

# TABLE OF CONTENTS

|   | Page |
|---|------|
| ABSTRACT .....  | iii  |
| DEFINITIONS .....   | xi   |
| INTRODUCTION .....  | xv   |
| <br>  |      |
| 1.0 GENERAL DESCRIPTION .....   | 1-1  |
| <br>  |      |
| I. Review Objective .....   | 1-1  |
| II. Areas of Review .....   | 1-1  |
| III. Regulatory Requirements .....  | 1-1  |
| 1. General Description and Operational Features .....                             | 1-1  |
| 2. Drawings .....   | 1-1  |
| 3. DCSS Contents .....  | 1-1  |
| 4. Qualifications of the Applicant .....  | 1-1  |
| 5. Quality Assurance .....  | 1-2  |
| 6. Consideration of 10 CFR Part 71 Requirements Regarding Transportation .....    | 1-2  |
| <br>  |      |
| IV. Acceptance Criteria .....   | 1-2  |
| 1. DCSS Description and Operational Features .....                                | 1-2  |
| 2. Drawings .....   | 1-2  |
| 3. DCSS Contents .....  | 1-2  |
| 4. Discussion of Organizational Roles .....                                       | 1-2  |
| 5. Quality Assurance .....  | 1-2  |
| 6. Consideration of 10 CFR Part 71 Requirements Regarding Transportation .....    | 1-3  |
| <br>  |      |
| V. Review Procedures .....  | 1-3  |
| 1. DCSS Description and Operational Features .....                                | 1-3  |
| 2. Drawings .....   | 1-3  |
| 3. DCSS Contents .....  | 1-4  |
| 4. Qualifications of the Applicant .....  | 1-4  |
| 5. Quality Assurance .....  | 1-4  |
| 6. Consideration of 10 CFR Part 71 Requirements Regarding Transportation .....    | 1-4  |
| <br>  |      |
| VI. Evaluation Findings .....   | 1-5  |
| VII. References .....   | 1-5  |
| <br>  |      |
| 2.0 PRINCIPAL DESIGN CRITERIA .....   | 2-1  |
| <br>  |      |
| I. Review Objective .....   | 2-1  |
| II. Areas of Review .....   | 2-1  |
| III. Regulatory Requirements .....  | 2-1  |
| 1. Structures, Systems and Components Important to Safety .....                   | 2-1  |
| 2. Design Bases for Structures, Systems, and Components Important to Safety ..... | 2-2  |
| 3. Design Criteria for Safety Protection Systems .....                            | 2-2  |
| <br>  |      |
| IV. Acceptance Criteria .....   | 2-4  |

