

# CONTENTS

Abstract	vii
Zusammenfassung	ix
1 INTRODUCTION	1
1.1 Responsibility	1
1.2 Radioactive Waste Inventories	2
1.3 Scope of this Thesis	6
2 SPENT FUEL	9
2.1 Nagra Fuel Characterization Methodology	10
2.1.1 TRITON Sequence	10
2.1.2 Model Assumptions and Optimization	13
2.1.3 Validation	14
2.2 Ongoing developments of the Nagra Fuel Characterization Methodology	15
2.2.1 Polaris Methods	15
2.2.2 Speed comparison between TRITON and Polaris	21
2.2.3 Outstanding challenges	22
2.3 Swiss Nuclear Power Plants: Studsvik CMS	23
2.4 Benchmark of SNF against Polaris	24
2.4.1 Scope	24
2.4.2 Code sequences	25
2.4.3 Results	25
2.5 Approaches to High-Fidelity Fuel Characterization for Waste Disposal	27
3 DECOMMISSIONING WASTE	29
3.1 Previous approaches	30
3.1.1 Interpolated Isolines Approach	30
3.1.2 Rotationally-symmetric Monte Carlo Approach	30
3.2 New Activation Code Sequence	35
3.2.1 Detailed three-dimensional models	37
3.2.2 New Hybrid Activation Methodology	43
3.2.3 ALGOPACK Optimized Packaging	50
3.3 Variance Reduction	54
3.3.1 Cell-splitting	54
3.3.2 MCNP Weight Window Generator	55
3.3.3 ADVANTG	57
3.3.4 DXTRAN Spheres	64
3.3.5 Techniques of Choice	65
3.4 Validation	66
3.4.1 Neutron Transport Validation	66
3.4.2 Activation Validation	74
3.4.3 Validation Summary	80
3.5 Results Application	81
3.5.1 Segmentation and Packaging Planning	81
3.5.2 Decay Storage Analysis	83

3.5.3	Dose Rate Calculations	84
3.6	Future Outlook	85
4	REACTOR WASTE	87
4.1	Total Activity Estimation	88
4.2	Nuclide Vector Determination	89
4.3	Activity Distribution Reconstruction	90
4.4	Numerical Instabilities	93
4.5	Overall Summary	95
5	CONCLUSION	97
	Appendices	99
A	ON THE USE OF COLOR	101
	Bibliography	117
	Curriculum Vitae	129