosimetry Type" in Column E/F:
    - Input will be constrained to the following list:
        - None
        - HSD (Hanford Standard Dosimeter)
        - HCND (Hanford Combination Neutron Dosimeter)
        - ExtRad (finger ring)
        - Chipstrate (which is the chip package taken from an ExtRad finger ring).
- The order for data input should be as follows:
    - Select dosimeter type for all dosimeters included in the multi-pack
    - Start with entering the shallow, deep, neutron and eye dose for the chest dosimeter
    - Enter the shallow, deep, neutron and eye dose for other whole body dosimeters used in the multi-pack, as appropriate
        - If no dosimeter was worn in any given whole body location, the data will be automatically be populated in the shallow, deep, neutron and eye dose cells based on the conventions listed for output parameter constraints
    - Enter the appropriate dose data based on the type of extremity dosimeters worn
        - The input data for HSD or HCND dosimeters used at extremity locations should be shallow, deep, neutron and eye dose
        - The input data for ExtRad finger rings or the ExtRad chipstate should be shallow dose only.

Since the calculation of effective dose requires data from all whole body compartments, the output parameter constraints will be as follows. The data from the nearest locations will be used when no dosimeter is worn in a given body location:

- If no dosimeter was worn for the head, the shallow, deep, neutron and eye dose from the chest dosimeter will be populated in these cells for this whole body location.

- If no dosimeter was worn for the abdomen or the groin, the shallow, deep, neutron and eye dose data from the chest dosimeter will be populated in the cells for this whole body location.
- If no dosimeter was worn for the abdomen but one was worn for the groin, the shallow, deep, neutron and eye groin data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the left thigh, the shallow, deep, neutron and eye the maximum of abdomen or groin data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the right thigh, the shallow, deep, neutron and eye, the maximum of abdomen or groin data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the left knee, the shallow, deep, neutron and eye the maximum of abdomen or groin data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the right knee, the shallow, deep, neutron and eye the maximum of abdomen or groin data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the groin, the shallow, deep, neutron and eye abdomen data will be populated in these cells for this whole body location.
- If no dosimeter was worn for the back, the shallow, deep, neutron and eye dose from the chest dosimeter will be populated in these cells for this whole body location.
- If no dosimeter was worn for the left upper arm, the shallow, deep, neutron and eye data from the chest dosimeter will be populated in these cells for this whole body location.
- If no dosimeter was worn for the right upper arm, the shallow, deep, neutron and eye data from the chest dosimeter will be populated in these cells for this whole body location.

2.6.1 MDCT Spreadsheet Tool Validation and Verification

A general description of the protection quantities and operational quantities used for multi-packs is given in Section 4.4.1 of PNL-MA-842. The process for calculation of effective dose from multi-pack use, including formulae, is given in Sections 6.8.2, 6.8.3, and 6.8.4 in PNL-MA-842.

The technical basis for the multiple dosimeter effective dose methodology was reviewed and approved by the Hanford Personnel Dosimetry Advisory Committee (HPDAC) and includes a description and derivation of the compartment weighting factors (CFs) used for beta-gamma dose and neutron dose (Hill 2009). The CFs used in the MDCT spreadsheet tool are given in Table 3 of that document. Formulae used for beta-gamma dose and neutron effective doses are given in Section 3.1 of that document. These same formulae are given in Section 6.8.2 of PNL-MA-842.

The MDCT spreadsheet tool was validated against the design criteria specified in Section 2.3, and documented in Table 1, which is also the requirements traceability matrix (RTM). In addition, the documentation of the spreadsheet validation and verification is discussed below and presented in its entirety in Appendix D.

Table 1. Validation of MDCT Spreadsheet Tool Against Design Criteria

#	DESIGN CRITERIA	VALIDATED
1.	Microsoft Excel® is the software of choice.	Microsoft Excel® is used.
2.	Simple interface for end users requiring minimal inputs in a non-confusing manner.	Input and output values seen on a single screen. This also represents the printed output.
3.	Certain input parameters will have defined ranges.	The input variables are constrained as documented in Section 2.6 and Appendix A.
4.	Certain input parameters will have default values given.	Default input variables are as documented in Section 2.6 and Appendix A.
5.	The main output values will be in standard units of mrem.	The effective and equivalent doses reported in the worksheet.
6.	The spreadsheet tool will undergo software quality assurance validation and verification in accordance with the R&HT PNL-MA-870 Procedure AP-14, *Software Verification and Validation.*	A completed "R&HT Software Grading" form for this tool is found in Appendix B. Software validation and verification are documented within this table and Appendix D.
7.	The spreadsheet tool will be protected from unintentional or unapproved modification.	The MDCT Spreadsheet Tool will be password protected and the password maintained by the software custodian and Program manager.

#	DESIGN CRITERIA	VALIDATED
8.	Calculations, assumptions, and constants should be protected from the user to ensure a clean user interface.	Only the input cells will be unlocked to the end user. The other cells will be password protected. The formula used in a cell is visible to the end user.
9.	The configuration control of the spreadsheet tool version will be maintained.	The MDCT Spreadsheet Tool will be available only from the software custodian or Program manager.
10.	Notes, comments, and help fields should be used, where needed, to assist the end user in making decisions on input values in clear language.	Comment boxes are automatically shown when an input box is selected.
11.	Instructions on use of MDCT Work Page worksheet will be given.	The “Instructions” worksheet provides an explanation how to input data into the MDCT Work Page worksheet. The “Diagrams” worksheet shows graphically the various whole body and extremity locations possible for the multiple dosimeters in a multi-pack.
12.	The basis for all calculations and assumptions is provided in PNL-MA-842 and the Hill 2009 technical basis for the multiple dosimeter effective dose methodology.	See Appendix A for an in-depth explanation of the equations/formulae from the technical basis document that are used in the MDCT Spreadsheet Tool.
13.	The spreadsheet tool should produce a printout with all inputs and outputs clearly shown.	The input/printout screen in the tool from the MDCT Work Page worksheet can be printed out and used to document the output of the tool.

The verification of the MDCT Spreadsheet Tool, as shown in Appendix D, documents that the spreadsheet was confirmed as functioning as it was designed and intended. Unique and non-unique formulae were technically correct, refer to the appropriate cells, and provide correct output in an acceptable format. In that verification review, 10 recommended changes were made that have all been accepted and incorporated into the final version of the MDCT Spreadsheet Tool.

Testing of the MDCT Spreadsheet Tool is documented in Sections 6.0 and 7.0, as well as Appendix E.

2.6.2 Other(s)

Testing and acceptance practices are discussed in Section 5.0.

2.7 Assumptions and Dependencies

2.7.1 Assumptions

The assumptions used in developing the compartment weighting factors are presented in Section 2.0 of Hill 2009 technical basis for the multiple dosimeter effective dose methodology.

A detailed description of the equations used, associated parameters, and their accepted ranges and defaults are given in Appendix A.

The MDCT Tool calculates two types of quantities: 1) protection quantities for the exposure period represented by the multi-pack, and 2), numerical values to enter into the REX operational fields that were intended for entry of operational quantities. The methods and equations from PNL-MA-842 Sections 6.8.2, 6.8.3, and 6.8.4 are used to calculate these values.

Protection Quantities: The MDCT Tool calculates the gamma and neutron components of effective dose (E_γ and E_η) as well as equivalent dose to the skin, H_{skin}, equivalent dose to the lens of the eye, H_{eye}, and equivalent dose to the extremities, $H_{extremites}$. This provides a correct assessment of the protection quantities for the specific exposure represented by the multi-pack.

- Operational Quantities: However, REX does not have comparable fields in which to enter the values for the above protection quantities. The REX fields available to enter dose results are called *shallow*, *eye*, *deep*, *neutron* and *ring*, and were intended for entry of operational quantities. So, the MDCT Tool also calculates values that can be entered directly into these REX operational fields that will ensure compliance of REX reported protection quantities with the protection limits in 10 CFR 835.

2.7.2 Dependencies

A Microsoft® Windows environment and Microsoft Excel® 2003 is required for proper functioning of the MDCT Spreadsheet Tool. To document the output of the tool, a printer is needed.

- **NOTE:** Due to the lack of macros within the MDCT Spreadsheet Tool, it is assumed that it will function appropriately in later versions of Microsoft Excel® (e.g., 2007). Although, when the PNNL dosimetry staff are required to upgrade to Microsoft Office® 2007, the MDCT Spreadsheet Tool V&V will be repeated.

2.8 Regulations, Procedures and Policies

The drivers (federal, state, contractual regulations, procedures, and policies) that have impact on the planned application of the MDCT Spreadsheet Tool are described in PNL-MA-842 and the Hill 2009 technical basis for the multiple dosimeter effective dose methodology.

2.9 External Interface Requirements

The MDCT Spreadsheet Tool will reside on stand-alone computer work stations. It will have no integration with the PNNL Intranet or have any outside interface.

2.9.1 User Interfaces

A Microsoft® Windows environment is used for the user interface.

2.9.2 Hardware Interfaces

The MDCT Spreadsheet Tool is compatible with Windows 2000 and XP. Installation of the spreadsheet tool may require up to 100 kB of hard disk space.

2.9.3 Software Interfaces

MDCT Spreadsheet Tool is a spreadsheet workbook that requires the use of Microsoft Excel®, version 2003.

2.9.4 Communication Interfaces

Either the software custodian or the Program manager will notify all authorized users when upgrades or error reporting is needed.

2.10 Internal Interfaces

The MDCT Spreadsheet Tool will reside on stand-alone computer work stations. There are no known computer interfaces internal to the company.

2.11 Specific Requirements

2.11.1 Functionality

The spreadsheet tool is designed to perform basic calculations necessary to effective and equivalent doses associated with use of multiple dosimeters in a multi-pack. The various calculations used to perform the analyses are given in Appendix A. The Excel® spreadsheet format provides a good platform for user input and simple calculations. The output is a printed form that includes input and calculated values presented in a concise consistent format that is appropriate to use as a radiological record.

2.11.2 Performance

The Excel® spreadsheet platform provides fast, automatic calculation as soon as the required input values are entered.

2.11.3 Attributes

2.11.3.1 Usability

The users of the MDCT Spreadsheet Tool have experience and training dosimetry operations. The MDCT Work Page worksheet in the MDCT Spreadsheet Tool was set up to look similar to the former multiple dosimeter forms used. Additional information has been added to document the compartment weighting factors used and automates the calculational methods, which was not formerly available.

For some input cells, comment or help boxes are given to provide a brief description of the data type and other important information.

2.11.3.2 Reliability

Each time the MDCT Spreadsheet Tool is opened, the formulae in cells G/H14 through I14, G/H15 through M24, and G/H26 through M33, are reset. If data is entered in these cells, the formulae are overwritten. To reset the formulae in the worksheet, the tool must be exited and reopened.

2.11.3.3 Supportability

All calculations performed in the MDCT Spreadsheet Tool are presented in Sections 6.8.2, 6.8.3, and 6.8.4 in PNL-MA-842. Questions on the MDCT Spreadsheet Tool can be directed to the software custodian or the Program manager. Comments or request for changes to the tool can be made using the MDCT Spreadsheet Tool Comment form given in Attachment A.

2.11.3.4 Operations

Operation and use of the MDCT Spreadsheet Tool is presented below in Section 5.0, “User Documentation”.

2.11.3.5 Maintenance

The software custodian or the Program manager will maintain the MDCT Spreadsheet Tool software configuration management at the R&HT group level. The Program manager will ensure that authorized users are using the most recent version of the MDCT Spreadsheet Tool released by the software custodian by ensuring that only the latest version is made available for distribution.

2.11.3.6 Backup and Recovery

If hardware or software failure occurs during use, the authorized users should contact the Program manager using the "MDCT Spreadsheet Tool Comment Form" in Attachment A.

2.11.3.7 Portability

The current version of the MDCT Spreadsheet Tool was created and tested in Microsoft Excel® 2003 because this is the Microsoft Office® version that all the PNNL dosimetry staff users have installed on their computer workstations. When the users are required to upgrade to Microsoft Office® 2007, the MDCT Spreadsheet Tool V&V will be repeated.

2.11.3.8 Transferability

The intended use of the MDCT Spreadsheet Tool spreadsheet is for PNNL Dosimetry Operations staff to perform effective and equivalent doses associated with use of multiple dosimeters in a multi-pack. The MDCT Spreadsheet Tool will reside on stand-alone computer work stations. The MDCT Spreadsheet Tool will also be made available to other Hanford contractor's dosimetry staff at their request. This is done to ensure that a consistent methodology of calculation of effective and equivalent doses are used by all Hanford contractors who analyze multi-pack data.

2.11.3.9 Conversion

No data conversion is necessary for use of the MDCT Spreadsheet Tool.

2.11.4 Software Controls

Operation and use of the MDCT Spreadsheet Tool is presented below in Section 5.0, "User Documentation".

2.11.5 Control of Controlled Use Information

The MDCT Spreadsheet Tool does provide Personally Identifiable Information (PII) data in the output reports. The authorized users are responsible for determining the level of quality and security in managing the output reports from the MDCT Spreadsheet Tool, as well as records management.

3.0 SOFTWARE DESIGN DESCRIPTION

The intended use of the MDCT Spreadsheet Tool is for PNNL Dosimetry Operations staff to perform effective and equivalent doses associated with use of multiple

dosimeters in a multi-pack. As mentioned above, dosimetry staff from other Hanford contractors may also use the MDCT Spreadsheet Tool.

