

**SAFETY EVALUATION REPORT  
FOR THE  
IDAHO SPENT FUEL FACILITY**

**Docket No. 72-25**

**Materials License No. SNM-2512**



# TABLE OF CONTENTS

| Section   | Page    |
|---|---------|
| TABLES .....  | xiii    |
| ACRONYMS .....  | xiv     |
| EXECUTIVE SUMMARY .....   | xvi     |
| INTRODUCTION .....  | xx      |
| <br>1 GENERAL DESCRIPTION .....   | <br>1-1 |
| 1.1 Conduct of Review .....   | 1-1     |
| 1.1.1 Introduction .....  | 1-2     |
| 1.1.2 General Description of Idaho Spent Fuel Facility Installation ..... | 1-3     |
| 1.1.3 General Systems Description .....                                   | 1-3     |
| 1.1.4 General Transfer Cask Systems Description .....                     | 1-4     |
| 1.1.5 Identification of Agents and Contractors .....                      | 1-5     |
| 1.1.6 Material Incorporated by Reference .....                            | 1-5     |
| 1.2 Evaluation Findings .....   | 1-5     |
| 1.3 References .....  | 1-6     |
| <br>2 SITE CHARACTERISTICS .....  | <br>2-1 |
| 2.1 Conduct of Review .....   | 2-1     |
| 2.1.1 Geography and Demography .....                                      | 2-1     |
| 2.1.1.1 Site Location .....   | 2-3     |
| 2.1.1.2 Site Description .....  | 2-3     |
| 2.1.1.3 Population Distribution and Trends .....                          | 2-4     |
| 2.1.1.4 Land and Water Uses .....   | 2-4     |
| 2.1.2 Nearby Industrial, Transportation, and Military Facilities .....    | 2-5     |
| 2.1.3 Meteorology .....   | 2-7     |
| 2.1.3.1 Regional Climatology .....  | 2-9     |
| 2.1.3.2 Local Meteorology .....   | 2-9     |
| 2.1.3.3 Onsite Meteorological Measurement Program .....                   | 2-10    |
| 2.1.3.4 Atmospheric Diffusion Estimates .....                             | 2-11    |
| 2.1.4 Surface Hydrology .....   | 2-11    |
| 2.1.4.1 Hydrologic Description .....                                      | 2-13    |
| 2.1.4.2 Floods .....  | 2-13    |
| 2.1.4.3 Probable Maximum Flood on Streams and Rivers .....                | 2-13    |
| 2.1.4.4 Potential Dam Failures (Seismically Induced) .....                | 2-14    |
| 2.1.4.5 Probable Maximum Surge and Seiche Flooding .....                  | 2-14    |
| 2.1.4.6 Probable Maximum Tsunami Flooding .....                           | 2-15    |
| 2.1.4.7 Ice Flooding .....  | 2-15    |
| 2.1.4.8 Flood Protection Requirements .....                               | 2-15    |

