

---

# Contents

---

<b>Acknowledgments</b> . . . . .	xi
<b>Acronyms and Abbreviations</b> . . . . .	xiii
<b>Preface</b> . . . . .	xix
<b>Chapter 1. Classification of Nuclear Accidents</b> . . . . .	1
1.1. Classification of nuclear events: incident or accident? . . . . .	1
1.2. Military classification . . . . .	3
1.3. Acknowledged, unknown and secret accidents . . . . .	6
1.4. Origin and frequency of accidents . . . . .	8
1.4.1. Origin of accidents . . . . .	8
1.4.2. Frequency of accidents. . . . .	8
<b>Chapter 2. Birth of Atomic Weapons and Their First Atrocious Applications</b> . . . . .	11
2.1. Introduction. . . . .	11
2.1.1. Discoveries of natural and artificial radioactivity . . . . .	12
2.1.2. The discovery of fission and the first nuclear reactor . . . . .	13
2.1.3. The A-bomb . . . . .	14
2.1.4. French research work before and after World War II . . . . .	15
2.2. The explosions in Hiroshima and Nagasaki: the first appalling applications of fission . . . . .	16
2.2.1. The facts . . . . .	17
2.2.2. The immediate effects (destruction of buildings) . . . . .	18
2.2.3. The environmental consequences . . . . .	20
2.2.4. Health consequences . . . . .	23

---

2.2.5. The sociological costs . . . . .	32
2.2.6. The economic costs. . . . .	33
2.3. Conclusion . . . . .	35
<b>Chapter 3. Atomic Bomb Tests . . . . .</b>	<b>37</b>
3.1. Introduction. . . . .	37
3.1.1. Test sites . . . . .	39
3.1.2. Various types of atomic tests . . . . .	42
3.1.3. Safety of atmospheric tests . . . . .	43
3.1.4. Various phases of a nuclear explosion . . . . .	43
3.2. Atmospheric atomic tests: massive voluntary releases . . . . .	44
3.2.1. A-bombs . . . . .	45
3.2.2. H-bombs . . . . .	45
3.2.3. Production of radionuclides from an explosion . . . . .	46
3.2.4. Production of particles and aerosols . . . . .	47
3.2.5. Surface deposits. . . . .	48
3.2.6. Accidents during atmospheric atomic tests. . . . .	48
3.3. Accidents during underground atomic tests . . . . .	52
3.3.1. Radioactive releases during underground tests. . . . .	52
3.3.2. Soviet accidents . . . . .	52
3.3.3. American accidents. . . . .	53
3.3.4. French accidents . . . . .	53
3.3.5. British and Chinese accidents. . . . .	54
3.4. Environmental consequences . . . . .	54
3.4.1. Geomechanical consequences . . . . .	54
3.4.2. Environmental contaminations . . . . .	55
3.5. Worldwide spatial consequences of atomic tests . . . . .	67
3.6. Health consequences . . . . .	71
3.6.1. Health consequences to military personnel. . . . .	72
3.6.2. Health consequences on workers. . . . .	73
3.6.3. Health consequences on local populations . . . . .	74
3.6.4. Health consequences on the world population . . . . .	90
3.7. Sociological consequences. . . . .	91
3.7.1. Taking into account the harm suffered from French tests . . . . .	91
3.7.2. The case of American military personnel and civilians. . . . .	94
3.7.3. Psychological illnesses related to nuclear explosions. . . . .	94
3.8. Economic impact . . . . .	95
3.8.1. Compensation for military personnel and local populations . . . . .	95
3.8.2. The cost of French tests at Mururoa and Fangataufa . . . . .	99
3.9. Conclusion . . . . .	99