3.1 Major Component Descriptions

The MDCT Spreadsheet Tool will be comprised of 4 worksheets, as follows:

- Cover page and MDCT revision history
- Multi-pack spreadsheet tool
- Instructions on use of the spreadsheet tool
- Diagrams of dosimeter placement on the body including the single letter body location designation.

3.2 Technical Description of Software Package

The intended use of the MDCT Spreadsheet Tool spreadsheet is for PNNL Dosimetry Operations staff to perform effective and equivalent doses associated with use of multiple dosimeters in a multi-pack. The equations/formulae used in the MDCT Spreadsheet Tool are given in Appendix A. The validation and verification report given in Appendix D documents that all formulae used in the MDCT Spreadsheet Tool perform their intended function correctly.

The user input is shown in light green shaded cells in the MDCT Work Page worksheet. Also, selection of the dosimeter type in Column E/F is allowed. The intermediary calculational data are presented in cells O14 through U34 and Q36 through Q38. The following conventions, as described in PNL-MA-842, were used to obtain the adjusted deep dose and neutron dose values used in Column S:

- For head/neck, the value from cell K15 or L15 is used, respectively
- For thorax, the maximum of the chest and back dose data from cells K14 and K22, or L14 and L22, respectively, is used
- For abdomen, the maximum of the abdomen and groin dose data from cells K16 and K21, or L16 and L21, respectively, is used
- For the left upper arm, the value in cell K23 or L23, respectively, is used
- For the right upper arm, the value in cell K24 or L24, respectively, is used
- For left thigh, the maximum of the left thigh and left knee dose data from cells K17 and K19, or L17 and L19, respectively, is used
- For right thigh, the maximum of the right thigh and right knee dose data from cells K18 and K20, or L18 and L20, respectively, is used

The data shown in columns W through Z are not included in the printed output, mainly due to lack of spacing. These columns also are not made visible to the user. However, this data can be easily reconstructed from the printed output page, if need. The shallow + neutron dose data for the chest and head/neck whole body locations are reported in cells W14 through W24. The maximum of these values is reported in cell Z16 and Q36. The eye + neutron dose data for all whole body locations are reported in cells X14 through X15. The maximum of these values is reported in cell Q37. The shallow + neutron dose data for all extremity locations are reported in cells W26 through W33. The maximum of these values is reported in cell Q38. However, if no extremity dosimeters are worn, then the maximum of cells W14 through W24 is reported in cell Q38.

The calculated effective doses and equivalent doses are reported in cells J38 through N/O38. These are listed as doses to be entered into REX.

3.3 Prescribed Input and Output Ranges

Section 2.6 provides a summary of the input and output ranges used in the MDCT Spreadsheet Tool.

3.4 Integration Point with PNNL Intranet

The MDCT Spreadsheet Tool will reside on stand-alone computer work stations. It will have no integration with the PNNL Intranet.

3.5 Data Model

Descriptions of the input data type and constraints are given in Section 2.6 and Appendix A. In the MDCT Work Page worksheet, comment/help boxes are given to provide a brief description of the data type and units to be used. The Instructions worksheet provides a description of each variable used in the three main worksheets. In addition, Appendix A provides a description of each formula used in the MDCT Spreadsheet Tool and a definition of each input variable.

The MDCT Work Page worksheet is designed to present both input and output data. As shown in Figure 1 below, the user input cells are shaded light green. All other cells in the workbook have a white background and will be password protected to prevent inadvertent change. This worksheet is designed to document all input and output data in a single printed record form. Each worksheet allows for one multi-pack set of dosimeter data to be documented in a single output form.

With the equations/formulae given in the tool, in Appendix A of this document, PNL-MA-842 and the Hill 2009 technical basis for the multiple dosimeter effective dose

methodology, the user will have all the information needed to perform hand calculations if needed to check the output of the MDCT Spreadsheet Tool.

3.6 Software Configuration

The MDCT Spreadsheet Tool will be available only from the software custodian or Program manager. They will ensure that authorized users are using the most recent version of the MDCT Spreadsheet Tool.

4.0 SOFTWARE PROJECT MANAGEMENT

4.1 Responsibilities

Primary authority and overall responsibility for meeting the safety software requirements for the MDCT software is vested in the assigned R&HT Program Manager (PM). Any software management activities are performed by the software custodian. A Software Quality Engineer (SQE) assigned to R&HT from the Quality Assurances organization provides guidance on implementing the requirements including the format and content of this document.

4.2 Quality Assurance and Risk Management

The high-level potential software risk factors are identified in the R&HT SCMP. Quality and integrity of the software application will be ensured by:

- Implementing the configuration management procedures contained within the R&HT SCMP.
- Maintaining this document to incorporate software or procedural changes. The document content should be reviewed on an annual basis and updated as needed.
- Performing periodic assessment and reviews of the software and as required by R&HT.
- Following a formal change control process to include:
    - How problem/change reports will be submitted
    - How subsequent fixes will be implemented
    - Methods for notifying stakeholders of a new version release
- Requiring user training.

4.3 Safety Software Classification

Because of its intended application and associated risks, MDCT Spreadsheet Tool meets the definition of **Level B** safety software provided in the HDI subject area: *Safety Software*. This classification is consistent with the Department of Energy (DOE)

definition for Level B safety software. This level of software control is also warranted based on the fact that the MDCT Spreadsheet Tool calculates personally identifiable information (PII).

All of the detailed classification information is contained in the completed R&HT Software Grading Form contained in Appendix B. The software is also tracked in the R&HT software inventory database and the PNNL Information Resource Inventory (IRI), MDCT entry: https://iri.pnl.gov/IRIItemDetail.aspx?ItemID=26052.

4.4 Component Safety Analysis

Even though the MDCT Spreadsheet Tool is considered a custom developed Level B safety software due to the complexity of the calculations, it is still a spreadsheet and therefore individual component safety analysis does not apply.

4.5 Software Change Management

The MDCT Spreadsheet Tool is made available to authorized users as a Level B configuration controlled spreadsheet tool. The program manager or software custodian will ensure that authorized users are using the most recent version of the MDCT Spreadsheet Tool released by maintaining a list of user email addresses and providing email notifications when new versions are available.

4.6 Reporting and Documenting Software Errors

Problems will be reported to the software custodian or the program manager using the "MDCT Spreadsheet Tool Comment Form" in Attachment A. Email notification of errors to authorized users will be done by the software custodian or the program manager.

4.7 Configuration Management

The MDCT Spreadsheet Tool configuration management follows the procedures within the R&HT SCMP. Configuration management is identified in the following subsections.

4.7.1 Software Controls

The MDCT Spreadsheet Tool will be used as supplied by the software custodian and program manager. No access to the source code will be allowed to the authorized users. All parts of the spreadsheet tool, except for the user input boxes, will be password protected. The password will be maintained by the software custodian and the program manager.

4.7.2 Version Control

The software version numbering will be incremented by 1 when a new version is released. The present version is MDCT V1. The software name, version number, and execution date are included on all output such that proper version identification can be obtained and individual results potentially impacted by bugs can be identified.

4.7.3 Security

A RASD is maintained for the machine that the MDCT Spreadsheet Tool software is installed on. The Windows operating system software is updated when required by PNNL infrastructure and data files are backed up on a nightly basis from the PNNL intranet using a backup service. The operating system is configured consistent with the computer security requirements in HDI.

4.7.4 Baseline Configuration

This includes the configuration items (CI) that need to be monitored and controlled to maintain the documentation associated with the software, protect the source code, and ensure data integrity for the initial and future releases. This consists of:

- This document, which includes testing documentation (and all exhibits and attachments).
- A completed software release and baseline configuration report—the format of the form is contained in the R&HT SCMP. The current software release and baseline configuration report included in Appendix C.
- The actual files identified in the baseline configuration report.

4.7.5 Configuration Repository

The MDCT Spreadsheet Tool configuration repository exists in a Records File Plan in the Total Records Information Management (TRIM) system, which is the only DOE approved document repository configuration management tool.

4.7.6 Validation and Verification

The verification and validation (V&V) of the MDCT Spreadsheet Tool is performed according to the R&HT Verification and Validation (V&V) procedure.

5.0 USER DOCUMENTATION

5.1 System Environment

A Microsoft Windows® environment is required for proper functioning of the MDCT Spreadsheet Tool.

5.1.1 Hardware

The MDCT Spreadsheet Tool is compatible with Windows® 2000 and XP. Complete installation may require up to 100 kB of hard disk space.

5.1.2 Software

The MDCT Spreadsheet Tool is a spreadsheet workbook that requires Microsoft Excel® 2003.

5.1.3 Typical and Maximum Use

The MDCT Spreadsheet Tool is a spreadsheet workbook that will be loaded on a stand-alone computer. It is not available to be used from the network. The spreadsheet tool can be downloaded to any number of stand-alone computers, but will be made available only to authorized users.

The user interaction with the software is through use of the navigation buttons and light green-shaded input cells. The printed version of the worksheet matches what is shown on the screen.

5.1.4 Security

The MDCT Spreadsheet Tool does provide PII data in the output reports. Therefore, the level of security for the software package source code and the associated output files is moderate.

5.2 Equipment Operation

The MDCT Spreadsheet Tool will be available as a single spreadsheet file.

The tool can be started as follows:

- Open Excel.
- Then select the FILE menu.
- Select the OPEN menu item and navigate to the subdirectory where the MDCT Spreadsheet Tool is stored.
- Click on the MDCT Spreadsheet Tool file name, and then click OPEN.

5.2.1 Assumptions

For more information on the assumptions used, see Section 2.7.1 and Appendix A of this document. PNL-MA-842 and the Hill 2009 technical basis for the multiple dosimeter effective dose methodology contain in-depth explanations of the technical basis for the equations used in the MDCT Spreadsheet Tool.

5.2.2 Operation Sequence

Instructions for use of the MDCT Spreadsheet Tool are given in the Instructions worksheet (Figure 2). The Diagrams worksheet shows graphically the various whole body and extremity locations possible for the multiple dosimeters in a multi-pack (Figure 3).

The user input is shown in light green shaded cells in the MDCT Work Page worksheet. The input sequence should be the following:

- Enter general information at the top of the spreadsheet
- Choose the dosimeter type for each dosimeter used in the multi-pack from Column E/F
- Enter the shallow, deep, neutron, and eye dosimeter data in the appropriate cells in Columns J, K, L, and M
    - If a mistake is made and the data is entered in the wrong row or wrong location, then the tool will need to be exited and reopened to start over. This is because the formulae in the cells in Columns J, K, L, and M would be overwritten with the spurious data entered by the user and must be reset. The only way to repopulate the formulae into those cells is to open a clean, new MDCT Spreadsheet Tool.

The intermediary calculational data are presented in cells O11 through U33 and Q36 through Q38. The data shown in columns W and X are not included in the printed output, mainly due to lack of spacing to make a legible output sheet.

The calculated effective doses and equivalent doses are reported in cells J38 through O38 and are ready for input into REX.