## TABLE OF CONTENTS (continued)

| Section   | Page    |
|---|---------|
| 2.1.4.9 Environmental Acceptance of Effluents . . . . .   | 2-15    |
| 2.1.5 Subsurface Hydrology . . . . .  | 2-16    |
| 2.1.5.1 Regional Characteristics . . . . .  | 2-17    |
| 2.1.5.2 Site Characteristics . . . . .  | 2-17    |
| 2.1.5.3 Contaminant Transport Analysis . . . . .  | 2-18    |
| 2.1.6 Geology and Seismology . . . . .  | 2-18    |
| 2.1.6.1 Basic Geologic and Seismic Information . . . . .  | 2-20    |
| 2.1.6.2 Ground Vibration and Exemption Request . . . . .  | 2-22    |
| 2.1.6.3 Surface Faulting . . . . .  | 2-33    |
| 2.1.6.4 Stability of Subsurface Materials . . . . .   | 2-34    |
| 2.1.6.5 Slope Stability . . . . .   | 2-35    |
| 2.1.6.6 Volcanism . . . . .   | 2-35    |
| 2.2 Evaluation Findings . . . . .   | 2-37    |
| 2.3 References . . . . .  | 2-37    |
| <br>3 OPERATION SYSTEMS . . . . .   | <br>3-1 |
| 3.1 Conduct of Review . . . . .   | 3-1     |
| 3.1.1 Operation Description . . . . .   | 3-1     |
| 3.1.2 SNF Handling Systems . . . . .  | 3-7     |
| 3.1.2.1 SNF Handling System . . . . .   | 3-8     |
| 3.1.2.2 SNF Storage . . . . .   | 3-18    |
| 3.1.3 Other Operation Systems . . . . .   | 3-21    |
| 3.1.4 Operation Support Systems . . . . .   | 3-32    |
| 3.1.5 Control Room and Control Area . . . . .   | 3-34    |
| 3.1.6 Analytical Sampling . . . . .   | 3-34    |
| 3.1.7 U.S. Department of Energy–Idaho Operations Office Transfer<br>Cask Repair and Maintenance . . . . . | 3-35    |
| 3.1.8 Pool and Pool Facility Systems . . . . .  | 3-36    |
| 3.2 Evaluation Findings . . . . .   | 3-36    |
| 3.3 References . . . . .  | 3-37    |
| <br>4 STRUCTURES, SYSTEMS, AND COMPONENTS AND DESIGN<br>CRITERIA EVALUATION . . . . .                     | <br>4-1 |
| 4.1 Conduct of Review . . . . .   | 4-1     |
| 4.1.1 Materials to be Stored . . . . .  | 4-6     |
| 4.1.2 Classification of Structures, Systems, and Components . . . . .                                     | 4-7     |
| 4.1.2.1 Classification of Structures, Systems, and Components—<br>Items Important to Safety . . . . .     | 4-7     |

## TABLE OF CONTENTS (Continued)

| Section | Page   |
|---------|--|
| 4.1.2.2 | Classification of Structures, Systems, and Components—<br>Items Not Important to Safety . . . . .  |
| 4-13    |  |
| 4.1.2.3 | Classification of Structures, Systems, and Components—<br>Conclusion . . . . .                     |
| 4-13    |  |
| 4.1.3   | Design Criteria for Structures, Systems, and Components Important<br>to Safety . . . . .           |
| 4-13    |  |
| 4.1.3.1 | General . . . . .  |
| 4-14    |  |
| 4.1.3.2 | Structural . . . . .   |
| 4-15    |  |
| 4.1.3.3 | Thermal . . . . .  |
| 4-20    |  |
| 4.1.3.4 | Shielding and Confinement . . . . .  |
| 4-21    |  |
| 4.1.3.5 | Criticality . . . . .  |
| 4-22    |  |
| 4.1.3.6 | Decommissioning . . . . .  |
| 4-22    |  |
| 4.1.3.7 | Retrieval . . . . .  |
| 4-23    |  |
| 4.1.4   | Design Criteria for Other Structures, Systems, and Components . .                                  |
| 4-23    |  |
| 4.2     | Evaluation Findings . . . . .  |
| 4-23    |  |
| 4.3     | References . . . . .   |
| 4-25    |  |
| 5       | INSTALLATION AND STRUCTURAL EVALUATION . . . . .   |
| 5-1     |  |
| 5.1     | Conduct of Review . . . . .  |
| 5-1     |  |
| 5.1.1   | Confinement Structures, Systems, and Components . . . . .  |
| 5-4     |  |
| 5.1.1.1 | Description of Confinement Structures . . . . .  |
| 5-4     |  |
| 5.1.1.2 | Design Criteria for Confinement Structures . . . . .   |
| 5-8     |  |
| 5.1.1.3 | Material Properties for Confinement Structures . . . . .   |
| 5-11    |  |
| 5.1.1.4 | Structural Analysis for Confinement Structures . . . . .   |
| 5-19    |  |
| 5.1.2   | Pool and Pool Confinement Facilities . . . . .   |
| 5-27    |  |
| 5.1.3   | Reinforced Concrete Structures . . . . .   |
| 5-27    |  |
| 5.1.3.1 | Description of Reinforced Concrete Structures . . . . .  |
| 5-28    |  |
| 5.1.3.2 | Design Criteria for Reinforced Concrete Structures . . . .   |
| 5-30    |  |
| 5.1.3.3 | Material Properties for Reinforced Concrete Structures .   |
| 5-32    |  |
| 5.1.3.4 | Structural Analysis for Reinforced Concrete Structures .   |
| 5-33    |  |
| 5.1.4   | Other Structures, Systems, and Components Important to Safety . .                                  |
| 5-38    |  |
| 5.1.4.1 | Description of Other Structures, Systems, and<br>Components Important to Safety . . . . .          |
| 5-38    |  |
| 5.1.4.2 | Design Criteria for Other Structures, Systems, and<br>Components Important to Safety . . . . .     |
| 5-50    |  |
| 5.1.4.3 | Material Properties for Other Structures, Systems, and<br>Components Important to Safety . . . . . |
| 5-58    |  |
| 5.1.4.4 | Structural Analysis for Other Structures, Systems, and<br>Components Important to Safety . . . . . |
| 5-63    |  |

