ABSTRACT

This document describes and quantitatively evaluates the effects of various factors on the detection sensitivity of commercially available portable field instruments being used to conduct radiological surveys in support of decommissioning. The U.S. Nuclear Regulatory Commission (NRC) has amended its regulations to establish residual radioactivity criteria for decommissioning of licensed nuclear facilities. In support of that rulemaking, the Commission has prepared a Generic Environmental Impact Statement (GEIS), consistent with the National Environmental Policy Act (NEPA). The effects of this new rulemaking on the overall cost of decommissioning are among the many factors considered in the GEIS. The overall cost includes the costs of decontamination, waste disposal, and radiological surveys to demonstrate compliance with the applicable guidelines. An important factor affecting the costs of such radiological surveys is the minimum detectable concentration (MDC) of field survey instruments in relation to the residual radioactivity criteria. The purpose of this study was two-fold. First, the data were used to determine the validity of the theoretical minimum detectable concentrations (MDCs) used in the GEIS. Second, the results of the study, published herein, provide guidance to licensees for (a) selection and proper use of portable survey instruments and (b) understanding the field conditions and the extent to which the capabilities of those instruments can be limited. The types of instruments commonly used in field radiological surveys that were evaluated included, in part, gas proportional, Geiger-Mueller (GM), zinc sulfide (ZnS), and sodium iodide (NaI) detectors.

CONTENTS

Section Page

ABSTRACT iii
ABBREVIATIONS xi
ACKNOWLEDGMENTS xii
FOREWORD xiii

1 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Need for This Report 1-1
1.3 Scope 1-2
1.4 Methodology 1-3

2 INSTRUMENTATION 2-1
2.1 Gas Proportional Detectors 2-1
2.2 Geiger-Mueller Detectors 2-1
2.3 Zinc Sulfide Scintillation Detectors 2-1
2.4 Sodium Iodide Scintillation Detectors 2-2
2.5 Ratemeter-Scalers 2-2
2.6 Pressurized Ionization Chamber 2-2
2.7 Portable Gamma Spectrometer 2-2
2.8 Laboratory Instrumentation 2-2
2.9 Additional Instrumentation 2-3

3 STATISTICAL INTERPRETATIONS OF MINIMUM DETECTABLE CONCENTRATIONS 3-1
3.1 MDC Fundamental Concepts 3-1
3.2 Review of MDC Expressions 3-6

4 VARIABLES AFFECTING INSTRUMENT MINIMUM DETECTABLE CONCENTRATIONS 4-1
4.1 Radionuclide Sources for Calibration 4-2
4.2 Source-to-Detector Distance 4-3
4.3 Window Density Thickness 4-4
4.4 Source Geometry Factors 4-5
4.5 Ambient Background Count Rate 4-6

5 VARIABLES AFFECTING MINIMUM DETECTABLE CONCENTRATIONS IN THE FIELD 5-1
5.1 Background Count Rates for Various Materials 5-1
5.2 Backscatter Effects 5-2
5.3 Effects of Surface Condition on Detection Sensitivity 5-3
5.3.1 Surface Preparation 5-3
5.3.2 Measurement Results for Various Surface Types 5-4
5.4 Attenuation Effects of Overlaying Material (Self-Absorption) 5-6
5.4.1 Methodology 5-6

Section Page

5.4.2 Measurement of Various Surface Coatings 5-8
5.5 Use of Alpha and/or Beta Measurements to Assess Surface Activity 5-10

6 HUMAN PERFORMANCE AND SCANNING SENSITIVITY 6-1
6.1 Introduction 6-1
6.2 Review of Scanning Sensitivity Expressions and Results 6-2
6.3 Signal Detection Theory 6-4
6.4 Human Factors and Two Stages of Scanning 6-5
6.5 The Ideal Observer Paradigm 6-6
6.6 Actual Surveyor Performance - Field Tests and Computer Simulations 6-7
6.6.1 Field Tests of Surveyor Performance 6-7
6.6.1.1 General Methodology of Field Tests 6-7
6.6.1.2 Field Test Results 6-8
6.6.2 Computer Simulation Tests of Surveyor Performance 6-9
6.6.2.1 Adaptive Procedure 6-9
6.6.2.2 Confidence Ratings Procedure 6-10
6.6.2.3 Continuous Monitoring Procedure 6-10
6.6.2.4 General Discussion 6-11
6.7 Estimation of Scan Minimum Detectable Count Rates (MDCRs) 6-11
6.7.1 Determination of MDCR and Use of Surveyor Efficiency 6-11
6.7.2 Review of Assumptions and Results 6-14
6.8 Scan MDCs for Structure Surfaces and Land Areas 6-15
6.8.1 Scan MDCs for Building/Structure Surfaces 6-15
6.8.2 Scan MDCs for Land Areas 6-17

