



TABLE OF CONTENTS

| | |
|---|-----------|
| STATEMENT OF ANTI PLAGIARISM | 2 |
| APPROVAL FORM..... | 3 |
| PROJECT FORM..... | 5 |
| TABLE OF CONTENTS..... | 6 |
| LIST OF FIGURES..... | 7 |
| LIST OF TABLES..... | 8 |
| ABSTRACT..... | 9 |
| 1 Introduction | 10 |
| 1.1 <i>Introduction to IRSN</i> | 10 |
| 1.1.1 Introduction to LPMA | 11 |
| 1.1.2 Introduction to EPICEA | 12 |
| 1.2 <i>Objectives and Goals</i> | 14 |
| 1.3 <i>Scope and Limit.....</i> | 14 |
| 2 General Introduction | 15 |
| 2.1 <i>Aerosol.....</i> | 15 |
| 2.1.1 Definition..... | 15 |
| 2.1.2 Classification | 16 |
| 2.1.3 Radioactive Aerosols | 17 |
| 2.2 <i>Alpha particles</i> | 18 |
| 2.2.1 Sources | 18 |
| 2.2.2 Alpha measurement | 20 |
| 2.3 <i>Continuous Airborne Monitor - CAM</i> | 21 |
| 2.4 <i>Geant4 Description.....</i> | 23 |
| 2.5 <i>Monte-Carlo method.....</i> | 24 |
| 3 Methodology..... | 27 |
| 4 Results and Discussions..... | 31 |
| 4.1 <i>Detector window entry determination.....</i> | 31 |
| 4.2 <i>Block versus spheres simulations.....</i> | 33 |
| 4.3 <i>Spectrum as the sum of different effects</i> | 36 |
| 4.4 <i>Mass deposition increases</i> | 40 |
| 5 Conclusion and Recommendation | 43 |
| 5.1 <i>Conclusion</i> | 43 |
| 5.2 <i>Recommendation.....</i> | 44 |
| REFERENCES | 45 |
| APPENDICES | 47 |
| Appendix 1: <i>The ABPM203M</i> | 47 |
| Appendix 2: <i>Simulation geometry</i> | 48 |



LIST OF FIGURES

| | |
|--|----|
| Figure 1: ICARE test bench at EPICEA..... | 13 |
| Figure 2: Electron micrographs of various aerosol particles. (a) aerosols particles formed a folded chain-like aggregate; (b) droplets evaporated in the electron microscope, (Maiello, Mark L. ; Hoover, 2011)..... | 15 |
| Figure 3: The number distribution of an average urban model aerosol showing a fit to a power law distribution and as the sum of three lognormal distributions, (Kulkarni et al., 2011)..... | 16 |
| Figure 4: Process of radon progeny in air, (Papastefanou, 2008)..... | 17 |
| Figure 5: Radon-222 decay series (Maiello, Mark L. ; Hoover, 2011) | 18 |
| Figure 6: Deposition process of Po-218, (Papastefanou, 2008) | 19 |
| Figure 7: Alpha aerosols measurement | 20 |
| Figure 8: Multiple entry ways to human respiratory system, (Maiello, Mark L. ; Hoover, 2011)..... | 22 |
| Figure 9: Configuration of CAM head, (Maiello, Mark L. ; Hoover, 2011) | 22 |
| Figure 10: Neutron interaction processes in fission material | 25 |
| Figure 11: Simulation geometry Z-axis | 27 |
| Figure 12: Whole geometry; front view (left figure); side view (right figure)..... | 28 |
| Figure 13: Source distribution in the simulation | 28 |
| Figure 14: Spheres distribution approach (with 1000 spheres) | 30 |
| Figure 15: Variation of detector window value | 31 |
| Figure 16: Ideal SiO ₂ window simulation result vs experiment..... | 32 |
| Figure 17: Ideal Al ₂ O ₃ window simulation result vs experiment | 32 |
| Figure 18: Comparison between ideal value of SiO ₂ and Al ₂ O ₃ | 33 |
| Figure 19: Comparison between block approach vs experiment..... | 33 |
| Figure 20: Comparison between sphere particles vs experiment | 34 |
| Figure 21: Sphere distribution along the Z-axis | 34 |
| Figure 22: Alpha energy spectra from a surface barrier detector from 5.49 MeV alphas with no absorber, alpha passing 2.6 mg/cm ² aluminum placed over the source; and from 2.6 mg/cm ² fiberglass filters placed over the source | 35 |
| Figure 23: Energy shift caused by homogeneous block | 36 |
| Figure 24: Comparison of homogeneous block and first block approach | 37 |
| Figure 25: Comparison of first block approach and second block approach | 38 |
| Figure 26: Comparison of the second block approach and third block approach . | 38 |
| Figure 27: Alpha interactions between blocks | 39 |
| Figure 28: Increasing mass for the block approach..... | 40 |
| Figure 29: Increasing mass in the experimental data | 41 |
| Figure 30: Stacked of distributed spheres..... | 41 |
| Figure 31: Increasing mass for the sphere distribution approach | 42 |
| Figure 32: ABPM203M..... | 47 |



LIST OF TABLES

| | |
|---|----|
| Table 1: The three block approaches | 37 |
| Table 2: Characteristic of ABPM203M..... | 47 |
| Table 3: Characteristics of the ABPM203M threshold | 47 |
| Table 4: The materials and dimensions of the geometry | 48 |