## TABLE OF CONTENTS (Continued)

| Section   | Page    |
|---|---------|
| 5.1.5 Other Structures, Systems, and Components Not Important to Safety . . . . .                           | 5-74    |
| 5.1.5.1 Description of Other Structures, Systems, and Components Not Important to Safety . . . . .          | 5-74    |
| 5.1.5.2 Design Criteria for Other Structures, Systems, and Components Not Important to Safety . . . . .     | 5-77    |
| 5.1.5.3 Material Properties for Other Structures, Systems, and Components Not Important to Safety . . . . . | 5-77    |
| 5.1.5.4 Structural Analysis for Other Structures, Systems, and Components Not Important to Safety . . . . . | 5-77    |
| 5.2 Evaluation Findings . . . . .   | 5-77    |
| 5.3 References . . . . .  | 5-79    |
| <br>6 THERMAL EVALUATION . . . . .  | <br>6-1 |
| 6.1 Conduct of Review . . . . .   | 6-1     |
| 6.1.1 Decay Heat Removal Systems . . . . .  | 6-1     |
| 6.1.1.1 Storage Area . . . . .  | 6-1     |
| 6.1.1.2 Transfer Area . . . . .   | 6-5     |
| 6.1.1.3 Cask Receipt Area . . . . .   | 6-15    |
| 6.1.1.4 Transfer Tunnel . . . . .   | 6-16    |
| 6.1.1.5 Transfer Cask . . . . .   | 6-17    |
| 6.1.2 Material Temperature Limits . . . . .   | 6-18    |
| 6.1.2.1 Storage Area . . . . .  | 6-18    |
| 6.1.2.2 Transfer Area . . . . .   | 6-27    |
| 6.1.2.3 Cask Receipt Area . . . . .   | 6-28    |
| 6.1.2.4 Transfer Tunnel . . . . .   | 6-29    |
| 6.1.2.5 Transfer Cask . . . . .   | 6-30    |
| 6.1.3 Thermal Loads and Environmental Conditions . . . . .  | 6-30    |
| 6.1.3.1 Thermal Loads . . . . .   | 6-31    |
| 6.1.3.2 Environmental Conditions . . . . .  | 6-32    |
| 6.1.4 Analytical Methods, Models, and Calculations . . . . .  | 6-33    |
| 6.1.4.1 Storage Area . . . . .  | 6-34    |
| 6.1.4.2 Transfer Area . . . . .   | 6-36    |
| 6.1.4.3 Cask Receipt Area . . . . .   | 6-37    |
| 6.1.4.4 Transfer Tunnel . . . . .   | 6-37    |
| 6.1.4.5 Transfer Cask . . . . .   | 6-38    |
| 6.1.5 Fire and Explosion Protection . . . . .   | 6-38    |
| 6.1.5.1 Fire . . . . .  | 6-38    |
| 6.1.5.2 Explosion . . . . .   | 6-47    |