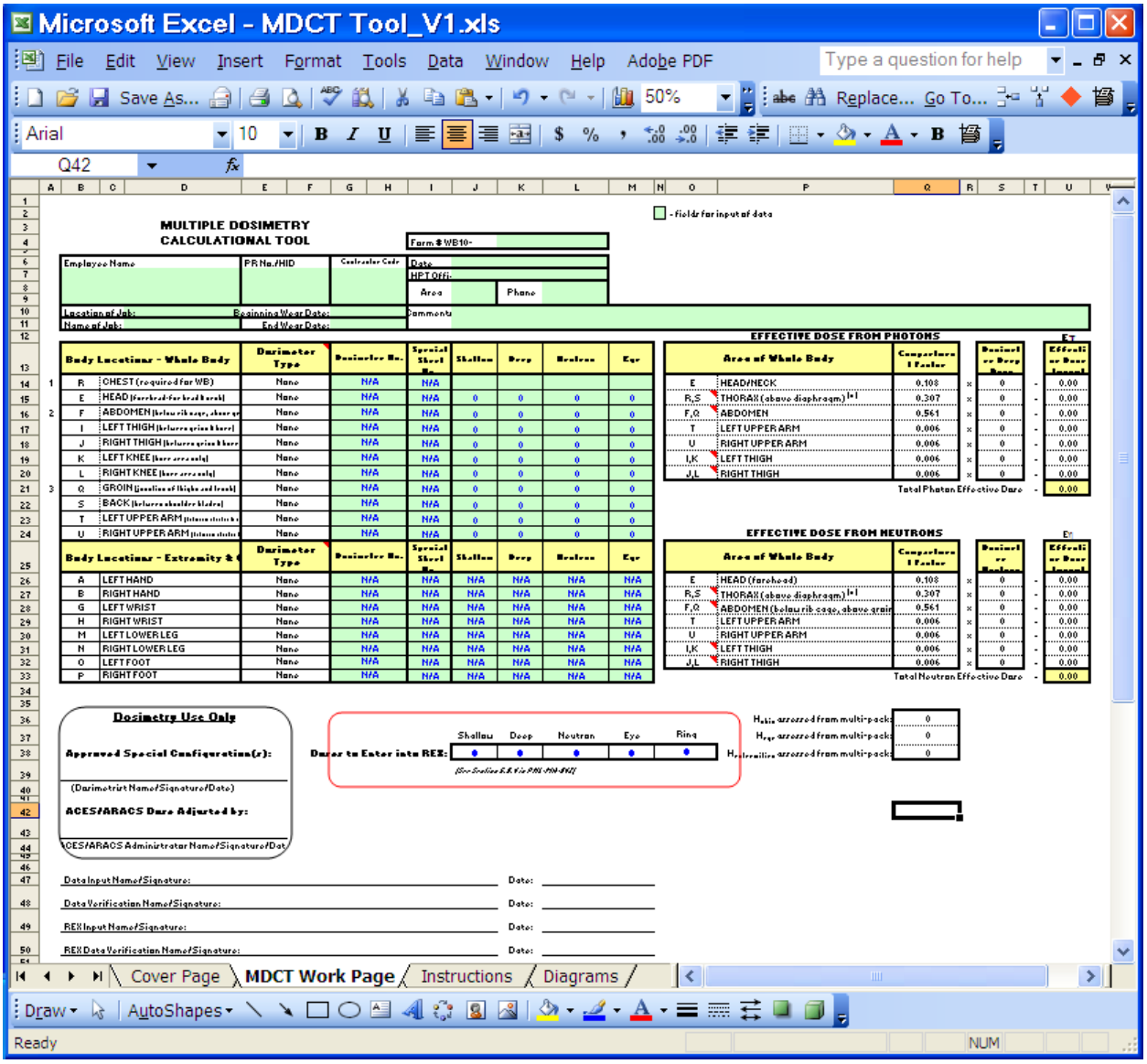
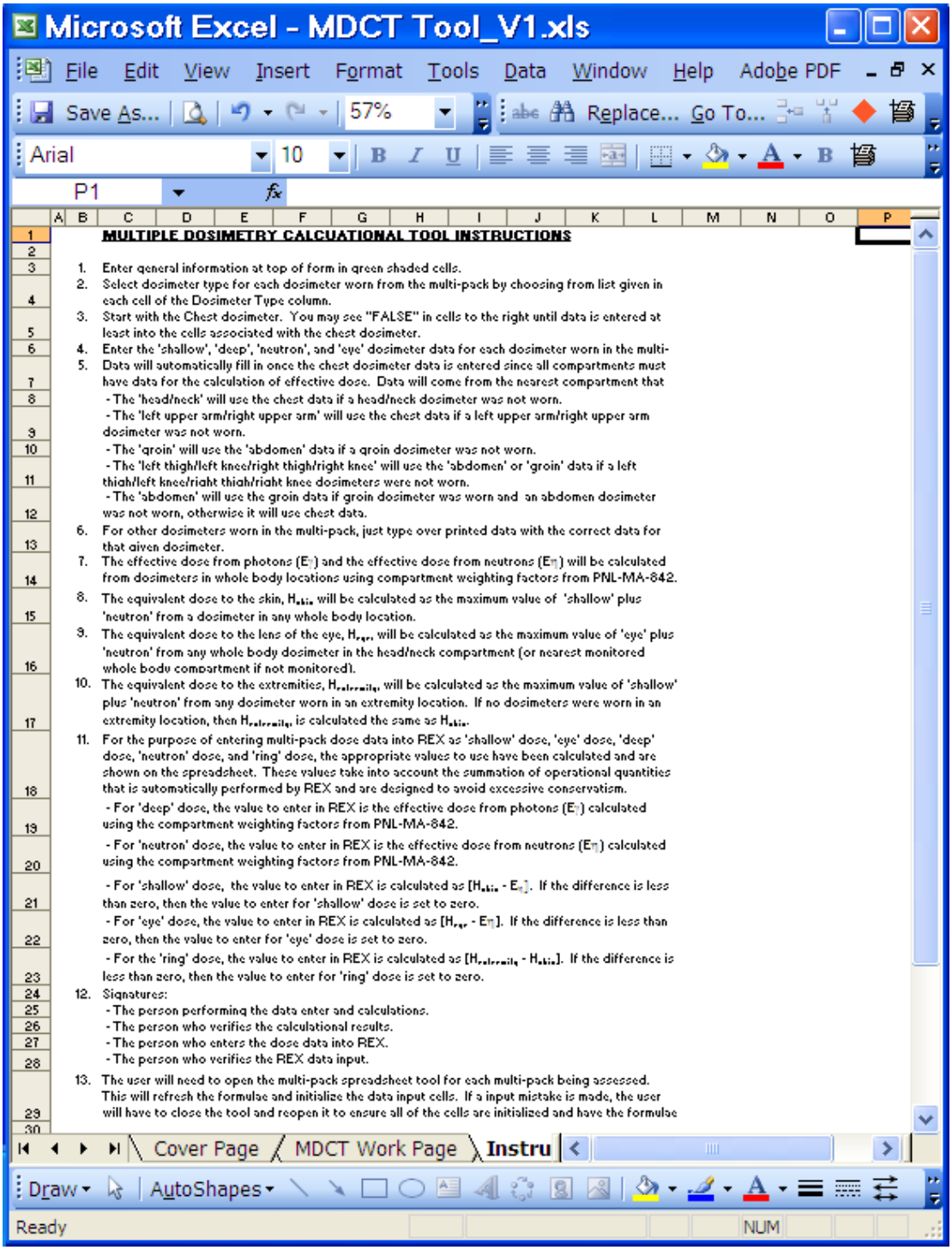


Figure 1. "MDCT Work Page" worksheet of MDCT Spreadsheet Tool.



MULTIPLE DOSIMETRY CALCUATIONAL TOOL INSTRUCTIONS

1. Enter general information at top of form in green shaded cells.
2. Select dosimeter type for each dosimeter worn from the multi-pack by choosing from list given in each cell of the Dosimeter Type column.
3. Start with the Chest dosimeter. You may see "FALSE" in cells to the right until data is entered at least into the cells associated with the chest dosimeter.
4. Enter the 'shallow', 'deep', 'neutron', and 'eye' dosimeter data for each dosimeter worn in the multi-
5. Data will automatically fill in once the chest dosimeter data is entered since all compartments must have data for the calculation of effective dose. Data will come from the nearest compartment that
   - The 'head/neck' will use the chest data if a head/neck dosimeter was not worn.
   - The 'left upper arm/right upper arm' will use the chest data if a left upper arm/right upper arm dosimeter was not worn.
   - The 'groin' will use the 'abdomen' data if a groin dosimeter was not worn.
   - The 'left thigh/left knee/right thigh/right knee' will use the 'abdomen' or 'groin' data if a left thigh/left knee/right thigh/right knee dosimeters were not worn.
   - The 'abdomen' will use the groin data if groin dosimeter was worn and an abdomen dosimeter was not worn, otherwise it will use chest data.
6. For other dosimeters worn in the multi-pack, just type over printed data with the correct data for that given dosimeter.
7. The effective dose from photons (E_γ) and the effective dose from neutrons (E_n) will be calculated from dosimeters in whole body locations using compartment weighting factors from PNL-MA-842.
8. The equivalent dose to the skin, H_{skin}, will be calculated as the maximum value of 'shallow' plus 'neutron' from a dosimeter in any whole body location.
9. The equivalent dose to the lens of the eye, H_{eye}, will be calculated as the maximum value of 'eye' plus 'neutron' from any whole body dosimeter in the head/neck compartment (or nearest monitored whole body compartment if not monitored).
10. The equivalent dose to the extremities, $H_{extremity}$, will be calculated as the maximum value of 'shallow' plus 'neutron' from any dosimeter worn in an extremity location. If no dosimeters were worn in an extremity location, then $H_{extremity}$ is calculated the same as H_{skin}.
11. For the purpose of entering multi-pack dose data into REX as 'shallow' dose, 'eye' dose, 'deep' dose, 'neutron' dose, and 'ring' dose, the appropriate values to use have been calculated and are shown on the spreadsheet. These values take into account the summation of operational quantities that is automatically performed by REX and are designed to avoid excessive conservatism.
    - For 'deep' dose, the value to enter in REX is the effective dose from photons (E_γ) calculated using the compartment weighting factors from PNL-MA-842.
    - For 'neutron' dose, the value to enter in REX is the effective dose from neutrons (E_n) calculated using the compartment weighting factors from PNL-MA-842.
    - For 'shallow' dose, the value to enter in REX is calculated as [H_{skin} - E_n]. If the difference is less than zero, then the value to enter for 'shallow' dose is set to zero.
    - For 'eye' dose, the value to enter in REX is calculated as [H_{eye} - E_n]. If the difference is less than zero, then the value to enter for 'eye' dose is set to zero.
    - For the 'ring' dose, the value to enter in REX is calculated as [$H_{extremity}$ - H_{skin}]. If the difference is less than zero, then the value to enter for 'ring' dose is set to zero.
12. Signatures:
    - The person performing the data enter and calculations.
    - The person who verifies the calculational results.
    - The person who enters the dose data into REX.
    - The person who verifies the REX data input.
13. The user will need to open the multi-pack spreadsheet tool for each multi-pack being assessed. This will refresh the formulae and initialize the data input cells. If a input mistake is made, the user will have to close the tool and reopen it to ensure all of the cells are initialized and have the formulae

Figure 2. Example of "Instructions" worksheet

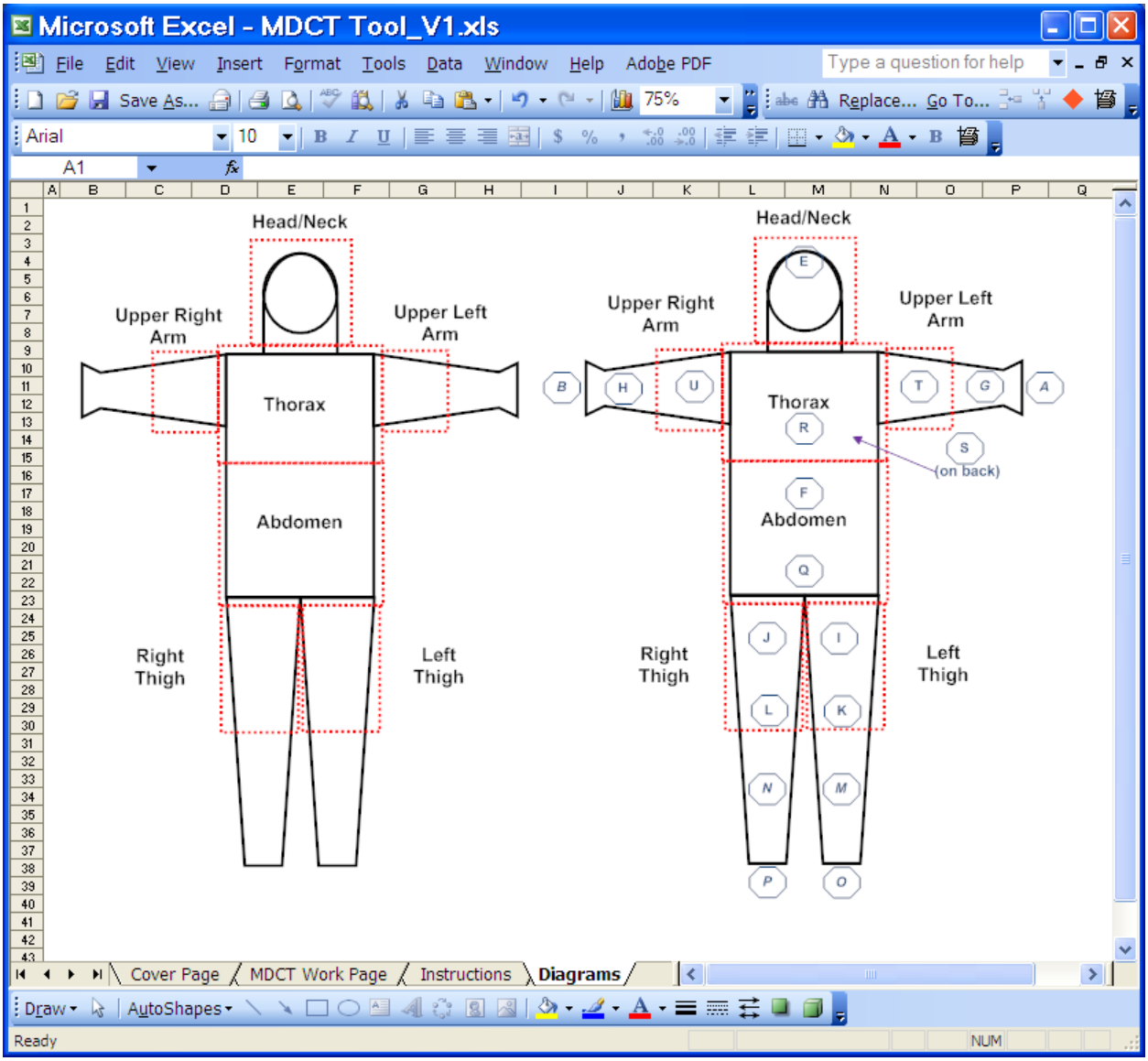


Figure 3. Example of "Diagrams" worksheet

5.3 System Operation

For help in using Microsoft Excel®, see http://office.microsoft.com/en-us/assistance/HA011161281033.aspx.

5.4 Input Specifications

The guidelines provided in this document, in the MDCT Spreadsheet Tool Instructions worksheet, and in the comment/help boxes give information on the input and output parameters used in the formulae of the various worksheets.

5.5 Output Specifications

The output of the MDCT Work Page worksheet is shown on the same screen as the input (see Figure 1). To print the form, select the FILE menu, and then select PRINT. Once printed out and reviewed and signed, the output form may be used as a radiological record of the multi-pack data that was analyzed by using the controlled MDCT tool. Note that the form is printed out without the cell background shading.

The MDCT Spreadsheet Tool does provide PII data in the output reports. The users are responsible for determining the level of quality and security in managing the output reports from the MDCT Spreadsheet Tool, as well as records management

5.6 Error/Help Messages

No error messages are included in this tool. Comment boxes and the Instructions worksheet provide instructions on use and data entry.