|      |  |      |
|------|--|------|
| 1.   | Structures, Systems and Components Important to Safety .....                                     | 2-4  |
| 2.   | Design Bases for Structures, Systems, and Components Important to Safety .....                   | 2-4  |
| 3.   | Design Criteria for Safety Protection Systems .....  | 2-5  |
| V.   | Review Procedures .....  | 2-6  |
| 1.   | Structures, Systems and Components Important to Safety .....                                     | 2-6  |
| 2.   | Design Bases for Structures, Systems, and Components Important to Safety .....                   | 2-6  |
| 3.   | Design Criteria for Safety Protection Systems .....  | 2-11 |
| VI.  | Evaluation Findings .....  | 2-12 |
| VII. | References .....   | 2-16 |
| 3.0  | STRUCTURAL EVALUATION .....  | 3-1  |
| I.   | Review Objective .....   | 3-1  |
| II.  | Areas of Review .....  | 3-1  |
| III. | Regulatory Requirements .....  | 3-1  |
| IV.  | Acceptance Criteria .....  | 3-2  |
| 1.   | Confinement Cask .....   | 3-2  |
| 2.   | Reinforced Concrete Structures Important to Safety, but not within the<br>Scope of ACI 359 ..... | 3-3  |
| 3.   | Other Reinforced Concrete Structures Subject to Approval .....                                   | 3-3  |
| 4.   | Other System Components Important to Safety .....  | 3-3  |
| 5.   | Other Components Subject to NRC Approval .....   | 3-4  |
| V.   | Review Procedures .....  | 3-4  |
| 1.   | Confinement Cask .....   | 3-6  |
| 2.   | Reinforced Concrete Components .....   | 3-19 |
| 3.   | Other System Components Important to Safety .....  | 3-28 |
| 4.   | Other Components Subject to NRC Approval .....   | 3-32 |
| VI.  | Evaluation Findings .....  | 3-33 |
| VII. | References .....   | 3-46 |
| 4.0  | THERMAL EVALUATION .....   | 4-1  |
| I.   | Review Objective .....   | 4-1  |
| II.  | Areas of Review .....  | 4-1  |
| III. | Regulatory Requirements .....  | 4-1  |
| IV.  | Acceptance Criteria .....  | 4-1  |
| V.   | Review Procedures .....  | 4-2  |
| 1.   | Spent Fuel Cladding .....  | 4-2  |
| 2.   | Cask System Thermal Design .....   | 4-3  |
| 3.   | Thermal Load Specification/Ambient Temperature .....   | 4-4  |
| 4.   | Model Specification .....  | 4-5  |
| 5.   | Thermal Analysis .....   | 4-7  |
| 6.   | Supplemental Information .....   | 4-11 |
| VI.  | Evaluation Findings .....  | 4-11 |

|  |      |
|--|------|
| VII. References .....  | 4-11 |
| 5.0 SHIELDING EVALUATION .....   | 5-1  |
| I. Review Objective .....  | 5-1  |
| II. Areas of Review .....  | 5-1  |
| III. Regulatory Requirements .....   | 5-1  |
| IV. Acceptance Criteria .....  | 5-1  |
| V. Review Procedures .....   | 5-2  |
| 1. Shielding Design Description .....  | 5-2  |
| 2. Radiation Source Definition .....   | 5-3  |
| 3. Shielding Model Specification .....   | 5-3  |
| 4. Shielding Analyses .....  | 5-4  |
| 5. Supplemental Information .....  | 5-7  |
| VI. Evaluation Findings .....  | 5-7  |
| VII. References .....  | 5-8  |
| 6.0 CRITICALITY EVALUATION .....   | 6-1  |
| I. Review Objective .....  | 6-1  |
| II. Areas of Review .....  | 6-1  |
| III. Regulatory Requirements .....   | 6-1  |
| IV. Acceptance Criteria .....  | 6-1  |
| V. Review Procedures .....   | 6-2  |
| 1. Criticality Design Criteria and Features .....  | 6-2  |
| 2. Fuel Specification .....  | 6-2  |
| 3. Model Specification .....   | 6-3  |
| 4. Criticality Analysis .....  | 6-4  |
| 5. Supplemental Information .....  | 6-6  |
| VI. Evaluation Findings .....  | 6-6  |
| VII. References .....  | 6-7  |
| 7.0 CONFINEMENT EVALUATION .....   | 7-1  |
| I. Review Objective .....  | 7-1  |
| II. Areas of Review .....  | 7-1  |
| III. Regulatory Requirements .....   | 7-1  |
| 1. Description of Structures, Systems, and Components Important to Safety .....  | 7-1  |
| 2. Protection of Spent Fuel Cladding .....   | 7-1  |
| 3. Redundant Sealing .....   | 7-1  |
| 4. Monitoring of Confinement System .....  | 7-2  |
| 5. Instrumentation .....   | 7-2  |
| 6. Release of Nuclides to the Environment .....  | 7-2  |
| 7. Evaluation of Confinement System .....  | 7-2  |
| 8. Annual Dose Limit in Effluents and Direct Radiation from an Independent Spent Fuel Storage Installation (ISFSI) ..... | 7-2  |

