COPYRIGHT

Distribution

Category UC-722

SAND98-

Unlimited Distribution

October 1, 1998

-- 8079

RADTRAN 5 USER GUIDE

K. S. Neuhauser and F. L. Kanipe
System Safety and vulnerability Assessment Department

Sandia National Laboratories

Albuquerque, NM 87185

ABSTRACT

This User Guide for the RADTRAN 5 computer code for transportation risk analysis describes basic risk concepts and provides the user with step-by-step directions for creating input files by means of either the RADDOG input file generator software or a text editor. It also contains information on how to interpret RADTRAN 5 output, how to obtain and use several types of important input data, and how to select appropriate analysis methods. Appendices include a glossary of terms, a listing of error messages, data-plotting information, images of RADDOG screens, and a table of all data in the internal radionuclide library.

/

COPYRIGHT

-- 8079

CHAPTER 1 INTRODUCTION AND OVERVIEW **1-1**

1.1 HISTORY OF RADTRAN **1-1**

1.2 FEATURES OF RADTRAN 5 1-1
1.2.1 Route-Specific Analysis *1-2*
1.2.2 Radioisotope Library File *1-2*
1.2.3 User-Definable Parameters Expanded *1-2*
1.2.4 Maximum Individual Accident Dose *1-2*
1.2.5 Ingestion Dose Model *1-2*
1.2.6 Nonradiological Fatalities *1-3*
1.3 SENSITIVITY AND UNCERTAINTY ANALYSIS 1-3
1.4 MATHEMATICAL MODELS IN RADTRAN 5 1-3
1.5 TECHNICAL INFORMATION SUMMARY 1-4
1.6 OUTLINE OF USER GUIDE 1-4

CHAPTER 2 TRANSPORTATION RISK - CONCEPTS AND OVERVIEW **2-1**

2.1 RISK AND RISK ASSESSMENT 2-1
2.2 TERMS USED IN RADIOACTIVE-MATERIAL TRANSPORTATION 2-2
2.2.1 Package and Packaging *2-2*
2.2.2 Radioactive Materials, Physical-Chemical Forms, and Radioisotopes *2-2*
2.2.3 Shipment and Related Terms *2-3*
2.3 TERMS ASSOCIATED WITH STOPS AND HANDLINGS 2-4
2.3.1 Two Options in Stop Model *2-5*
2.3.2 Separate Model for Handling and Inspection *2-6*

CHAPTER 3 CREATING AN INPUT FILE FOR RADTRAN 5 ..... **3=1**

3.1 ACCESS TO RADTRAN 5 3-1
3.1.1 The TRANSNET System *3-1*
3.1.2 Executable RADTRAN 5 ..... *3-1*
3.2 RADTRAN 5 ON TRANSNET 3-1
3.2.1 How to Access TRANSNET *3-1*
3.2.2 RADTRAN 5 Input File Generator Software (RADDOG) *3-2*
3.3 RADTRAN 5 ON A WORKSTATION OR MAINFRAME 3-5
3.3.1 Creating an Input File with a Text Editor for Personal Computers *3-5*
3.3.2 Running RADTRAN 5 on a Workstation *3-8*
3.3.3 Saving Output Files on a Workstation *3-9*
3.4 PROBLEM-SPECIFIC INPUT PARAMETERS 3-9
3.5.1 Package-Specific Parameters *3-9*
3.4.2 Vehicle-Specific Parameters *3-10*
3.4.3 Route-Specific Parameters *3-11*
3.5 RADIONUCLIDE-DATA 3-12
3.5.1 Structure of the RADTRAN 5 Radionuclide Library *3-12*
3.5.2 Isotope Names and Values and the DEFINE option *3-15*
3.6 MODSTD DATA FOR INCIDENT-FREE DOSE CALCULATION BY MODE 3-15
3.7 DATA FOR ACCIDENT RISK CALCULATION BY MODE AND MATERIAL TYPE 3-17
3.7.1 Introduction to STANDARD Values for Accident Risk Analysis *3-17*
3.7.2 Atmospheric Dispersion Parameters *3-17*
3.7.3 Other Accident Parameters with STANDARD Values *3-18*
3.9 ROLE OF THE INPUT ECHO 3-21
3.9 MASTER LIST OF RADTRAN 5 KEYWORDS 3-26

CHAPTER 4 RADTRAN 5 OUTPUT **4-1**

4.1 INPUT ECHO AND TABLES 4-1

2

COPYRIGHT

4.2 CONSEQUENCES OF INCIDENT-FREE TRANSPORTATION 4-1
4.3 POPULATION RISKS AND CONSEQUENCES FROM ACCIDENTS 4-2
4.4 EARLY FATALITY CALCULATIONS 4-6
4.4.1 Radiological Early Fatality Risk *4-6*
4.4.2 Nonradiological Fatality Risk *4-6*
4.5 INDIVIDUAL DOSE CALCULATIONS 4-6
4.5.1 Maximum Individual In-Transit Dose (incident-free) *4-6*
4.5.2 Maximum Individual Downwind Doses (following a dispersion accident) *4-7*
4.6 POPULATION DATA IN OUTPUT 4-7
4.6.1. Population within User-Specified Distance of Route *4-7*
4.6.2 Population Potentially Exposed to Radiation from Dispersed Particulates *4-7*

CHAPTER 5 ANALYSIS METHODS 5-1

5.1 PACKAGE AND SHIPMENT VALUES 5-1
5.1.1 Package and Conveyance Dimensions *5-1*
5.1.2 Package and Shipment Dose Rates *5-3*
5.1.4 Gamma and Neutron Components of Dose Rate *5-5*
5.2 MULTIPLE-RADIONUCLIDE MATERIALS 5-6
5.2.1 Assignment of Physical-Chemical Groups *5-6*
5.2.2 Using a Relative Hazard Index *5-7*
5.3 ROUTE DATA 5-9
5.3.1 Aggregate Route Segments and other Data *5-9*
5.3.2 Linear Route-Specific Analysis *5-10*
5.3.3 Non-Linear Applications *5-13*
5.3.4 Stop Data *5-13*
5.3.5 Handling Data *5-14*
5.3.6 Evacuation Time *5-15*
5.4 POST-ACCIDENT OPTIONS 5-15
5.5 OUTPUT OPTIONS 5-16
5.5.1 Output as Dose-Risks or Health-Effects Risks *5-16*
5.5.2 Nonstochastic Radiation Health Effects *5-16*
5.5.3 Unit-Risk Factors *5-18*

REFERENCES R-1

APPENDIX A GLOSSARY OF TERMS A-1

APPENDIX B INTERMEDIATE DATA AND PLOTS B-1

APPENDIX C ERROR MESSAGES C-1

APPENDIX D RADDOG SCREENS D-1

APPENDIX E RADIONUCLIDE DATA BASE ..... E 1

COPYRIGHT

Acknowledgments

The authors thank Regina Hunter, Jeremy Sprung, and Scott Mills for their thorough technical reviews and advice. We also wish to acknowledge the secretarial assistance of Marceline Jordan and Jolene Manning.