5.7 System Recovery

If hardware or software failure occurs during use, the authorized users should contact the software custodian or the Program manager using the “MDCT Spreadsheet Tool Comment Form” in Attachment A. A replacement copy of the MDCT Spreadsheet Tool can be obtained for download from Hanford Software Distribution. An additional copy of the MDCT Spreadsheet Tool can be requested from the software custodian or the Program manager.

6.0 TEST PLAN

6.1 Introduction

The testing for the MDCT Spreadsheet Tool spreadsheet is provided in the following discussion. A report of the testing results is provided in Section 7.0 of this document. The hand calculations for each Test Case as well as the printed input/output sheet from the MDCT Spreadsheet Tool are provided in Appendix E.

6.2 Test Overview

For testing of the MDCT Spreadsheet Tool, four example cases were chosen. For each, the input information from the cases is used and the output results are compared to hand calculations.

R&HT staff members ([A] Technical Manager of External Dosimetry [B]; and the lead dosimetry technician) was assigned do the testing. The results of the MDCT Spreadsheet Tool were compared to the hand calculations results.

The testing was done in December 2009.

6.3 Test Requirements

Five test cases were chosen to exercise the features in the MDCT Spreadsheet Tool. The input values used for each case are summarized in Table 2. Input/Output reports will be generated for each of the five cases and reviewed to compare the output with the hand calculated results. The hand-calculated results and tool output pages are presented in Table 3 in Section 7.0.

Input values for the five test cases are given in Tables 2-5.

Table 2. Input Values for Test Case 1

Body Location	Dosimetry Type	Shallow	Deep	Neutron	Eye
Chest	HSD	271	266	0	266
Left Hand	ExtRad	1276	---	---	---
Right Hand	ExtRad	987	---	---	---

Table 3. Input Values for Test Case 2

Body Location	Dosimetry Type	Shallow	Deep	Neutron	Eye
Chest	HSD	327	318	10	318
Left Knee	HSD	380	365	15	365
Right Knee	HSD	395	380	20	380

Table 4. Input Values for Test Case 3

Body Location	Dosimetry Type	Shallow	Deep	Neutron	Eye
Chest	HCND	350	213	24	213
Head	HCND	375	250	21	250
Abdomen	HCND	326	195	20	195
Groin	HCND	321	180	19	180
Back	HCND	354	209	20	209
Left Hand	ExtRad	987	---	---	---
Right Hand	ExtRad	1276	---	---	---

Table 5. Input Values for Test Case 4

Body Location	Dosimetry Type	Shallow	Deep	Neutron	Eye
Chest	HSD	320	302	5	302
Left Knee	HSD	380	365	15	365
Right Knee	HSD	395	380	20	380
Groin	HSD	327	318	10	318
Back	HSD	330	320	12	320
Left Foot	HSD	510	500	12	501
Right Foot	HSD	504	498	11	499

Table 6. Input Values for Test Case 5

Body Location	Dosimetry Type	Shallow	Deep	Neutron	Eye
Chest	HCND	350	213	24	213
Head	HCND	375	250	21	250
Abdomen	HCND	326	195	20	195
Groin	HCND	450	350	100	350

6.4 Test Report Requirements

The test report results are summarized in Section 7.0 below. Copies of the output from the MDCT Spreadsheet Tool for each test case as well as the requisite hand calculations are provided in Appendix E.

7.0 TESTING RESULTS

7.1 Summary of Results

The documented results of the testing of five test cases are given in Table 7 for Tester [A] and Tester [B]. The test report along with the Input/Printout printouts for each case are provided in Appendix E.

Table 7. Testing Results

Test Case	Shallow	Deep	Neutron	Eye	Ring
1 - Tool	271	266	0	266	1005
Verification Result [A]	271	266	0	266	1005
Verification Result [B]	271	266	0	266	1005
2 - Tool	405	319	10	318	0
Verification Result [A]	405	319	10	318	0

Test Case	Shallow	Deep	Neutron	Eye	Ring
Verification Result [B]	405	319	10	318	0
3 - Tool	375	207	21	250	880
Verification Result [A]	375	207	21	250	880
Verification Result [B]	375	207	21	250	880
4 - Tool	405	317	10	297	107
Verification Result [A]	405	317	10	297	107
Verification Result [B]	405	317	10	297	107
5 - Tool	483	295	67	204	0
Verification Result [A]	483	295	67	204	0
Verification Result [B]	483	295	67	204	0

As discussed in Section 2.6 and Appendix D, the verification of the MDCT Spreadsheet Tool documented that the spreadsheet is functioning as it was designed and intended. Unique and non-unique formulae were technically correct, refer to the appropriate cells, and provide correct output in an acceptable format. In the verification review, 10 recommended changes were made that have all been accepted and incorporated into the final version of the MDCT Spreadsheet Tool. Verification of the MDCT Spreadsheet Tool is given as the testing documented in Appendix D.

7.2 Evaluation

For each of the five example cases ran, the output results from the MDCT Spreadsheet Tool were the same as the expected values, within mathematical rounding. Therefore, MDCT Spreadsheet Tool is deemed acceptable for use.

7.3 Approvals

The MDCT Spreadsheet Tool meets the specified criteria for use. The R&HT Software Quality Engineer provides the final approval for use and for ensuring any applicable software quality assurance criteria are met by this document.

8.0 USER TRAINING AND AUTHORIZED USERS

The primary users of this software will be the dosimetry staff of various Hanford contractors, including PNNL. This document will serve as an instrument for user training.

9.0 REFERENCES

PNNL HDI Subject Area – Safety Software, Exhibit: Utility Calculation Guidance.

Hill, R.L. 2009. Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09.

PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010.

10.0 APPENDICES and ATTACHMENTS

Appendix A. Equations Used in MDCT Spreadsheet Tool

Appendix B. R&HT Software Grading Form

Appendix C. Software Release and Baseline Configuration Report

Appendix D. MDCT Spreadsheet Tool Verification

Appendix E. MDCT Spreadsheet Tool Testing Results

Attachment A. MDCT Spreadsheet Tool Comment Form

APPENDIX A

Equations/Formulae Used in *MDCT Spreadsheet Tool*

Appendix A. Equations/Formulae Used in the MDCT Spreadsheet Tool

The following are the equations/formulae used in the MDCT Spreadsheet Tool.

For data input, the cells located in Columns J – M are as follows:

BODY LOCATION	CELL	SHALLOW	DEEP	NEUTRON	EYE
Chest	J14 – M14	(empty)	(empty)	(empty)	(empty)
Head	J15 – M15	=IF($E15="None",J$14)	=IF($E15="None",K$14)	=IF($E15="None",L$14)	=IF($E15="None",M$14)
Abdomen	J16 – M16	=IF(AND(E$16="None",E$21="None"),J$14,IF(AND(E$16="None",E$21<>"None"),J$21))	=IF(AND(E$16="None",E$21="None"),K$14,IF(AND(E$16="None",E$21<>"None"),K$21))	=IF(AND(E$16="None",E$21="None"),L$14,IF(AND(E$16="None",E$21<>"None"),L$21))	=IF(AND(E$16="None",E$21="None"),M$14,IF(AND(E$16="None",E$21<>"None"),M$21))
Left Thigh	J17– M17	=IF($E17="None",MAX(J$16,J$21))	=IF($E17="None", MAX(K$16,K$21))	=IF($E17="None", MAX(L$16,K$21))	=IF($E17="None", MAX(M$16,M$21))
Right Thigh	J18 – M18	=IF($E18="None",MAX(J$16,J$21))	=IF($E18="None", MAX(K$16,K$21))	=IF($E18="None", MAX(L$16,K$21))	=IF($E18="None", MAX(M$16,M$21))
Left Knee	J19 – M19	=IF($E19="None",MAX(J$16,J$21))	=IF($E19="None", MAX(K$16,K$21))	=IF($E19="None", MAX(L$16,K$21))	=IF($E19="None", MAX(M$16,M$21))
Right Knee	J20 – M20	=IF($E20="None",MAX(J$16,J$21))	=IF($E20="None", MAX(K$16,K$21))	=IF($E20="None", MAX(L$16,K$21))	=IF($E20="None", MAX(M$16,M$21))
Groin	J21 – M21	=IF($E21="None",J$16)	=IF($E21="None",K$16)	=IF($E21="None",L$16)	=IF($E21="None",M$16)
Back	J22 – M22	=IF($E22="None",J$14)	=IF($E22="None",K$14)	=IF($E22="None",L$14)	=IF($E22="None",M$1)
Left Upper Arm	J23 – M23	=IF($E23="None",J$14)	=IF($E23="None",K$14)	=IF($E23="None",L$14)	=IF($E23="None",M$14)
Right Upper Arm	J24 – M24	=IF($E24="None",J$14)	=IF($E24="None",K$14)	=IF($E24="None",L$14)	=IF($E24="None",M$14)
Left hand	J26 – M26	=IF(E26="None","N/A"," ")	=IF(OR($E26="HSD",$E26="HCND"),"","N/A")	=IF(OR($E26="HSD",$E26="HCND"),"","N/A")	=IF(OR($E26="HSD",$E26="HCND"),"","N/A")
Right Hand	J27 – M27	=IF(E27="None","N/A"," ")	=IF(OR($E27="HSD",$E27="HCND"),"","N/A")	=IF(OR($E27="HSD",$E27="HCND"),"","N/A")	=IF(OR($E27="HSD",$E27="HCND"),"","N/A")

BODY LOCATION	CELL	SHALLOW	DEEP	NEUTRON	EYE
Left Wrist	J28 – M28	=IF(E28="None","N/A"," ")	=IF(OR($E28="HSD",$E28="HCND"),"","N/A")	=IF(OR($E28="HSD",$E28="HCND"),"","N/A")	=IF(OR($E28="HSD",$E28="HCND"),"","N/A")
Right Wrist	J29 – M29	=IF(E29="None","N/A"," ")	=IF(OR($E29="HSD",$E29="HCND"),"","N/A")	=IF(OR($E29="HSD",$E29="HCND"),"","N/A")	=IF(OR($E29="HSD",$E29="HCND"),"","N/A")
Left Lower Leg	J30 – M30	=IF(E30="None","N/A"," ")	=IF(OR($E30="HSD",$E30="HCND"),"","N/A")	=IF(OR($E30="HSD",$E30="HCND"),"","N/A")	=IF(OR($E30="HSD",$E30="HCND"),"","N/A")
Right Lower Leg	J31 – M31	=IF(E31="None","N/A"," ")	=IF(OR($E31="HSD",$E31="HCND"),"","N/A")	=IF(OR($E31="HSD",$E31="HCND"),"","N/A")	=IF(OR($E31="HSD",$E31="HCND"),"","N/A")
Left Foot	J32 – M32	=IF(E32="None","N/A"," ")	=IF(OR($E32="HSD",$E32="HCND"),"","N/A")	=IF(OR($E32="HSD",$E32="HCND"),"","N/A")	=IF(OR($E32="HSD",$E32="HCND"),"","N/A")
Right Foot	J33 – M33	=IF(E33="None","N/A"," ")	=IF(OR($E33="HSD",$E33="HCND"),"","N/A")	=IF(OR($E33="HSD",$E33="HCND"),"","N/A")	=IF(OR($E33="HSD",$E33="HCND"),"","N/A")

For the calculation of photon effective doses, the following equations were used in cells Q14 through U21:

Whole Body Location	Compartment Factor	Adjusted Deep Dose	(Eγ) Effective Dose (mrem)
HEAD/NECK	0.108	=K15	=Q14*S14
THORAX	0.307	=MAX(K14,K22)	=Q15*S15
ABDOMEN	0.561	=MAX(K16,K21)	=Q16*S16
LEFT UPPER ARM	0.006	=K23	=Q17*S17
RIGHT UPPER ARM	0.006	=K24	=Q18*S17
LEFT THIGH	0.006	=MAX(K17,K19)	=Q19*S17
RIGHT THIGH	0.006	=MAX(K18,K20)	=Q20*S20
		Total Photon Effective Dose	=SUM(U14:U20)

For the calculation of neutron effective doses, the following equations were used in cells Q26 through U33:

Whole Body Location	Compartment Factor	Adjusted Deep Dose	(Eη) Effective Dose (mrem)
HEAD/NECK	0.108	=L15	=Q26*S26
THORAX	0.307	=MAX(L14,L22)	=Q27*S27
ABDOMEN	0.561	=MAX(L16,L21)	=Q28*S28
LEFT UPPER ARM	0.006	=L23	=Q29*S29
RIGHT UPPER ARM	0.006	=L24	=Q30*S30
LEFT THIGH	0.006	=MAX(L17,L19)	=Q31*S31
RIGHT THIGH	0.006	=MAX(L18,L20)	=Q32*S32
		Total Neutron Effective Dose	=SUM(U26:U32)

For data output, the cells located at Q36 – Q38 are as follows:

Assessed H_{skin} from multi-pack:	=MAX(W14:W24)
Assessed H_{eye} from multi-pack:	=IF(E15<>"None",X15,X14)
Assessed $H_{extremities}$ from multi-pack:	=IF(AND(E26="None",E27="None",E28="None",E29="None",E30="None",E31="None",E32="None",E33="None"),MAX(W14:W24),MAX(W26:W33))

For data output, the cells located at J38 – N/O39 are as follows:

	SHALLOW	DEEP	NEUTRON	EYE	RING
Doses to Enter into REX:	=IF(Q36-U33<0,0,Q36-U33)	=U21	=U33	=IF(Q37-U33<0,0,Q37-U33)	=IF(Q38-Q36<0,0,Q38-Q36)