---

<b>Chapter 4. Accidents Involving Deterrence</b> . . . . .	101
4.1. Introduction. . . . .	101
4.1.1. The principle of nuclear deterrence . . . . .	101
4.1.2. Acquisition of the bomb . . . . .	103
4.1.3. From massive retaliation to flexible response . . . . .	104
4.1.4. The second path to nuclear arms . . . . .	104
4.1.5. The situation in the 21st Century. . . . .	105
4.1.6. The main non-proliferation treaties . . . . .	106
4.2. Accidents involving weapons in service . . . . .	107
4.2.1. Accidents involving bombers carrying nuclear weapons. . . . .	107
4.2.2. Accidents involving submarines carrying nuclear weapons . . . . .	110
4.2.3. Missile and rocket accidents . . . . .	116
4.2.4. Accidents during armed missile tests . . . . .	117
4.2.5. Accidents involving power generators and satellites . . . . .	119
4.2.6. Various accidents . . . . .	120
4.3. Consequences for the environment . . . . .	121
4.3.1. Consequences of bomber aircraft accidents . . . . .	121
4.3.2. Consequences of submarine wrecks . . . . .	124
4.3.3. Consequences of submerged military waste . . . . .	127
4.4. Consequences for flora and fauna. . . . .	130
4.5. Consequences on human health . . . . .	131
4.6. Economic consequences: the cost of nuclear deterrence . . . . .	134
4.6.1. The American costs of nuclear deterrence . . . . .	134
4.6.2. French costs of nuclear deterrence . . . . .	139
4.6.3. British costs of nuclear deterrence . . . . .	140
4.6.4. The costs of nuclear deterrence for other nations . . . . .	140
4.7. Strike force in the future . . . . .	141
4.8. Conclusion . . . . .	144
<b>Chapter 5. Accidents Involving the Production of Atomic Weapons</b> . . . . .	145
5.1. Introduction. . . . .	145
5.2. Accidents involving plutonium production units . . . . .	151
5.2.1. The Windscale accident . . . . .	151
5.2.2. The Kyshtym accident at Mayak . . . . .	152
5.2.3. The accident at Tomsk . . . . .	154
5.2.4. The Gore accident . . . . .	155
5.3. Criticality accidents . . . . .	155
5.4. The consequences of an accident on atomic bomb storage sites . . . . .	159

---

5.5. Environmental impact . . . . .	160
5.5.1. Windscale . . . . .	160
5.5.2. Kyshtym and its surroundings . . . . .	161
5.5.3. Tomsk . . . . .	169
5.5.4. Hanford and Los Alamos . . . . .	169
5.6. Health consequences . . . . .	170
5.6.1. Windscale . . . . .	170
5.6.2. Kyshtym . . . . .	172
5.6.3. Tomsk . . . . .	179
5.6.4. Gore . . . . .	179
5.7. Costs of weapons production plants . . . . .	180
5.8. Conclusion . . . . .	182
<b>Chapter 6. Nuclear Warfare . . . . .</b>	<b>185</b>
6.1. Introduction . . . . .	185
6.2. Humanity and the legitimacy of a nuclear war . . . . .	186
6.3. The risks of a nuclear war . . . . .	187
6.3.1. Nuclear war has not taken place... but it is possible . . . . .	187
6.3.2. International crises and moments of senseless escalation . . . . .	188
6.3.3. Accidents that may trigger nuclear war . . . . .	190
6.3.4. False alarms that may trigger nuclear war . . . . .	191
6.3.5. Geopolitics and nuclear war . . . . .	192
6.4. How to avoid nuclear war . . . . .	194
6.4.1. Increased awareness and establishment of peace movements . . . . .	194
6.4.2. The Stockholm Appeal . . . . .	195
6.4.3. Limiting those that possess the bomb . . . . .	196
6.4.4. Towards a new treaty for outlawing nuclear weapons? . . . . .	196
6.4.5. Peace movements . . . . .	197
6.5. Scenarios of nuclear war . . . . .	198
6.6. The environmental impact of nuclear war . . . . .	199
6.6.1. Large-scale fires and smoke . . . . .	200
6.6.2. Dust . . . . .	201
6.6.3. Radioactive fallout . . . . .	201
6.6.4. Depletion of the stratospheric ozone layer and increase in UV rays . . . . .	201
6.6.5. Oxygen losses and increases in carbon dioxide . . . . .	202
6.6.6. Reductions in light and temperatures . . . . .	202
6.6.7. Nuclear winter . . . . .	203
6.6.8. Radioactive contamination . . . . .	204

6.7. Ecological impact of nuclear war . . . . .	205
6.8. Impact of nuclear war on health. . . . .	206
6.9. Expenditure on dismantling and destroying nuclear weapons in the United States . . . . .	207
6.10. Conclusion . . . . .	211
<b>Conclusion</b> . . . . .	213
<b>References</b> . . . . .	215
<b>Index</b> . . . . .	247