|      |   |      |
|------|---|------|
| IV.  | Acceptance Criteria .....                                     | 7-2  |
| V.   | Review Procedures .....                                       | 7-3  |
| 1.   | Confinement Design Characteristics .....                      | 7-3  |
| 2.   | Confinement Monitoring Capability .....                       | 7-4  |
| 3.   | Nuclides with Potential for Release .....                     | 7-5  |
| 4.   | Confinement Analyses .....                                    | 7-6  |
| 5.   | Supplemental Information .....                                | 7-7  |
| VI.  | Evaluation Findings .....                                     | 7-8  |
| VII. | References .....  | 7-8  |
| 8.0  | OPERATING PROCEDURES .....                                    | 8-1  |
| I.   | Objective .....   | 8-1  |
| II.  | Areas of Review .....   | 8-1  |
| III. | Regulatory Requirements .....                                 | 8-1  |
| IV.  | Acceptance Criteria .....                                     | 8-2  |
| V.   | Review Procedures .....                                       | 8-3  |
| 1.   | Cask Loading .....  | 8-4  |
| 2.   | Cask Handling and Storage Operations .....                    | 8-6  |
| 3.   | Cask Unloading .....  | 8-6  |
| VI.  | Evaluation Findings .....                                     | 8-8  |
| VII. | References .....  | 8-8  |
| 9.0  | ACCEPTANCE TESTS AND MAINTENANCE PROGRAM .....                | 9-1  |
| I.   | Review Objective .....  | 9-1  |
| II.  | Areas of Review .....   | 9-1  |
| III. | Regulatory Requirements .....                                 | 9-1  |
| 1.   | Testing and Maintenance .....                                 | 9-1  |
| 2.   | Resolution of Issues Concerning Adequacy or Reliability ..... | 9-2  |
| 3.   | Cask Identification .....                                     | 9-2  |
| IV.  | Acceptance Criteria .....                                     | 9-2  |
| V.   | Review Procedures .....                                       | 9-3  |
| 1.   | Acceptance Tests .....  | 9-3  |
| 2.   | Maintenance Program .....                                     | 9-6  |
| VI.  | Evaluation Findings .....                                     | 9-7  |
| VII. | References .....  | 9-8  |
| 10.0 | RADIATION PROTECTION .....                                    | 10-1 |
| I.   | Review Objective .....  | 10-1 |
| II.  | Areas of Review .....   | 10-1 |
| III. | Regulatory Requirements .....                                 | 10-1 |
| IV.  | Acceptance Criteria .....                                     | 10-1 |
| 1.   | Design Criteria .....   | 10-1 |

|      |   |      |
|------|---|------|
| 2.   | Occupational Exposures .....  | 10-2 |
| 3.   | Public Exposures .....  | 10-2 |
| 4.   | ALARA .....   | 10-2 |
| V.   | Review Procedures .....   | 10-2 |
| 1.   | Radiation Protection Design Criteria and Features .....                                     | 10-2 |
| 2.   | Occupational Exposures .....  | 10-3 |
| 3.   | Public Exposures .....  | 10-3 |
| 4.   | ALARA .....   | 10-4 |
| VI.  | Evaluation Findings .....   | 10-4 |
| VII. | References .....  | 10-4 |
| 11.0 | ACCIDENT ANALYSES .....   | 11-1 |
| I.   | Review Objective .....  | 11-1 |
| II.  | Areas of Review .....   | 11-1 |
| III. | Regulatory Requirements .....   | 11-1 |
| IV.  | Acceptance Criteria .....   | 11-2 |
| 1.   | Dose Limits for Off-Normal Events .....   | 11-2 |
| 2.   | Dose Limit for Design-Basis Accidents .....   | 11-2 |
| 3.   | Criticality .....   | 11-2 |
| 4.   | Confinement .....   | 11-2 |
| 5.   | Retrievability .....  | 11-2 |
| 6.   | Instrumentation .....   | 11-3 |
| V.   | Review Procedures .....   | 11-3 |
| 1.   | Cause of the Event .....  | 11-3 |
| 2.   | Detection of the Event .....  | 11-3 |
| 3.   | Summary of Event Consequence and Regulatory Compliance .....                                | 11-3 |
| 4.   | Corrective Course of Action .....   | 11-3 |
| VI.  | Evaluation Findings .....   | 11-4 |
| VII. | References .....  | 11-4 |
| 12.0 | CONDITIONS FOR CASE USE--OPERATING CONTROLS AND<br>LIMITS OR TECHNICAL SPECIFICATIONS ..... | 12-1 |
| I.   | Review Objective .....  | 12-1 |
| II.  | Areas of Review .....   | 12-1 |
| III. | Regulatory Requirements .....   | 12-1 |
| 1.   | General Requirement for Technical Specifications .....                                      | 12-1 |
| 2.   | Specific Requirements for Technical Specifications--Storage Cask Approval .....             | 12-1 |
| IV.  | Acceptance Criteria .....   | 12-2 |
| V.   | Review Procedures .....   | 12-3 |
| VI.  | Evaluation Findings .....   | 12-4 |
| VII. | References .....  | 12-4 |

