

A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys

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ABSTRACT

This report describes a nonparametric statistical methodology for the design and analysis of final status decommissioning surveys in support of the final rulemaking on Radiological Criteria for License Termination published by the Nuclear Regulatory Commission in the *Federal Register* on July 21, 1997. The techniques described are expected to be applicable to a broad range of circumstances, but do not preclude the use of alternative methods as particular situations may warrant. Nonparametric statistical methods for testing compliance with decommissioning criteria are provided both for the case in which the radionuclides of concern occur in background and also for the case in which they do not occur in background. The tests described are the Sign test, the Wilcoxon Rank Sum test, and a Quantile test. These tests are performed in conjunction with an Elevated Measurement Comparison to provide confidence that the radiological criteria specified for license termination are met. The Data Quality Objectives process is used for the planning of final site surveys. This includes methods for determining the number of samples needed to obtain statistically valid comparisons with decommissioning criteria and the methods for conducting the statistical tests with the resulting sample data.

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ABBREVIATIONS

ALARA	as low as is reasonably achievable
CFR	Code of Federal Regulations
DCGL	Derived Concentration Guideline Level
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
EMC	elevated measurement comparison
EPA	U.S. Environmental Protection Agency
LBGR	Lower Boundary of the Gray Region
MCA	multichannel analyzer
MDC	minimum detectable concentration
NIST	National Institute for Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
PC	personal computer
PDL	predicted dose level
PIC	pressurized ionization chamber
QA	quality assurance
QC	quality control
TEDE	total effective dose equivalent
WRS	Wilcoxon Rank Sum Test
WSR	Wilcoxon Signed Ranks Test

FOREWORD

The NRC has amended its regulations to establish residual radioactivity criteria for decommissioning of licensed nuclear facilities. As part of this initiative, the NRC staff has evaluated the application of nonparametric statistical methods as an alternative to the parametric statistical approach described in the U.S. Nuclear Regulatory Commission (NRC) draft report NUREG/CR-5849 (1992), entitled, "Manual for Conducting Radiological Surveys in Support of License Termination." The nonparametric statistical approach described in this report is expected to be simpler and more cost-effective for the design and analysis of final status decommissioning surveys when radiological criteria for decommissioning approach background radiation levels. This report also shows the advantages of using the Data Quality Objectives process as it relates to the planning and analysis of final site surveys. The application of the proposed DQO process includes methods for determining the number of samples needed to obtain statistically valid comparisons with decommissioning criteria and the methods for conducting the statistical tests with the resulting sample data.

The initial draft of this report was published in August 1995. As a result of the comments received, extensive revisions were made to include alternative scenarios for statistical hypothesis testing. A number of new concepts have been introduced, and examples for some special cases have been added. The results, approaches and methods described herein are provided for information only.

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