APPENDIX B

R&HT Software Grading Form

R&HT Software Grading Form

0

Software Grading Form Revision History				
• If updates do NOT affect Software Grading, then approval signatures for revised form are not required				
Software Name and Version	Multiple Dosimetry Calculational Tool (MDCT), Version 1 (V01)	Software Grading Revisions	Safety Software or Non-Safety Software Classification	☐
			Safety Software Category	☐
			Safety Software Type	☐
			Safety Software Grading Level	☐
Date	Form Revised By	Form Revisions		
2/15/2010	Onette Gibson R&HT Software Quality Engineer	Section 0: Added Section 0, Software Grading Form Revision History Table Section 1: Updated SQE Signature/Date to "Not Applicable to Revision" Section 2: Updated Both PM Signature/Date and Custodian Signature/Date to "Not Applicable to Revision" Section 3: Project Title and Scope: changed PNL-MA-842, Section 6.8.2 to remove reference to specific section Section 4: Updated software version number Footer: Updated form version number and date Other: Minor font, table cell size and spacing to keep length of form to two pages		

1

Grading Status and Software Quality Engineer (SQE) Approval			
Graded Date	12/30/2009	Graded By	Robin Hill
SQE Name	Onette T. Gibson	SQE Signature/Date	Not Applicable to Revision

2

Project Management Grading Approval			
Project Manager (PM) Name	Jim Hilliard	PM Signature/Date	Not Applicable to Revision
Custodian Name	Robin Hill	Custodian Signature/Date	Not Applicable to Revision

3

Electronic Prep & Risk (EPR) Project Information (if applicable)			
Project No		PAAA?	☒

Project Title and Scope:

Multiple Dosimetry Calculational Tool (MDCT): The spreadsheet tool allows input of dosimeter data (shallow, deep, neutron, and eye doses) from dosimeters worn at various locations on the body. The effective dose for beta-gamma and for neutron exposure is calculated using the revised compartment factors documented in PNL-MA-842. The tool also calculates the equivalent dose to skin of the whole body (to represent shallow dose), eye equivalent dose, and extremities equivalent dose (to represent ring dose). The changes are made in response to implementation of the 2007 revision to 10 CFR 835.

4

Software Identification

- Information Resource Inventory (IRI) registration required for safety software
- Except for utility calculations, all R&HT Safety and Non-Safety software required to be entered in the R&HT software inventory database.

Software Name and Version	Multiple Dosimetry Calculational Tool (MDCT), Version 1 (V01)		
Required to be registered in IRI	☒	Date Registered in IRI	12/31/2009
Entered in R&HT software inventory database	☒	Date Entered in R&HT software inventory database	12/31/2009

Functional Description of Software and the Intended Use:

The intended use of the *Multiple Dosimetry Calculational Tool (MDCT)* spreadsheet is for dosimetry staff of Hanford contractors to perform calculations of effective dose and equivalent doses from multiple dosimeters worn together in the field, also called a multi-pack, using the newly developed methodology. The calculations used in the spreadsheet tool are based on the technical information provided in PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010, and Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09," Hill (2009).

5

Safety Software or Non-Safety Software Classification			
Safety Software	☒	Non-Safety Software	☐

Justification for Safety Software or Non-Safety Software Classification:

Multiple Dosimetry Calculational Tool (MDCT) spreadsheet meets the safety software criteria for safety management and administrative controls software because it is used in support of radiological safety management programs necessary to provide adequate protection from radiological hazards (e.g., to limit, eliminate, or mitigate radiological hazards to workers, the public, or the environment).

Safety Software Category, Type, and Grading

Safety Software Category:

Safety System Software	☐	Safety and hazard analysis software and design software	☐	Safety management and administrative controls software	☒

Safety Software Type:

Custom Developed	☒	Utility Calculations Single Use?	☐ ☐
Configurable	☐	Commercial Design and Analysis	☐
Acquired	☐	Other (must explain)	☐

Safety Software Grading Level:

Level A	☐	Level B	☒	Level C	☐

Justification for Safety Software Grading Level Assigned:

Multiple Dosimetry Calculational Tool (MDCT) spreadsheet is used to provide data calculations required to monitor potentially hazardous exposures to workers, the public, or the environment. Failure of this software could result in incorrect analysis, design, monitoring, alarming, or recording of hazardous exposures to workers or the public.

7

Software Risks (not required for low risk non-safety software):

As with any computer program or calculational spreadsheet, the user is more important than the software. Specific software risks of the *Multiple Dosimetry Calculational Tool (MDCT)* spreadsheet are based on the user attention to detail and appropriate user data entry into user input boxes and that the user must objectively be satisfied that the results of the spreadsheet tool calculations are reasonable.

9

Support Software (not required for low risk non-safety software):

System Software (Operating System):

Windows XP SP2	☒

Software Tools:

Microsoft Excel® 2003

10

Software Documentation Content:

Project Management Planning: R&HT Project Management Plan	☒
Risk Mitigation Planning: R&HT Software Configuration Management Plan	☒
Software Quality Assurance Planning: R&HT Quality Assurance Program Plan	☒
Software Configuration Management Planning: R&HT Software Configuration Management Plan	☒
Software Requirements (include identification of support software tools)	☒
Software Design (include identification of system software)	☒
Verification & Validation V&V Testing Records (according to R&HT V&V procedure)	☒
Baseline Configuration: Software Release Report (version, purpose, authorization, date, required user notifications) Version History Baseline Configuration Report (identification of files, file locations, file creation dates)	 ☒ ☒ ☒
The software release shall also include baseline configuration files (as applicable): Custom developed Microsoft Excel® spreadsheet file - MDCT Tool_V0.xlt Software Application Microsoft Word® Document – MDCT Tool Application Document Rev0.doc (includes Requirements, Design, Software Management, User Documentation, V&V, User Training, Calculations, Software Change Request (SCR) form, and Baseline Configuration)	 ☒ ☒
Software Retirement Planning R&HT Project Management Plan	☒

11

Additional Notes:

While the MDCT Spreadsheet Tool is a spreadsheet (utility calculation), it was assigned the safety software type of custom developed due to the complexity of the calculations.

APPENDIX C

Software Release and Baseline Configuration Report

Software Release and Baseline Configuration Report

Name of application: __Multiple Dosimetry Calculational Tool (MDCT)_____
Software Custodian: _____Robin Hill_____
Version: _____V1_____ **Version Creation Date**: __2/16/2010__

Purpose of Version: Release of Rev. 1 *Multiple Dosimetry Calculational Tool (MDCT)* spreadsheet for dosimetry staff of Hanford contractors to perform calculations of effective dose and equivalent doses from multiple dosimeters worn together in the field.

========== [Support Software] ==========

System Software: system utilities; operating systems; database servers; and etc.

Software Name	Type	Version
Microsoft Windows® XP SP2	Operating System	XP SP2

Software Tools: compilers; decompilers/disassemblers; test case generators; code generators; timing analyzers; component libraries; testing scripts; automated tests; and etc.

Software Name	Type	Version
Microsoft Excel®	Spreadsheet	2003

========== [Electronic Implementation Files] ==========

Electronic Files: source code; web pages; user, system administration and hardware manuals; acquired software programs; configuration files; database/input files; and etc.

Software Location/Name	Type	Version	Creation Date	Size
TRIM/Radiation Records/Dosimetry Operations/MDCT_Tool_V1.xls	Microsoft Excel® Spreadsheet	V1	2/16/2010	
TRIM/Radiation Records/Dosimetry Operations/MDCT Tool Application Document Rev0.doc	Microsoft Word® Document	Revision 1	2/16/2010	

2/19/10

========== [Approvals] ==========

Release Approved (Program Manager): _____ **Date:** 2/16/10

Release Approved (Custodian): _____ **Date:** 2/16/10

APPENDIX D

MDCT Spreadsheet Tool Verification

Spreadsheet Verification Form	1. Date of Verification: 2/12/10
	1a. # pages: 5

2.	**Software custodian/Org/MSIN/Phone #:**	Robin Hill/HRRP/P7-01/376-1533
3.	**Spreadsheet File Name/Version #:**	MDCT Tool_V1.xls
4.	**Function and Purpose:**	Calculate effective and equivalent doses for input into REX from dosimeters used in a multi-pack.
5.	**Software QA Level of Control:**	B
6.	**Spreadsheet Category:**	
7.	**Associated Documents:**	Hill, R.L. 2009. Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09. PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010.
8.	**Scope of Verification:**	Check input and output values
9.	**Scope Description:**	Check that spreadsheet produces the appropriate values for shallow, deep, neutron, eye, and ring doses for input into REX from multiple dosimeters worn from a multi-pack.

10.	**Verification Checklist:**	**YES**	**NO**	**N/A**
a.	All unique formulae in spreadsheet have been checked that they correctly perform their intended function.	X		
b.	Non-unique formulae have been reviewed to confirm that they have been correctly copied.	X		
c.	All values are correctly labeled with units.	X		
d.	Input data ranges used in spreadsheet where appropriate.	X		
e.	All output values have been checked for numerical correctness using comparison with alternate calculations.	X		
f.	All output data is reported out correctly and in the intended format	X		
g.	All cell references have been checked and are correct.	X		
h.	Formulae on hidden pages verified.			X
i.	Links to other workbooks verified.			X
j.	Spreadsheet has been reviewed for common errors.	X		
k.	Assumptions in spreadsheet are reasonable and supportable.	X		
l.	Macros contained in spreadsheet have been verified for correct operation.			X
m.	Add-in software is commercially available software (COTS), suitable for its intended purpose, and is a production version of the software (e.g., not 'beta' test version).			X
n.	Spreadsheet contains documentation sheet with spreadsheet purpose, methodology, assumptions, and reference to current software quality assurance documentation.	X		
o.	A change log is included in multiple-use or revised single-use spreadsheets and all changes in the log have been verified.	X		
p.	If the spreadsheet is software control level A, B, C, or D, then a published document has been produced that provides a description of the spreadsheet purpose, assumptions, and methodology.	X		
q.	Spreadsheet has been protected against inadvertent change.	X		
r.	All errors identified during verification have been corrected and the spreadsheet is suitable for its intended purpose.	X		

11. **Comments** (including explanation of any item marked "NO" in Block 10 must be provided):

- Used input values from Tables 2-6 for Test Cases 1-5

12. Approvals:	Printed Name	Signature	Date
Software Custodian:	R.L. Hill		2/12/10
Spreadsheet Verifier:	R.L. Hill		2/12/10
Program Manager:	J. Hilliard		2/17/10
R&HT Software Quality Engineer:	O.T. Gibson		2/17/10

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date 2/12/10
TEST CASE 1			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

CHEST DOSIMETER NEED USE FOR ALL

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			271	266	0	266
E	HEAD (forehead-for head & neck)	None	N/A	N/A	271	266	0	266
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	271	266	0	266
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
K	LEFT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
L	RIGHT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	271	266	0	266
S	BACK (between shoulder blades)	None	N/A	N/A	271	266	0	266
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	271	266	0	266
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	271	266	0	266
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad			1276	N/A	N/A	N/A
B	RIGHT HAND	ExtRad			987	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	266	=	28.73
R,S	THORAX (above diaphragm) [c]	0.307	x	266	=	81.66
F,Q	ABDOMEN	0.561	x	266	=	149.23
T	LEFT UPPER ARM	0.006	x	266	=	1.60
U	RIGHT UPPER ARM	0.006	x	266	=	1.60
I,K	LEFT THIGH	0.006	x	266	=	1.60
J,L	RIGHT THIGH	0.006	x	266	=	1.60
				Total Photon Effective Dose	=	266.00

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	0	=	0.00
R,S	THORAX (above diaphragm) [c]	0.307	x	0	=	0.00
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	0	=	0.00
T	LEFT UPPER ARM	0.006	x	0	=	0.00
U	RIGHT UPPER ARM	0.006	x	0	=	0.00
I,K	LEFT THIGH	0.006	x	0	=	0.00
J,L	RIGHT THIGH	0.006	x	0	=	0.00
				Total Neutron Effective Dose	=	0.00

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	271	266	0	266	1005

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	271
H_{eye} assessed from multi-pack:	266
$H_{extremities}$ assessed from multi-pack:	1276

OIL 2/12/10

Data Input Name/Signature: RLHill Date: 2/12/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

TEST CASE 1 - Verification

- Only one whole body dosimeter worn; finger rings also worn

	Shallow	Deep	Neutron	Eye		A-Shallow	B-Shallow	Neutron	
HSD input:	271	266	0	266	ExtRad:	1276	987	0	0

WB	Shallow + Neutron
R	271
E	271
F	271
I	271
J	271
K	271
L	271
Q	271
S	271
T	271
U	271
MAX	271

	Eye + Neutron		Ext + Neutron
R	266	A	1276
E	266	B	987
MAX	266	MAX	1276

- These values used for all whole body locations

MAX		Dosimeter Value		CF		E_{gamma}	Dosimeter Value		CF		$E_{neutron}$
E	Head/neck	266	*	0.108	=	28.73	0	*	0.108	=	0
R,S	Thorax	266	*	0.307	=	81.66	0	*	0.307	=	0
F,Q	Abdomen	266	*	0.561	=	149.23	0	*	0.561	=	0
T	Lt Upper Arm	266	*	0.006	=	1.60	0	*	0.006	=	0
U	Rt Upper Arm	266	*	0.006	=	1.60	0	*	0.006	=	0
I,K	Lt Thigh	266	*	0.006	=	1.60	0	*	0.006	=	0
J,L	Rt Thigh	266	*	0.006	=	1.60	0	*	0.006	=	0
				SUM		266.00			SUM		0.00

H_{skin}	271
H_{eye}	266
$H_{extremities}$	1276

- H_{skin} is maximum of (shallow + neutron) for whole body locations
- H_{eye} is maximum of (neutron + eye) for chest or head/neck dosimeter
- Extremity dosimeters worn; so, for $H_{extremities}$, take maximum of (shallow + neutron) for ~~Extremity~~ locations

For REX input:

Shallow = H_{skin} - $E_{neutron\text{-}wb}$ =	271.00	**271**
Deep = E_{gamma} =	266.00	**266**
Neutron = $E_{neutron}$ =	0.00	**0**
Eye = H_{eye} - $E_{neutron\text{-}wb}$ =	266.00	**266**
Ring = H_{ext} - H_{skin} =	1005.00	**1005**

OK WA 2/17/10

USE CHEST DEEP FOR ALL BUT KNEES / THIGHS

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date 2/12/10
TEST CASE 2			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			327	318	10	318
E	HEAD (forehead-for head & neck)	None	N/A	N/A	327	318	10	318
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD			380	365	15	365
L	RIGHT KNEE (knee area only)	HSD			395	380	20	380
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	327	318	10	318
S	BACK (between shoulder blades)	None	N/A	N/A	327	318	10	318
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	327	318	10	318
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	327	318	10	318
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	318	=	34.34
R,S	THORAX (above diaphragm) [c]	0.307	x	318	=	97.63
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	318	=	1.91
U	RIGHT UPPER ARM	0.006	x	318	=	1.91
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	318.65

HAND CALC = 318.