|   |  |      |
|---|--|------|
| 13.0  | QUALITY ASSURANCE .....  | 13-1 |
| I.  | Review Objective .....   | 13-1 |
| II.   | Areas of Review .....  | 13-1 |
| III.  | Regulatory Requirements .....  | 13-1 |
| IV.   | Acceptance Criteria .....  | 13-1 |
| 1.  | Quality Assurance Organization .....                                 | 13-2 |
| 2.  | Quality Assurance Plan .....   | 13-2 |
| 3.  | Design Control .....   | 13-2 |
| 4.  | Procurement Document Control .....                                   | 13-2 |
| 5.  | Instructions, Procedures, and Drawings .....                         | 13-3 |
| 6.  | Document Control .....   | 13-3 |
| 7.  | Control of Purchased Material, Equipment, and Services .....         | 13-3 |
| 8.  | Identification and Control of Materials, Parts, and Components ..... | 13-3 |
| 9.  | Control of Special Processes .....                                   | 13-3 |
| 10.   | Licensee Inspection .....  | 13-3 |
| 11.   | Test Control .....   | 13-3 |
| 12.   | Control of Measuring and Test Equipment .....                        | 13-3 |
| 13.   | Handling, Storage, and Shipping Control .....                        | 13-3 |
| 14.   | Inspection, Test, and Operating Status .....                         | 13-3 |
| 15.   | Nonconforming Materials, Parts, or Components .....                  | 13-4 |
| 16.   | Corrective Action .....  | 13-4 |
| 17.   | Quality Assurance Records .....                                      | 13-4 |
| 18.   | Audits .....   | 13-4 |
| V.  | Review Procedures .....  | 13-4 |
| VI.   | Evaluation Findings .....  | 13-5 |
| VII.  | References .....   | 13-5 |
| 14.0  | DECOMMISSIONING .....  | 14-1 |
| I.  | Review Objective .....   | 14-1 |
| II.   | Areas of Review .....  | 14-1 |
| III.  | Regulatory Requirements .....  | 14-1 |
| IV.   | Acceptance Criteria .....  | 14-2 |
| V.  | Review Procedures .....  | 14-2 |
| VI.   | Evaluation Findings .....  | 14-3 |
| VII.  | References .....   | 14-3 |
| APPENDIX A — SAMPLE CHECKLIST FOR EVALUATING QUALITY ASSURANCE<br>PROGRAM ELEMENTS FOR DRY CASK STORAGE SYSTEMS ..... |  | A-1  |
| APPENDIX B—MATERIALS AND COMPONENTS OF HLW STORAGE SYSTEMS .....  |  | B-1  |
| APPENDIX C —GLOSSARY .....  |  | C-1  |