7 *IN SITU* GAMMA SPECTROMETRY AND EXPOSURE RATE MEASUREMENTS . . . 7-1
7.1 *In Situ* Gamma Spectrometry Measurements in Outdoor Test Area 7-1
7.2 Exposure Rate Measurements in Outdoor Test Area 7-2

8 LABORATORY INSTRUMENTATION DETECTION LIMITS 8-1
8.1 Review of Analytical Minimum Detectable Concentrations 8-1
8.2 Background Activities for Various Soil Types 8-1
8.3 Effects of Soil Condition on MDC 8-2
8.3.1 Effects of Soil Moisture on MDC 8-3
8.3.2 Effects of Soil Density on MDC 8-4
8.3.3 Effects of High-Z Materials on MDC 8-4

9 REFERENCES 9-1

TABLES

Table		Page
3.1	MDC Results for Data Obtained From Gas Proportional Detector Using Various MDC Expressions	3-7
4.1	Characteristics of Radionuclide Sources Used for Calibration and Static Measurements	4-7
4.2	Average Total Efficiencies for Various Detectors and Radionuclides	4-8
4.3	Minimum Detectable Concentrations for Various Detectors and Radionuclides	4-9
4.4	Instrument Efficiencies	4-10
4.5	Source-to-Detector Distance Effects for β Emitters	4-11
4.6	Source-to-Detector Distance Effects for α Emitters	4-11
4.7	Minimum Detectable Concentrations for Various Source-to-Detector Distances for β Emitters	4-12
4.8	Minimum Detectable Concentrations for Various Source-to-Detector Distances for α Emitters	4-13
4.9	Window Density Thickness Effects for β Emitters	4-14
4.10	Minimum Detectable Concentrations for Various Window Density Thicknesses	4-15
4.11	Source Geometry Effects on Instrument Efficiency	4-16
4.12	Ambient Background Effects	4-17
5.1	Background Count Rate for Various Materials	5-14
5.2	Minimum Detectable Concentrations for Various Materials	5-15
5.3	Efficiencies and Backscatter Factors for SrY-90	5-16
5.4	Surface Material Effects on Source Efficiency for Tc-99 Distributed on Various Surfaces	5-17
5.5	Surface Material Effects on Source Efficiency for Th-230 Distributed on Various Surfaces	5-18
5.6	Surface Material Effects on MDC for Tc-99 and Th-230 Distributed on Various Surfaces	5-19
5.7	Effects of Oil Density Thickness on Source Efficiency and MDC (Gas Proportional—α + β)	5-20
5.8	Effects of Paint Density Thickness on Source Efficiency and MDC (Gas Proportional—α + β)	5-21
5.9	Effects of Paint Density Thickness on Source Efficiency and MDC (Gas Proportional—α-only)	5-22
5.10	Effects of Paint Density Thickness on Source Efficiency and MDC (Gas Proportional—β-only)	5-23
5.11	Effects of Paint Density Thickness on Source Efficiency and MDC (GM Detector)	5-24
5.12	Effects of Paint Density Thickness on Source Efficiency and MDC (ZnS Scintillation Detector)	5-25
5.13	Effects of Dust Density Thickness on Source Efficiency and MDC (Gas Proportional—α + β)	5-26
5.14	Effects of Dust Density Thickness on Source Efficiency and MDC (Gas Proportional—α only)	5-27

