

Contents

Preface	iii
Symbols	ix
1. Introduction	1
2. Basic Principles of Gamma-Ray Spectrometry	4
2.1 Photon Interactions with Matter	4
2.2 Gamma-Ray Spectrometers	4
2.2.1 The Detector	5
2.2.2 The Electronics and Software	6
2.3 Spectrum Analysis	7
2.3.1 Detector Response Function	7
2.3.2 Peak Position and Area	8
2.4 Energy Calibration	9
2.5 Detector Peak Response as a Function of Photon Energy	10
2.6 Detector Peak Response as a Function of Angle of Incidence	11
2.7 Activity Determination	13
2.8 Quality Assurance	14
3. Ground-Level Gamma-Ray Spectrometry	15
3.1 Radionuclides in Plane Terrain	15
3.1.1 Exponential Distribution and Attenuation Coefficients	15
3.1.2 Angular Correction Factor	16
3.1.3 Fluence Rates per Unit Activity	17
3.1.4 Sensitivity and Uncertainties	21
3.1.5 <i>In situ</i> Evaluation of the Attenuation by the Ground	22
3.2 Radionuclides in Structured Terrain	24
3.3 Radionuclides in Air	25
4. Airborne Gamma-Ray Spectrometry	28
4.1 Detector Characteristics and Recording Technique	28
4.1.1 Detector Types	28
4.1.2 Recording Technique	29
4.1.3 Calibration Approaches	29
4.2 Natural Radionuclides in the Ground	31
4.2.1 IAEA Recommended Method	31
4.2.2 Future Developments	32
4.3 Anthropogenic Radionuclides on the Ground	32
4.3.1 Extending the Window Method to ^{137}Cs and ^{134}Cs	33
4.3.2 Calibration Factors and Field of View	34
4.4 Radionuclides in Air	35
4.4.1 Measurements of Radon Decay Products	36
4.4.2 Monitoring of Atmospheric Radionuclide Releases	36
5. Determination of Gamma-Ray Dose Quantities	41
5.1 Radionuclide-Specific Calculations	41
5.2 Measurement of Spectral Absorbed Dose Rate Distributions in Air	43
5.2.1 Determination of Detector Response Functions	44
5.2.2 Spectrum Unfolding	46
5.2.3 Applications	48
6. Conclusions and Recommendations	50

Appendix A: Fluences of Primary Photons in Air due to Radionuclide Distributions in the Environment	52
A.1 Radionuclides in the Ground	52
A.2 Radionuclides in the Air	53
Appendix B: Kerma-Rates in Air due to Radionuclide Distributions in the Environment	66
B.1 Radionuclides in the Ground	66
B.2 Radionuclides in the Air	66
References	69
ICRU Reports	75
Index	79

