TABLE OF CONTENTS

Section Page
K. Long-Term Radiological Impact Analysis for the No-Action Alternative K-1

K.1 Introduction K-1

K.2 Analytical Methods K-3
K.2.1 General Methodology K-4
K.2.1.1 Concrete Storage Module Degradation K-5
K.2.1.2 Storage Canister Degradation K-7
K.2.1.3 Infiltration K-9
K.2.1.4 Cladding K-9
K.2.1.4.1 Commercial Spent Nuclear Fuel Cladding K-9
K.2.1.4.2 DOE Spent Nuclear Fuel Cladding K-12
K.2.1.5 Dissolution of Spent Nuclear Fuel and High-Level Radioactive Waste K-12
K.2.1.5.1 Commercial Spent Nuclear Fuel Dissolution K-12
K.2.1.5.2 DOE Spent Nuclear Fuel Dissolution K-12
K.2.1.5.3 High-Level Radioactive Waste Dissolution K-12
K.2.1.6 Regionalization of Sites for Analysis K-12
K.2.2 Radionuclide Release K-13
K.2.3 Environmental Transport of Radioactive Materials K-14
K.2.3.1 Groundwater Transport K-16
K.2.3.2 Surface-Water Transport K-19
K.2.3.3 Atmospheric Transport K-20
K.2.4 Human Exposure and Dose Calculations K-20
K.2.4.1 Gardener Impacts K-21
K.2.4.2 Direct Exposure K-24
K.2.5 Accident Methodology K-24
K.2.5.1 Aircraft Crash K-25
K.2.5.2 Criticality K-26

K.3 Results K-28
K.3.1 Radiological Impacts K-28
K.3.2 Unusual Events K-34
K.3.2.1 Accident Scenarios K-34
K.3.2.2 Sabotage K-34

K.4 Uncertainties K-35
K.4.1 Societal Values, Natural Events, and Improvements in Technology K-35
K.4.1.1 Societal Values K-35
K.4.1.2 Changes in Natural Events K-35
K.4.1.3 Improvements in Technology K-36
K.4.2 Changes in Human Behavior K-36
K.4.3 Mathematical Representations of Physical Processes and of the Data Input K-37
K.4.3.1 Waste Package and Material Degradation K-37
K.4.3.2 Human Health Effects K-40
K.4.3.3 Accidents and Their Uncertainty K-41
K.4.4 Uncertainty Summary K-41

References K-42

LIST OF TABLES

Table Page
K-1 Time after the assumed loss of effective institutional control at which first failures would occur and radioactive materials could reach the accessible environment K-9
K-2 Average regional precipitation K-9
K-3 Proposed Action and Module 1 quantities of spent nuclear fuel and canisters of high-level radioactive waste in each geographic region K-13
K-4 Radionuclides and relative contributions over 10,000 years to Scenario 2 impacts K-14
K-5 Multimedia Environmental Pollutant Assessment System default elemental equilibrium adsorption coefficients for soil pH between 5 and 9 ..... K-17
K-6 Regional source terms and environmental transport data for important isotopes used for collective drinking water radiological impact analysis K-18
K-7 Transport and population data for drinking water pathway impact analysis K-18
K-8 Multimedia Environmental Pollutant Assessment System regional groundwater input parameters K-19
K-9 Multimedia Environmental Pollutant Assessment System human exposure input parameters for determination of all pathways radiological impacts sensitivity analysis K-22
K-10 Multimedia Environmental Pollutant Assessment System groundwater transport input parameters for estimating radiological impacts to the onsite and near-site gardener K-23
K-11 Estimated collective radiological impacts to the public from continued storage of Proposed Action and Module 1 inventories of spent nuclear fuel and high-level radioactive waste at commercial and DOE storage facilities – Scenario 2 ..... K-29
K-12 Estimated internal dose rates and year of peak exposure for the onsite and near-site gardeners – Scenario 2 ..... K-32
K-13 Estimated external peak dose rates for the onsite and near-site gardeners – Scenario 2 ..... K-33
K-14 Consequences of aircraft crash onto degraded spent nuclear fuel concrete storage module K-34
K-15 Review of approaches, assumptions, and related uncertainties K-38

LIST OF FIGURES

Figure Page
K-1 Primary steps and processes involved in the degradation of the engineered barrier system K-5
K-2 No-Action Alternative analysis regions K-6
K-3 Failure times for above-ground concrete storage modules K-8
K-4 Precipitation ranges for regions with existing spent nuclear fuel and high-level radioactive waste storage facilities K-10
K-5 Percent of commercial spent nuclear fuel exposed over time due to new failures K-11
K-6 Potential exposure pathways associated with degradation of spent nuclear fuel and high-level radioactive waste K-15
K-7 Major waterways near commercial and DOE sites K-30
K-8 Regional collective dose from the Proposed Action inventory under No-Action Scenario 2 ..... K-31
K-9 Total potential latent cancer fatalities throughout the United States from the Proposed Action inventory under No-Action Scenario 2 ..... K-31