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	10	=	1.08
R,S	THORAX (above diaphragm) [c]	0.307	x	10	=	3.07
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	10	=	0.06
U	RIGHT UPPER ARM	0.006	x	10	=	0.06
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.09

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	405	319	10	318	0

(See Section 6.8.4 in PNL-MA-842)

415-415=0

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	328
$H_{extremities}$ assessed from multi-pack:	415

Data Input Name/Signature: RLNIU Date: 2/12/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

2/12/10

TEST CASE 2 - Verification

- Three (3) whole body dosimeters worn; no extremity dosimeters worn

HSD input:	Shallow	Deep	Neutron	Eye
R	327	318	10	318
K	380	365	15	365
L	395	380	20	380

No Extremity dosimeters

- These values used for all whole body locations

MAX		Dosimeter Value		CF		E_{gamma}	Dosimeter Value		CF		$E_{neutron}$
E	Head/neck	318	*	0.108	=	34.34	10	*	0.108	=	1.08
R,S	Thorax	318	*	0.307	=	97.63	10	*	0.307	=	3.07
F,Q	Abdomen	318	*	0.561	=	178.40	10	*	0.561	=	5.61
T	Lt Upper Arm	318	*	0.006	=	1.91	10	*	0.006	=	0.06
U	Rt Upper Arm	318	*	0.006	=	1.91	10	*	0.006	=	0.06
I,K	Lt Thigh	365	*	0.006	=	2.19	15	*	0.006	=	0.09
J,L	Rt Thigh	380	*	0.006	=	2.28	20	*	0.006	=	0.12
				SUM		318.65			SUM		10.09

WB	Shallow + Neutron
R	337
E	337
F	337
I	337
J	337
K	395
L	415
Q	337
S	337
T	337
U	337
MAX	415

	Eye + Neutron		Ext + Neutron
R	328	A	0
E	328	B	0
MAX	328	MAX	0

H_{skin}	415
H_{eye}	328
$H_{extremities}$	415

- H_{skin} is maximum of (shallow + neutron) for whole body locations
- H_{eye} is maximum of (neutron + eye) for chest or head/neck dosimeter
- No extremity dosimeters worn; so, for $H_{extremities}$, take maximum of (shallow + neutron) for Whole Body locations

For REX input:

Shallow = H_{skin} - $E_{neutron\text{-}wb}$ =	404.91	**405**
Deep = E_{gamma} =	318.65	**319**
Neutron = $E_{neutron}$ =	10.09	**10**
Eye = H_{eye} - $E_{neutron\text{-}wb}$ =	317.91	**318**
Ring = H_{ext} - H_{skin} =	0.00	**0**

2/17/10

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date 2/12/10
TEST CASE 3			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

PULLS RESP + NEUTRON DOSES FROM APPROPRIATE CELLS

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND			350	213	24	213
E	HEAD (forehead-for head & neck)	HCND			375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND			326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
K	LEFT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
L	RIGHT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
Q	GROIN (junction of thighs and trunk)	HCND			321	180	19	180
S	BACK (between shoulder blades)	HCND			354	209	20	209
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb-	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad			987	N/A	N/A	N/A
B	RIGHT HAND	ExtRad			1276	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	195	=	109.40
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	195	=	1.17
J,L	RIGHT THIGH	0.006	x	195	=	1.17
				Total Photon Effective Dose	=	206.68

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	20	=	11.22
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	20	=	0.12
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	21.38

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	375	207	21	250	880

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	396
H_{eye} assessed from multi-pack:	271
$H_{extremities}$ assessed from multi-pack:	1276

2/12/10

Data Input Name/Signature: RLHILL Date: 2/12/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

TEST CASE 3 - Verification

- Five (5) whole body dosimeters worn; finger rings worn

HSD input:	Shallow	Deep	Neutron	Eye
R	350	213	24	213
E	375	250	21	250
F	326	195	20	195
Q	321	180	19	180
S	354	209	20	209

Ext:	Shallow	Neutron
A	987	0
B	1276	0

Automatic fill-in for whole body locations from nearest location with dosimeter

I	326	195	20	195	from F - abdomen
J	326	195	20	195	from F - abdomen
K	326	195	20	195	from F - abdomen
L	326	195	20	195	from F - abdomen
T	350	213	24	213	from R - chest
U	350	213	24	213	from R - chest

- These values used for all whole body locations

MAX		Dosimeter Value		CF		E_{gamma}	Dosimeter Value		CF		$E_{neutron}$
E	Head/neck	250	*	0.108	=	27.00	21	*	0.108	=	2.268
R,S	Thorax	213	*	0.307	=	65.39	24	*	0.307	=	7.368
F,Q	Abdomen	195	*	0.561	=	109.40	20	*	0.561	=	11.22
T	Lt Upper Arm	213	*	0.006	=	1.28	24	*	0.006	=	0.144
U	Rt Upper Arm	213	*	0.006	=	1.28	24	*	0.006	=	0.144
I,K	Lt Thigh	195	*	0.006	=	1.17	20	*	0.006	=	0.12
J,L	Rt Thigh	195	*	0.006	=	1.17	20	*	0.006	=	0.12
				SUM		206.68			SUM		21.38

WB	Shallow + Neutron
R	374
E	396
F	346
I	346
J	346
K	374
L	374
Q	340
S	374
T	374
U	374
MAX	396

	Eye + Neutron		Ext + Neutron
R	237	A	987.00
E	271	B	1276.00
MAX	271	MAX	1276.00

H_{skin}	396
H_{eye}	271
$H_{extremities}$	1276.00

- H_{skin} is maximum of (shallow + neutron) for whole body locations
- H_{eye} is maximum of (neutron + eye) for chest or head/neck dosimeter
- Extremity dosimeters worn; so, for $H_{extremities}$, take maximum of (shallow + neutron) for Extremity locations

For REX input:

Shallow = H_{skin} - $E_{neutron\text{-}wb}$ =	374.62	**375**
Deep = E_{gamma} =	206.68	**207**
Neutron = $E_{neutron}$ =	21.38	**21**
Eye = H_{eye} - $E_{neutron\text{-}wb}$ =	249.62	**250**
Ring = H_{ext} - H_{skin} =	880.00	**880**

OK MM 2/17/10

Deep + Neutron doses proxied for appropriate cells

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date 2/12/10
TEST CASE 4			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			320	302	5	302
E	HEAD (forehead-for head & neck)	None	N/A	N/A	320	302	5	302
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD			380	365	15	365
L	RIGHT KNEE (knee area only)	HSD			395	380	20	380
Q	GROIN (junction of thighs and trunk)	HSD			327	318	10	318
S	BACK (between shoulder blades)	HSD			330	320	12	320
T	LEFT UPPER ARM (between shoulder & elbow)	None	N/A	N/A	320	302	5	302
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	320	302	5	302
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	HSD			510	500	12	501
P	RIGHT FOOT	HSD			504	498	11	499

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	302	=	32.62
R,S	THORAX (above diaphragm) [c]	0.307	x	320	=	98.24
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	302	=	1.81
U	RIGHT UPPER ARM	0.006	x	302	=	1.81
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	317.35

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	5	=	0.54
R,S	THORAX (above diaphragm) [c]	0.307	x	12	=	3.68
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	5	=	0.03
U	RIGHT UPPER ARM	0.006	x	5	=	0.03
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.10

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	405	317	10	297	107

(See Section 6.8.4 in PNL-MA-842)

522-415=107

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	307
$H_{extremities}$ assessed from multi-pack:	522

Data Input Name/Signature: RLHill Date: 2/12/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

TEST CASE 4 - Verification

- Five (5) whole body dosimeters worn; extremity HSDs worn on feet

HSD input:	Shallow	Deep	Neutron	Eye
R	320	302	5	302
K	380	365	15	365
L	395	380	20	380
Q	327	318	10	318
S	330	320	12	320

Ext:	Shallow	Deep	Neutron	Eye
O	510	500	12	107
P	504	498	11	499

Automatic fill-in for whole body locations from nearest location with dosimeter

E	320	302	5	302	from R - chest
F	327	318	10	318	from Q -groin
I	327	318	10	318	from Q -groin
J	327	318	10	318	from Q -groin
T	320	302	5	302	from R - chest
U	320	302	5	302	from R - chest

- These values used for all whole body locations

MAX		Dosimeter Value		CF		E_{gamma}	Dosimeter Value		CF		$E_{neutron}$
E	Head/neck	302	*	0.108	=	32.62	5	*	0.108	=	0.54
R,S	Thorax	320	*	0.307	=	98.24	12	*	0.307	=	3.684
F,Q	Abdomen	318	*	0.561	=	178.40	10	*	0.561	=	5.61
T	Lt Upper Arm	302	*	0.006	=	1.81	5	*	0.006	=	0.03
U	Rt Upper Arm	302	*	0.006	=	1.81	5	*	0.006	=	0.03
I,K	Lt Thigh	365	*	0.006	=	2.19	15	*	0.006	=	0.09
J,L	Rt Thigh	380	*	0.006	=	2.28	20	*	0.006	=	0.12
				SUM		317.35			SUM		10.10

WB	Shallow + Neutron
R	325
E	325
F	337
I	337
J	337
K	395
L	415
Q	337
S	342
T	325
U	325
MAX	415

	Eye + Neutron		Ext + Neutron
O	307	A	522.00
P	307	B	515.00
MAX	307	MAX	522.00

H_{skin}	415
H_{eye}	307
$H_{extremities}$	522.00

- H_{skin} is maximum of (shallow + neutron) for whole body locations
- H_{eye} is maximum of (neutron + eye) for chest or head/neck dosimeter
- Extremity dosimeters worn; so, for $H_{extremities}$, take maximum of (shallow + neutron) for Extremity locations

For REX input:

Shallow = H_{skin} - $E_{neutron\text{-}wb}$ =	404.90	**405**
Deep = E_{gamma} =	317.35	**317**
Neutron = $E_{neutron}$ =	10.10	**10**
Eye = H_{eye} - $E_{neutron\text{-}wb}$ =	296.90	**297**
Ring = H_{ext} - H_{skin} =	107.00	**107**

OK WH 2/17/10

PLUS DEEP+NEUTRON DOSES FROM MANUAL ACES

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date 2/12/10
TEST CASE 5			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND			350	213	24	213
E	HEAD (forehead-for head & neck)	HCND			375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND			326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
K	LEFT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
L	RIGHT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
Q	GROIN (junction of thighs and trunk)	HCND			450	350	100	350
S	BACK (between shoulder blades)	None	N/A	N/A	350	213	24	213
T	LEFT UPPER ARM (between shoulder & elbow)	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

	Area of Whole Body	Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	350	=	196.35
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	350	=	2.10
J,L	RIGHT THIGH	0.006	x	350	=	2.10
				Total Photon Effective Dose	=	295.50

EFFECTIVE DOSE FROM NEUTRONS

	Area of Whole Body	Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	100	=	56.10
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	100	=	0.60
J,L	RIGHT THIGH	0.006	x	100	=	0.60
				Total Neutron Effective Dose	=	67.22

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	483	295	67	204	0

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	550
H_{eye} assessed from multi-pack:	271
$H_{extremities}$ assessed from multi-pack:	550

550-550=0

Data Input Name/Signature: ALHM Date: 2/12/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

2/12/10

MDCT Tool_V1_TEST CASE 5.xls

Printed: 2/12/2010; 1:55 PM

TEST CASE 5 - Verification

- Four (4) whole body dosimeters worn; no extremity dosimeters worn

HSD input:	Shallow	Deep	Neutron	Eye
R	350	213	24	213
E	375	250	21	250
F	326	195	20	195
Q	450	350	100	350

