

Contents

Preface	iii
Contents	vi
1. Introduction	1
1.1 Purposes of the Report	1
2. Quantitative Concepts and Dosimetry in Radiobiology	3
2.1 Dosimetric Quantities	3
2.2 Quantitative Relationships in Radiobiology	3
2.2.1 Dose Effect Relationships	4
2.2.2 Cell Survival Curves	4
2.2.3 Organ and Animal Survival	7
2.2.4 Curves of Functional or Phenotypic Change	8
2.3 Damage and Repair	9
2.3.1 Repair, Repopulation and Recovery	9
2.3.2 Cell-Age Dependence	10
2.3.3 Damage Modification	10
2.4 Response Modification	12
2.4.1 Reference Conditions	12
2.4.2 Dose Modification	12
2.4.3 The Effect of Oxygen	13
2.4.4 Relative Biological Effectiveness	13
2.4.5 Gain Factor	14
2.5 Damage Interaction	14
3. Specification of Radiation Quality	16
3.1 Introduction	16
3.2 Linear Energy Transfer	16
3.3 Track Structure	17
3.4 Microdosimetric Specifications of Radiation Quality	19
3.4.1 Distributions of Lineal Energy, y	19
3.4.2 Distributions of Specific Energy, z	20
4. Determination of Absorbed Dose	22
4.1 Definition of Absorbed Dose	22
4.2 Calculation of Absorbed Dose	22
4.2.1 Absorbed Dose from Exposure	22
4.2.2 Neutron Absorbed Dose from Fluence	22
4.2.3 Absorbed Dose from Internal Emitters	23
4.3 Ionization Dosimetry	23
4.3.1 Exposure Measurements	23
4.3.2 Cavity Ionization: The Bragg-Gray Principle	23
4.4 Chemical Dosimetry	25
4.5 Other Methods of Dosimetry	25
4.6 Biological Dosimetry	26
5. Practical Aspects of Dose Distribution and Specification	27
5.1 General	27
5.2 Sources of Dose Nonuniformity in the Exposed Specimen	27

5.2.1 Nonuniformity of the Radiation Beam	27
5.2.2 Geometrical Attenuation	27
5.2.3 Absorption and Scattering in the Specimen	28
5.2.4 Scatter from Electromagnetic Particle Radiations	30
5.2.5 Charged Particle Equilibrium	30
5.2.6 Supporting Materials for Small Specimens	32
5.2.7 Atomic Composition, Entire Specimen	32
5.2.8 Atomic Composition Within Specimen	33
5.3 Variation of Output Versus Time	33
5.4 Degree of Uniformity of Exposure	34
5.5 Specification of Dosimetric Factors and Dose	34
APPENDIX A Examples of Conditions for Exposure of Biological Specimens	36
A.1 General	36
A.2 X and Gamma Rays	36
A.3 Fast Electrons	37
A.4 Fast Neutrons	40
A.5 Negative Pi Mesons	47
A.6 Heavy Ion Beams	48
APPENDIX B Glossary	53
References	58
ICRU Reports	66
Index	69