

# CONTENTS

<b>Preface</b> .....	iii
<b>Contents</b> .....	vi
<b>List of Symbols</b> .....	viii
<b>1. Introduction</b> .....	1
1.1 Applications of Neutrons in Biology and Medicine .....	1
1.2 Purpose of the Report .....	1
1.3 Neutron Interactions with Biological Matter .....	2
<b>2. Concepts and Principles</b> .....	5
2.1 Fluence and Energy Fluence .....	5
2.2 Interaction Coefficients and Kerma .....	7
2.3 Absorbed Dose .....	8
2.3.1 Energy Imparted and Absorbed Dose .....	8
2.3.2 Relation Between Absorbed Dose and Kerma .....	9
2.3.3 The Bragg-Gray Theorem .....	10
2.4 Quality .....	11
2.4.1 Linear Energy Transfer .....	11
2.4.2 Lineal Energy and Specific Energy .....	13
2.5 Interface Dosimetry .....	14
2.6 Calibration .....	16
2.7 Mixed-Field Dosimetry .....	17
2.8 Effects of Finite Size of Dosimeter .....	19
<b>3. Methods and Instrumentation</b> .....	22
3.1 Gaseous Devices .....	22
3.1.1 Ionization Chambers .....	22
3.1.2 Proportional Counters .....	27
3.1.3 Geiger-Müller Counters .....	29
3.2 Calorimeters .....	30
3.3 Solid State Devices .....	32
3.3.1 Photographic Emulsions .....	32
3.3.2 Thermoluminescent Devices .....	33
3.3.3 Scintillation Devices .....	34
3.3.4 Semiconductor Devices .....	35
3.3.5 Nuclear Track Recorders .....	37
3.4 Activation and Fission Methods .....	37
3.5 Ferrous Sulfate Dosimeters .....	40
<b>4. Monitoring</b> .....	43
4.1 Total Absorbed Dose or Neutron Absorbed Dose .....	43
4.2 Gamma-Ray Absorbed Dose .....	44
4.3 Quality .....	44
4.4 Examples of Monitoring Arrangements .....	45
<b>5. Neutron Sources</b> .....	47
5.1 Monoenergetic Sources .....	47
5.2 Polyenergetic Accelerator Sources .....	49
5.3 Reactors .....	52
5.4 Isotopic Sources .....	54
<b>6. Dosimetry for Radiobiology</b> .....	56
6.1 Specimen Composition .....	56

6.2 Charged Particle Equilibrium . . . . .	57
6.3 Geometrical Factors, Absorption, and Scattering . . . . .	60
<b>7. Dosimetry for Radiotherapy . . . . .</b>	<b>64</b>
7.1 External Beam Therapy . . . . .	64
7.1.1 Transverse Absorbed Dose Distribution . . . . .	64
7.1.2 Central Axis Absorbed Dose Distribution . . . . .	66
7.2 Interstitial and Intracavitary Therapy . . . . .	69
<b>8. Conclusions . . . . .</b>	<b>72</b>
8.1 Comparison of Dosimetry Methods . . . . .	72
8.2 Recommendations . . . . .	73
<b>APPENDIX A Kerma Factors . . . . .</b>	<b>74</b>
<b>APPENDIX B Elemental Compositions of Compounds and Mix- tures . . . . .</b>	<b>91</b>
<b>APPENDIX C Tissue-Equivalent Plastic: Properties and Fabri- cation . . . . .</b>	<b>93</b>
<b>APPENDIX D Ionization Chambers: Techniques of Construction and Measurements . . . . .</b>	<b>97</b>
<b>APPENDIX E Cross Section Data for Some Neutron Threshold Reactions . . . . .</b>	<b>102</b>
<b>References . . . . .</b>	<b>117</b>
<b>ICRU Reports . . . . .</b>	<b>129</b>
<b>Index . . . . .</b>	<b>131</b>