No Extremity dosimeters

- These values used for all whole body locations

MAX		Dosimeter Value		CF		E_{gamma}	Dosimeter Value		CF		$E_{neutron}$
E	Head/neck	250	*	0.108	=	27.00	21	*	0.108	=	2.268
R,S	Thorax	213	*	0.307	=	65.39	24	*	0.307	=	7.368
F,Q	Abdomen	350	*	0.561	=	196.35	100	*	0.561	=	56.1
T	Lt Upper Arm	213	*	0.006	=	1.28	24	*	0.006	=	0.144
U	Rt Upper Arm	213	*	0.006	=	1.28	24	*	0.006	=	0.144
I,K	Lt Thigh	350	*	0.006	=	2.10	100	*	0.006	=	0.6
J,L	Rt Thigh	350	*	0.006	=	2.10	100	*	0.006	=	0.6
				SUM		295.50			SUM		67.22

WB	Shallow + Neutron
R	374
E	396
F	346
I	550
J	550
K	550
L	550
Q	550
S	374
T	374
U	374
MAX	550

	Eye + Neutron
R	237
E	271
MAX	271

	Ext + Neutron
A	0
B	0
MAX	0

H_{skin}	550
H_{eye}	271
$H_{extremities}$	550

- H_{skin} is maximum of (shallow + neutron) for whole body locations
- H_{eye} is maximum of (neutron + eye) for chest or head/neck dosimeter
- No extremity dosimeters worn; so, for $H_{extremities}$, take maximum of (shallow + neutron) for Whole Body locations

For REX input:

Shallow = H_{skin} - $E_{neutron\text{-}wb}$ =	482.78	**483**
Deep = E_{gamma} =	295.50	**295**
Neutron = $E_{neutron}$ =	67.22	**67**
Eye = H_{eye} - $E_{neutron\text{-}wb}$ =	203.78	**204**
Ring = H_{ext} - H_{skin} =	0.00	**0**

O/C 2/17/10

APPENDIX E

MDCT Spreadsheet Tool Testing Results

Spreadsheet Verification Form	1. Date of Verification: 1/27/10
	1a. # pages: 11

2.	**Software custodian/Org/MSIN/Phone #:**	Robin Hill/HRRP/P7-01/376-1533
3.	**Spreadsheet File Name/Version #:**	MDCT Tool_V1.xls
4.	**Function and Purpose:**	Calculate effective and equivalent doses for input into REX from dosimeters used in a multi-pack.
5.	**Software QA Level of Control:**	B
6.	**Spreadsheet Category:**	
7.	**Associated Documents:**	Hill, R.L. 2009. Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09. PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010.
8.	**Scope of Verification:**	Check input and output values
9.	**Scope Description:**	Check that spreadsheet produces the appropriate values for shallow, deep, neutron, eye, and ring doses for input into REX from multiple dosimeters worn from a multi-pack.

10.	**Verification Checklist:**	YES	NO	N/A
a.	All unique formulae in spreadsheet have been checked that they correctly perform their intended function.	✓		
b.	Non-unique formulae have been reviewed to confirm that they have been correctly copied.	✓		
c.	All values are correctly labeled with units.	✓		
d.	Input data ranges used in spreadsheet where appropriate.	✓		
e.	All output values have been checked for numerical correctness using comparison with alternate calculations.	✓		
f.	All output data is reported out correctly and in the intended format	✓		
g.	All cell references have been checked and are correct.	✓		
h.	Formulae on hidden pages verified.	✓		
i.	Links to other workbooks verified.			✓
j.	Spreadsheet has been reviewed for common errors.	✓		
k.	Assumptions in spreadsheet are reasonable and supportable.	✓		
l.	Macros contained in spreadsheet have been verified for correct operation.			✓
m.	Add-in software is commercially available software (COTS), suitable for its intended purpose, and is a production version of the software (e.g., not 'beta' test version).			✓
n.	Spreadsheet contains documentation sheet with spreadsheet purpose, methodology, assumptions, and reference to current software quality assurance documentation.	✓		
o.	A change log is included in multiple-use or revised single-use spreadsheets and all changes in the log have been verified.			
p.	If the spreadsheet is software control level A, B, C, or D, then a published document has been produced that provides a description of the spreadsheet purpose, assumptions, and methodology.	✓		
q.	Spreadsheet has been protected against inadvertent change.	✓		
r.	All errors identified during verification have been corrected and the spreadsheet is suitable for its intended purpose.	✓		

11. **Comments** (including explanation of any item marked "NO" in Block 10 must be provided):

12. Approvals:	Printed Name	Signature	Date
Software Custodian:	R.L. Hill	[illegible]	2/2/10
Spreadsheet Verifier:	B.A Rathbone	B.O. Rathbone	1/27/10
Program Manager:	J. Hilliard	[illegible]	2/17/10
R&HT Software Quality Engineer:	O.T. Gibson	Otto T. Gibson	2/17/10

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date
TEST CASE 1			HPT Office
			Area / Phone

Location of Job:	Beginning Wear Date:	Comments:
Name of Job:	End Wear Date:	

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			271	266	0	266
E	HEAD (forehead-for head & neck)	None	N/A	N/A	271	266	0	266
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	271	266	0	266
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
K	LEFT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
L	RIGHT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	271	266	0	266
S	BACK (between shoulder blades)	None	N/A	N/A	271	266	0	266
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	271	266	0	266
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	271	266	0	266
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad			1276	N/A	N/A	N/A
B	RIGHT HAND	ExtRad			987	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	266	=	28.73
R,S	THORAX (above diaphragm) [c]	0.307	x	266	=	81.66
F,Q	ABDOMEN	0.561	x	266	=	149.23
T	LEFT UPPER ARM	0.006	x	266	=	1.60
U	RIGHT UPPER ARM	0.006	x	266	=	1.60
I,K	LEFT THIGH	0.006	x	266	=	1.60
J,L	RIGHT THIGH	0.006	x	266	=	1.60
				Total Photon Effective Dose	=	266.00

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	0	=	0.00
R,S	THORAX (above diaphragm) [c]	0.307	x	0	=	0.00
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	0	=	0.00
T	LEFT UPPER ARM	0.006	x	0	=	0.00
U	RIGHT UPPER ARM	0.006	x	0	=	0.00
I,K	LEFT THIGH	0.006	x	0	=	0.00
J,L	RIGHT THIGH	0.006	x	0	=	0.00
				Total Neutron Effective Dose	=	0.00

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	271	266	0	266	1005

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	271
H_{eye} assessed from multi-pack:	266
$H_{extremities}$ assessed from multi-pack:	1276

Brian Rathbone
2/16/2010

Data Input Name/Signature: _____ Date: _____

Data Verification Name/Signature: _____ Date: _____

REX Input Name/Signature: _____ Date: _____

REX Data Verification Name/Signature: _____ Date: _____

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date
TEST CASE 2			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			327	318	10	318
E	HEAD (forehead-for head & neck)	None	N/A	N/A	327	318	10	318
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD			380	365	15	365
L	RIGHT KNEE (knee area only)	HSD			395	380	20	380
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	327	318	10	318
S	BACK (between shoulder blades)	None	N/A	N/A	327	318	10	318
T	LEFT UPPER ARM (between shoulder & elbow)	None	N/A	N/A	327	318	10	318
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	327	318	10	318
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	318	=	34.34
R,S	THORAX (above diaphragm) [c]	0.307	x	318	=	97.63
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	318	=	1.91
U	RIGHT UPPER ARM	0.006	x	318	=	1.91
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	318.65

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	10	=	1.08
R,S	THORAX (above diaphragm) [c]	0.307	x	10	=	3.07
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	10	=	0.06
U	RIGHT UPPER ARM	0.006	x	10	=	0.06
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.09

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	405	319	10	318	0

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	328
$H_{extremities}$ assessed from multi-pack:	415

Brian Rathbone

2/16/2010

Data Input Name/Signature: Date:

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date
TEST CASE 3			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND			350	213	24	213
E	HEAD (forehead-for head & neck)	HCND			375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND			326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
K	LEFT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
L	RIGHT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
Q	GROIN (junction of thighs and trunk)	HCND			321	180	19	180
S	BACK (between shoulder blades)	HCND			354	209	20	209
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad			987	N/A	N/A	N/A
B	RIGHT HAND	ExtRad			1276	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	195	=	109.40
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	195	=	1.17
J,L	RIGHT THIGH	0.006	x	195	=	1.17
				Total Photon Effective Dose	=	206.68

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	20	=	11.22
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	20	=	0.12
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	21.38

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	375	207	21	250	880

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	396
H_{eye} assessed from multi-pack:	271
$H_{extremities}$ assessed from multi-pack:	1276

Brian Rathbone
2/16/2010

Data Input Name/Signature: _____ Date: _____

Data Verification Name/Signature: _____ Date: _____

REX Input Name/Signature: _____ Date: _____

REX Data Verification Name/Signature: _____ Date: _____

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date
TEST CASE 4			HPT Office
			Area / Phone
Location of Job:	Beginning Wear Date:		Comments:
Name of Job:	End Wear Date:		

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD			320	302	5	302
E	HEAD (forehead-for head & neck)	None	N/A	N/A	320	302	5	302
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD			380	365	15	365
L	RIGHT KNEE (knee area only)	HSD			395	380	20	380
Q	GROIN (junction of thighs and trunk)	HSD			327	318	10	318
S	BACK (between shoulder blades)	HSD			330	320	12	320
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	320	302	5	302
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	320	302	5	302
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	HSD			510	500	12	501
P	RIGHT FOOT	HSD			504	498	11	499

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	302	=	32.62
R,S	THORAX (above diaphragm) [c]	0.307	x	320	=	98.24
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	302	=	1.81
U	RIGHT UPPER ARM	0.006	x	302	=	1.81
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	317.35

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_n Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	5	=	0.54
R,S	THORAX (above diaphragm) [c]	0.307	x	12	=	3.68
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	5	=	0.03
U	RIGHT UPPER ARM	0.006	x	5	=	0.03
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.10

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	405	317	10	297	107

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	307
$H_{extremities}$ assessed from multi-pack:	522

Bruce Rathbone

2/16/2010

Data Input Name/Signature: _____ Date: _____

Data Verification Name/Signature: _____ Date: _____

REX Input Name/Signature: _____ Date: _____

REX Data Verification Name/Signature: _____ Date: _____

MDCT Tool_V1.xls

Printed: 2/16/2010; 5:53 PM

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date
TEST CASE 5			HPT Office
			Area / Phone

Location of Job:	Beginning Wear Date:	Comments:
Name of Job:	End Wear Date:	

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND			350	213	24	213
E	HEAD (forehead-for head & neck)	HCND			375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND			326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
K	LEFT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
L	RIGHT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
Q	GROIN (junction of thighs and trunk)	HCND			450	350	100	350
S	BACK (between shoulder blades)	None	N/A	N/A	350	213	24	213
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	350	=	196.35
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	350	=	2.10
J,L	RIGHT THIGH	0.006	x	350	=	2.10
				Total Photon Effective Dose	=	295.50

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	100	=	56.10
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	100	=	0.60
J,L	RIGHT THIGH	0.006	x	100	=	0.60
				Total Neutron Effective Dose	=	67.22

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	483	295	67	204	0

(See Section 6.8.4 in PNL-MA-842)

H_{skin} assessed from multi-pack:	550
H_{eye} assessed from multi-pack:	271
$H_{extremities}$ assessed from multi-pack:	550

Bruce Rathbone
2/16/2010

Data Input Name/Signature: B.A. Rathbone Date: 2/16/2010

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MDCT Tool_V1.xls

Printed: 2/16/2010; 5:58 PM

Spreadsheet Verification Form	1. Date of Verification: 2/15/10
	1a. # pages:

2.	**Software custodian/Org/MSIN/Phone #:**	Robin Hill/HRRP/P7-01/376-1533
3.	**Spreadsheet File Name/Version #:**	MDCT Tool_V1.xls
4.	**Function and Purpose:**	Calculate effective and equivalent doses for input into REX from dosimeters used in a multi-pack.
5.	**Software QA Level of Control:**	B
6.	**Spreadsheet Category:**	
7.	**Associated Documents:**	Hill, R.L. 2009. Technical Basis for HPDAC Proposal on Multiple Dosimetry Effective Dose Methodology – for HPDAC Review and Approval 3/17/09. PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, Revision 1, January 1, 2010.
8.	**Scope of Verification:**	Check input and output values
9.	**Scope Description:**	Check that spreadsheet produces the appropriate values for shallow, deep, neutron, eye, and ring doses for input into REX from multiple dosimeters worn from a multi-pack.