Table Page

5.15 Effects of Dust Density Thickness on Source Efficiency and MDC (Gas Proportional—β only) 5-28
5.16 Effects of Dust Density Thickness on Source Efficiency and MDC (GM Detector) 5-29
5.17 Effects of Dust Density Thickness on Source Efficiency and MDC (ZnS Scintillation Detector) 5-30
5.18 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—α+β/C-14) 5-31
5.19 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—α+β/Tc-99) 5-32
5.20 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—α+β/SrY-90) 5-33
5.21 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—α-only) 5-34
5.22 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—β-only/C-14) 5-35
5.23 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—β-only/Tc-99) 5-36
5.24 Effects of Water Density Thickness on Source Efficiency and MDC (Gas Proportional—β-only/SrY-90) 5-37
5.25 Effects of Water Density Thickness on Source Efficiency and MDC (GM Detector/C-14) 5-38
5.26 Effects of Water Density Thickness on Source Efficiency and MDC (GM Detector/Tc-99) 5-39
5.27 Effects of Water Density Thickness on Source Efficiency and MDC (GM Detector/SrY-90) 5-40
5.28 Effects of Water Density Thickness on Source Efficiency and MDC (ZnS Scintillation Detector) 5-41
5.29 Total Efficiencies for Detectors Used To Assess Uranium Surface Activity 5-42
5.30 Normalized Total Efficiencies for Processed Uranium With Various Absorber Thicknesses 5-43
5.31 Detector Efficiency for Low Enriched Uranium (3%) Using a 126-cm^2 Proportional Detector with a 0.4 mg cm^{-2} Window (Gas Proportional—α + β) 5-43
5.32 Detector Efficiency for Low Enriched Uranium (3%) Using a 126-cm^2 Proportional Detector with a 3.8 mg cm^{-2} Window (Gas Proportional—β-only) 5-44
6.1 Values of d' for Selected True Positive and False Positive Proportions 6-23
6.2 Scanning Sensitivity (MDCR) of the Ideal Observer for Various Background Levels 6-23
6.3 NaI Scintillation Detector Count Rate Versus Exposure Rate (cpm per μR/h) 6-24
6.4 NaI Scintillation Detector Scan MDCs for Common Radiological Contaminants 6-25
7.1 *In Situ* Gamma Spectrometry Data From Outdoor Test Area 7-4
7.2 Exposure Rate Measurements From Outdoor Test Area 7-5

Table | Page

8.1 Typical Radionuclide Concentrations Found in Background Soil Samples in the United States 8-5
8.2 Effects of Moisture Content on Gamma Spectrometry Analyses 8-6
8.3 Effects of High-Z Content on Gamma Spectrometry Analyses 8-7

FIGURES

Figure

3.1 Critical Level, L_C 3-8
3.2 Detection Limit, L_D 3-8
4.1 MDCs for Gas Proportional Detector (α+β Mode) for Various Radionuclides 4-18
4.2 MDCs for GM Detector for Various Radionuclides 4-18
4.3 Source-to-Detector Distance Effects on MDC for Higher Energy β Emitters 4-19
4.4 Source-to-Detector Distance Effects on MDC for Lower Energy β Emitters 4-19
4.5 Source-to-Detector Distance Effects on MDC for α Emitters 4-20
4.6 Effects of Window Density Thickness on Total Efficiency for Higher Energy β Emitters 4-20
4.7 Effects of Window Density Thickness on Total Efficiency for Lower Energy β Emitters 4-21
4.8 Effects of Window Density Thickness on MDC for Higher Energy β Emitters 4-21
4.9 Effects of Window Density Thickness on MDC for Lower Energy β Emitters 4-22
4.10 Effects of Ambient Background on MDC Calculation 4-22
5.1 Effect of Surface Material on Gas Proportional Detector (α only) MDC 5-45
5.2 Effect of Surface Material on Gas Proportional Detector (β-only) MDC 5-45
5.3 Effects of Oil Density Thickness on Source Efficiency for Various Sources 5-46
5.4 Effects of Oil Density Thickness on MDC for Various Sources 5-46
5.5 Effects of Paint Density Thickness on Source Efficiency (Gas Proportional - α + β) 5-47
5.6 Effects of Paint Density Thickness on Source Efficiency (Gas Proportional - α-Only) 5-47
5.7 Effects of Paint Density Thickness on Source Efficiency (Gas Proportional - β-Only) 5-48
5.8 Effects of Paint Density Thickness on Source Efficiency (GM Detector) 5-48
5.9 Effects of Paint Density Thickness on Source Efficiency (ZnS Scintillation Detector) 5-49
5.10 Effects of Dust Density Thickness on Source Efficiency (Gas Proportional - α + β) 5-49
5.11 Effects of Dust Density Thickness on Source Efficiency (Gas Proportional - α-Only) 5-50
5.12 Effects of Dust Density Thickness on Source Efficiency (Gas Proportional - β-Only) 5-50