10.	**Verification Checklist:**	YES	NO	N/A
a.	All unique formulae in spreadsheet have been checked that they correctly perform their intended function.			✓
b.	Non-unique formulae have been reviewed to confirm that they have been correctly copied.	✓		
c.	All values are correctly labeled with units.	✓		
d.	Input data ranges used in spreadsheet where appropriate.	✓		
e.	All output values have been checked for numerical correctness using comparison with alternate calculations.			✓
f.	All output data is reported out correctly and in the intended format	✓		
g.	All cell references have been checked and are correct.	✓		
h.	Formulae on hidden pages verified.			✓
i.	Links to other workbooks verified.			✓
j.	Spreadsheet has been reviewed for common errors.	✓		
k.	Assumptions in spreadsheet are reasonable and supportable.	✓		
l.	Macros contained in spreadsheet have been verified for correct operation.			✓
m.	Add-in software is commercially available software (COTS), suitable for its intended purpose, and is a production version of the software (e.g., not 'beta' test version).			✓
n.	Spreadsheet contains documentation sheet with spreadsheet purpose, methodology, assumptions, and reference to current software quality assurance documentation.	✓		
o.	A change log is included in multiple-use or revised single-use spreadsheets and all changes in the log have been verified.	✓		
p.	If the spreadsheet is software control level A, B, C, or D, then a published document has been produced that provides a description of the spreadsheet purpose, assumptions, and methodology.			✓
q.	Spreadsheet has been protected against inadvertent change.			✓
r.	All errors identified during verification have been corrected and the spreadsheet is suitable for its intended purpose.	✓		

11. **Comments** (including explanation of any item marked "NO" in Block 10 must be provided):

12. Approvals:	Printed Name	Signature	Date
Software Custodian:	R.L. Hill	[signature]	2/16/10
Spreadsheet Verifier:	D. Gateley	[signature]	2/15/10
Program Manager:	J. Hilliard	[signature]	2/17/10
R&HT Software Quality Engineer:	O.T. Gibson	[signature]	2/17/10

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date	
Test Case 1			HPT Office	
			Area	Phone
Location of Job:	Beginning Wear Date:		Comments:	
Name of Job:	End Wear Date:			

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD	Abxxx	Acxxx	271	266	0	266
E	HEAD (forehead-for head & neck)	None	N/A	N/A	271	266	0	266
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	271	266	0	266
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	271	266	0	266
K	LEFT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
L	RIGHT KNEE (knee area only)	None	N/A	N/A	271	266	0	266
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	271	266	0	266
S	BACK (between shoulder blades)	None	N/A	N/A	271	266	0	266
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	271	266	0	266
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	271	266	0	266
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad	12345	ACxxx	1276	N/A	N/A	N/A
B	RIGHT HAND	ExtRad	12346	Acxxx	987	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	266	=	28.73
R,S	THORAX (above diaphragm) [c]	0.307	x	266	=	81.66
F,Q	ABDOMEN	0.561	x	266	=	149.23
T	LEFT UPPER ARM	0.006	x	266	=	1.60
U	RIGHT UPPER ARM	0.006	x	266	=	1.60
I,K	LEFT THIGH	0.006	x	266	=	1.60
J,L	RIGHT THIGH	0.006	x	266	=	1.60
				Total Photon Effective Dose	=	266.00

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	0	=	0.00
R,S	THORAX (above diaphragm) [c]	0.307	x	0	=	0.00
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	0	=	0.00
T	LEFT UPPER ARM	0.006	x	0	=	0.00
U	RIGHT UPPER ARM	0.006	x	0	=	0.00
I,K	LEFT THIGH	0.006	x	0	=	0.00
J,L	RIGHT THIGH	0.006	x	0	=	0.00
				Total Neutron Effective Dose	=	0.00

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	271	266	0	266	1005

(See Section 6.8.4 in PML-MA-842.)

H_{skin} assessed from multi-pack:	271
H_{eye} assessed from multi-pack:	266
$H_{extremity}$ assessed from multi-pack:	1276

Data Input Name/Signature: dgutlin Date: 2/15/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MDCT Tool_V1.xls

Printed: 2/15/2010; 8:53 AM

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date	
Test Case 2			HPT Office	
			Area	Phone
Location of Job:	Beginning Wear Date:		Comments:	
Name of Job:	End Wear Date:			

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD	Txxxx	Nxxxx	327	318	10	318
E	HEAD (forehead-for head & neck)	None	N/A	N/A	327	318	10	318
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD	Txxxx	Nxxxx	380	365	15	365
L	RIGHT KNEE (knee area only)	HSD	Txxxx	Nxxxx	395	380	20	380
Q	GROIN (junction of thighs and trunk)	None	N/A	N/A	327	318	10	318
S	BACK (between shoulder blades)	None	N/A	N/A	327	318	10	318
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	327	318	10	318
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	327	318	10	318
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	318	=	34.34
R,S	THORAX (above diaphragm) [c]	0.307	x	318	=	97.63
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	318	=	1.91
U	RIGHT UPPER ARM	0.006	x	318	=	1.91
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	318.65

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	10	=	1.08
R,S	THORAX (above diaphragm) [c]	0.307	x	10	=	3.07
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	10	=	0.06
U	RIGHT UPPER ARM	0.006	x	10	=	0.06
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.09

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

Doses to Enter into REX:	Shallow	Deep	Neutron	Eye	Ring
	405	319	10	318	0

(See Section 6.8.4 in PML-MA-842.)

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	328
$H_{extremity}$ assessed from multi-pack:	415

Data Input Name/Signature: [signature] Date: 2/15/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date	
Test Case 3			HPT Office	
			Area	Phone
Location of Job:	Beginning Wear Date:		Comments:	
Name of Job:	End Wear Date:			

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND	Txxxx	Mxxx	350	213	24	213
E	HEAD (forehead-for head & neck)	HCND	Txxxx	Mxxx	375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND	Txxxx	Mxxx	326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	326	195	20	195
K	LEFT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
L	RIGHT KNEE (knee area only)	None	N/A	N/A	326	195	20	195
Q	GROIN (junction of thighs and trunk)	HCND	Txxxx	Mxxx	321	180	19	180
S	BACK (between shoulder blades)	HCND	Txxxx	Mxxx	354	209	20	209
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	ExtRad	12345	Mxxx	987	N/A	N/A	N/A
B	RIGHT HAND	ExtRad	12346	Mxxx	1276	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	195	=	109.40
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	195	=	1.17
J,L	RIGHT THIGH	0.006	x	195	=	1.17
				Total Photon Effective Dose	=	206.68

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	20	=	11.22
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	20	=	0.12
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	21.38

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

	Shallow	Deep	Neutron	Eye	Ring
Doses to Enter into REX:	**375**	**207**	**21**	**250**	**880**

(See Section 6.8.4 in PML-MA-842.)

H_{skin} assessed from multi-pack:	396
H_{eye} assessed from multi-pack:	271
$H_{extremity}$ assessed from multi-pack:	1276

Data Input Name/Signature: [illegible] Date: 2/15/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date	
Test Case 4			HPT Office	
			Area	Phone
Location of Job:	Beginning Wear Date:		Comments:	
Name of Job:	End Wear Date:			

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HSD	Txxxx	Pxxx	320	302	5	302
E	HEAD (forehead-for head & neck)	None	N/A	N/A	320	302	5	302
F	ABDOMEN (below rib cage, above groin)	None	N/A	N/A	327	318	10	318
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	327	318	10	318
K	LEFT KNEE (knee area only)	HSD	Txxxx	Pxxx	380	365	15	365
L	RIGHT KNEE (knee area only)	HSD	Txxxx	Pxxx	395	380	20	380
Q	GROIN (junction of thighs and trunk)	HSD	Txxxx	Pxxx	327	318	10	318
S	BACK (between shoulder blades)	HSD	Txxxx	Pxxx	330	320	12	320
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	320	302	5	302
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	320	302	5	302
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	HSD	Txxxx	Pxxx	510	500	12	501
P	RIGHT FOOT	HSD	Txxxx	Pxxx	504	498	11	499

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	302	=	32.62
R,S	THORAX (above diaphragm) [c]	0.307	x	320	=	98.24
F,Q	ABDOMEN	0.561	x	318	=	178.40
T	LEFT UPPER ARM	0.006	x	302	=	1.81
U	RIGHT UPPER ARM	0.006	x	302	=	1.81
I,K	LEFT THIGH	0.006	x	365	=	2.19
J,L	RIGHT THIGH	0.006	x	380	=	2.28
				Total Photon Effective Dose	=	317.35

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	5	=	0.54
R,S	THORAX (above diaphragm) [c]	0.307	x	12	=	3.68
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	10	=	5.61
T	LEFT UPPER ARM	0.006	x	5	=	0.03
U	RIGHT UPPER ARM	0.006	x	5	=	0.03
I,K	LEFT THIGH	0.006	x	15	=	0.09
J,L	RIGHT THIGH	0.006	x	20	=	0.12
				Total Neutron Effective Dose	=	10.10

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

	Shallow	Deep	Neutron	Eye	Ring
Doses to Enter into REX:	405	317	10	297	107

(See Section 6.8.4 in PML-MA-842.)

H_{skin} assessed from multi-pack:	415
H_{eye} assessed from multi-pack:	307
$H_{extremity}$ assessed from multi-pack:	522

Data Input Name/Signature: [signature] Date: 2/15/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

MDCT Tool_V1.xls

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MULTIPLE DOSIMETRY CALCULATIONAL TOOL

Form # WB10-

Employee Name	PR No./HID	Contractor Code	Date	
Test Case 5			HPT Office	
			Area	Phone
Location of Job:	Beginning Wear Date:		Comments:	
Name of Job:	End Wear Date:			

Body Locations - Whole Body		Dosimeter Type	Dosimeter No.	Special Sheet No.	Shallow	Deep	Neutron	Eye
R	CHEST (required for WB)	HCND	Txxx	Lxxx	350	213	24	213
E	HEAD (forehead-for head & neck)	HCND	Txxx	Lxxx	375	250	21	250
F	ABDOMEN (below rib cage, above groin)	HCND	Txxx	Lxxx	326	195	20	195
I	LEFT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
J	RIGHT THIGH (between grion & knee)	None	N/A	N/A	450	350	100	350
K	LEFT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
L	RIGHT KNEE (knee area only)	None	N/A	N/A	450	350	100	350
Q	GROIN (junction of thighs and trunk)	HCND	Txxx	Lxxx	450	350	100	350
S	BACK (between shoulder blades)	None	N/A	N/A	350	213	24	213
T	LEFT UPPER ARM (between shoulder & elbow	None	N/A	N/A	350	213	24	213
U	RIGHT UPPER ARM (between shoulder & elb	None	N/A	N/A	350	213	24	213
Body Locations - Extremity & Other		**Dosimeter Type**	**Dosimeter No.**	**Special Sheet No.**	**Shallow**	**Deep**	**Neutron**	**Eye**
A	LEFT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
B	RIGHT HAND	None	N/A	N/A	N/A	N/A	N/A	N/A
G	LEFT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
H	RIGHT WRIST	None	N/A	N/A	N/A	N/A	N/A	N/A
M	LEFT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
N	RIGHT LOWER LEG	None	N/A	N/A	N/A	N/A	N/A	N/A
O	LEFT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A
P	RIGHT FOOT	None	N/A	N/A	N/A	N/A	N/A	N/A

EFFECTIVE DOSE FROM PHOTONS

Area of Whole Body		Compartment Factor		Dosimeter Deep Dose		E_γ Effective Dose (mrem)
E	HEAD/NECK	0.108	x	250	=	27.00
R,S	THORAX (above diaphragm) [c]	0.307	x	213	=	65.39
F,Q	ABDOMEN	0.561	x	350	=	196.35
T	LEFT UPPER ARM	0.006	x	213	=	1.28
U	RIGHT UPPER ARM	0.006	x	213	=	1.28
I,K	LEFT THIGH	0.006	x	350	=	2.10
J,L	RIGHT THIGH	0.006	x	350	=	2.10
				Total Photon Effective Dose	=	295.50

EFFECTIVE DOSE FROM NEUTRONS

Area of Whole Body		Compartment Factor		Dosimeter Neutron Dose		E_η Effective Dose (mrem)
E	HEAD (forehead)	0.108	x	21	=	2.27
R,S	THORAX (above diaphragm) [c]	0.307	x	24	=	7.37
F,Q	ABDOMEN (below rib cage, above groin) [d]	0.561	x	100	=	56.10
T	LEFT UPPER ARM	0.006	x	24	=	0.14
U	RIGHT UPPER ARM	0.006	x	24	=	0.14
I,K	LEFT THIGH	0.006	x	100	=	0.60
J,L	RIGHT THIGH	0.006	x	100	=	0.60
				Total Neutron Effective Dose	=	67.22

Dosimetry Use Only

Approved Special Configuration(s):

(Dosimetrist Name/Signature/Date)

ACES/ARACS Dose Adjusted by:

(ACES/ARACS Administrator Name/Signature/Date)

	Shallow	Deep	Neutron	Eye	Ring
Doses to Enter into REX:	**483**	**295**	**67**	**204**	**0**

(See Section 6.8.4 in PML-MA-842.)

H_{skin} assessed from multi-pack:	550
H_{eye} assessed from multi-pack:	271
$H_{extremity}$ assessed from multi-pack:	550

Data Input Name/Signature: [signature] Date: 2/15/10

Data Verification Name/Signature: Date:

REX Input Name/Signature: Date:

REX Data Verification Name/Signature: Date:

ATTACHMENT A

MDCT Spreadsheet Tool Comment Form

COMMENT FORM FOR (MDCT SPREADSHEET TOOL)

MDCT Tool V1.xls

Date Submitted:			
Type of Comment: *(Choose one)*	☐ Error Found ☐ Editorial Comment ☐ Change Requested	**Applies to:** *(Check all that apply)*	☐ MDCT Work Page Worksheet ☐ Instructions Worksheet ☐ Diagrams Worksheet
COMMENT DESCRIPTION: *(**NOTE:** For all cases, you must attach a printed copy of the MDCT Spreadsheet Tool output that documents the situation you are describing. For errors, also provide a copy of hand calculations that document the correct answer.)*			
Submitted by:			
Printed Name	**Signature**	**Date**	
DO NOT WRITE BELOW THIS LINE **– FOR USE BY SOFTWARE CUSTODIAN/PROGRAM MANAGER ONLY –**			
Date Received:	**Resolution:** ☐ Accept comment ☐ Reject comment		
Appropriate Attachments Received:	☐ Yes ☐ No ☐ N/A		
Comments:			
Date Resolved:	Resolved by:		
Date Resolution Sent to Submitter:			