Figure Page

5.13 Effects of Dust Density Thickness on Source Efficiency (GM Detector) 5-51
5.14 Effects of Dust Density Thickness on Source Efficiency (ZnS Scintillation Detector) 5-51
5.15 Effects of Water Density Thickness on Source Efficiency (Gas Proportional - α + β) 5-52
5.16 Effects of Water Density Thickness on Source Efficiency (Gas Proportional - α-Only) 5-52
5.17 Effects of Water Density Thickness on Source Efficiency (Gas Proportional - β-Only) 5-53
5.18 Effects of Water Density Thickness on Source Efficiency (GM Detector) 5-53
5.19 Effects of Water Density Thickness on Source Efficiency (ZnS Scintillation Detector) 5-54
5.20 Effects of Dust Density Thickness on MDC for Various Sources Using the Gas Proportional Detector in α + β and α-only modes 5-54
5.21 Effects of Dust Density Thickness on MDC for Various Sources Using the Gas Proportional Detector in β-Only mode 5-55
5.22 Effects of Dust Density Thickness on MDC for Various Sources Using the GM Detector 5-55
5.23 Effects of Dust Density Thickness on MDC for an Alpha Source Using the ZnS Scintillation Detector 5-56
5.24 Overall Effects of Paint, Dust, and Water Density Thickness on Source Efficiency for Various Sources Using the Gas Proportional Detector in β-only mode 5-56
6.1 Signal Detection Theory Measures of Sensitivity (d') and Criterion Shown Relative to Assumed Underlying Distributions 6-26
6.2 Relative Operating Characteristic (Ideal Observer) for Detection of 120 cpm (Net) in a Background of 60 cpm; Observation Intervals of 1 Second and 4 Seconds 6-26
6.3 Instructions Provided to Field Survey Test Participants for Indoor GM Scans 6-27
6.4 Scale Map of the Wall Showing Location, Extent, and Radiation Levels of Hidden Sources for GM Scans 6-28
6.5 Scale Map of the Wall Showing Location, Extent, and Radiation Levels of Hidden Sources for Gas Proportional Scans 6-28
6.6 Scale Map of the Outdoor Scan Test Area Showing Location, Extent, and Radiation Levels of Hidden Sources for NaI Scans 6-29
7.1 Co-60 *In Situ* Gamma Spectrometry Results in Outdoor Test Area 7-6
7.2 Exposure Rate Measurements in the Outdoor Test Area 7-7
8.1 Efficiency vs. Energy for Various Densities 8-8

ABBREVIATIONS

ANL	Argonne National Laboratory
ANSI	American National Standards Institute, Inc.
BNL	Brookhaven National Laboratory
DCGL	derived concentration guideline level
dpm	disintegrations per minute
EML	Environmental Measurements Laboratory (U.S. Dept. of Energy)
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
FIDLER	Field Instrument for the Detection of Low Energy Radiation
GEIS	Generic Environmental Impact Statement
GM	Geiger-Mueller
LARADS	laser assisted ranging and data system
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
NaI	sodium iodide
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
PNNL	Pacific Northwest National Laboratory
PIC	pressurized ionization chamber
ROC	relative operating characteristic
TEDE	total effective dose equivalent
USRADS	ultrasonic ranging and data system
ZnS	zinc sulfide

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FOREWORD

The NRC has amended its regulations to establish residual radioactivity criteria for decommissioning of licensed nuclear facilities. In support of that rulemaking, the Commission has prepared a Generic Environmental Impact Statement (GEIS), consistent with the National Environmental Policy Act (NEPA). The effects of this new rulemaking on the overall cost of decommissioning are among the many factors considered in the GElS. The overall cost includes the costs of decontamination, waste disposal, and radiological surveys to demonstrate compliance with the applicable guidelines.

An important factor affecting the costs of such radiological surveys is the minimum detectable concentration (MDC) of field survey instruments in relation to the residual contamination guidelines. This study provides guidance to licensees for (a) selection and proper use of portable survey instruments and (b) understanding the field conditions and the extent to which the capabilities of those instruments can be limited. The types of instruments commonly used in field radiological surveys that were evaluated include, in part, gas proportional, Geiger-Mueller (GM), zinc sulfide (ZnS), and sodium iodide (NaI) detectors. This report describes and quantitatively evaluates the effects of various factors on the detection sensitivity of commercially available portable field instruments being used to conduct radiological surveys in support of decommissioning.

The initial draft of this report was published in August 1995. In response to the comments received, substantial revisions were made to include modifications to the scan MDC approach and the determination of instrument sensitivity for uranium and thorium decay series. The results, approaches and methods described herein are provided for information only.

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