## TABLE OF CONTENTS (Continued)

| Section | Page   |
|---------|--|
| 6.2     | Evaluation Findings ..... 6-47                       |
| 6.3     | References ..... 6-48                                |
| 7       | SHIELDING EVALUATION ..... 7-1                       |
| 7.1     | Conduct of Review ..... 7-1                          |
| 7.1.1   | Contained Radiation Source ..... 7-2                 |
| 7.1.2   | Storage and Transfer Systems ..... 7-4               |
| 7.1.2.1 | Design Criteria ..... 7-4                            |
| 7.1.2.2 | Design Features ..... 7-4                            |
| 7.1.3   | Shielding Composition and Details ..... 7-5          |
| 7.1.3.1 | Composition and Material Properties ..... 7-5        |
| 7.1.3.2 | Shielding Details ..... 7-5                          |
| 7.1.4   | Analysis of Shielding Effectiveness ..... 7-6        |
| 7.1.4.1 | Computational Methods and Data ..... 7-6             |
| 7.1.4.2 | Dose Rate Estimates ..... 7-6                        |
| 7.1.5   | Confirmatory Calculations ..... 7-8                  |
| 7.2     | Evaluation Findings ..... 7-8                        |
| 7.3     | References ..... 7-9                                 |
| 8       | CRITICALITY EVALUATION ..... 8-1                     |
| 8.1     | Conduct of Review ..... 8-1                          |
| 8.1.1   | Criticality Design Criteria and Features ..... 8-2   |
| 8.1.2   | Stored Material Specification ..... 8-2              |
| 8.1.2.1 | TRIGA Fuel ..... 8-2                                 |
| 8.1.2.2 | Peach Bottom Fuel ..... 8-2                          |
| 8.1.2.3 | Shippingport Reflector Modules ..... 8-3             |
| 8.1.3   | Analytical Means ..... 8-3                           |
| 8.1.3.1 | Model Configuration ..... 8-3                        |
| 8.1.3.2 | Material Properties ..... 8-7                        |
| 8.1.4   | Applicant Criticality Analyses ..... 8-7             |
| 8.1.4.1 | Computer Programs ..... 8-8                          |
| 8.1.4.2 | Multiplication Factor ..... 8-8                      |
| 8.1.4.3 | Benchmark Comparisons ..... 8-9                      |
| 8.1.5   | Burnup Credit in the Criticality Analysis ..... 8-11 |
| 8.2     | Evaluation Findings ..... 8-11                       |
| 8.3     | References ..... 8-12                                |
| 9       | CONFINEMENT EVALUATION ..... 9-1                     |
| 9.1     | Conduct of Review ..... 9-1                          |
| 9.1.1   | Radionuclide Confinement Analysis ..... 9-1          |
| 9.1.2   | Confinement Monitoring ..... 9-5                     |

## TABLE OF CONTENTS (Continued)

| Section   | Page  |
|---|-------|
| 9.1.3 Protection of Stored Materials from Degradation .....             | 9-6   |
| 9.2 Evaluation Findings .....   | 9-7   |
| 9.3 References .....  | 9-7   |
| 10 CONDUCT OF OPERATIONS EVALUATION .....                               | 10-1  |
| 10.1 Conduct of Review .....  | 10-1  |
| 10.1.1 Organizational Structure .....                                   | 10-1  |
| 10.1.1.1 Corporate Organization .....                                   | 10-2  |
| 10.1.1.2 Onsite Organization .....                                      | 10-6  |
| 10.1.1.3 Management and Administrative Controls .....                   | 10-12 |
| 10.1.1.4 Evaluation Findings .....                                      | 10-15 |
| 10.1.2 Preoperational Testing and Startup Operations .....              | 10-16 |
| 10.1.2.1 Preoperational Testing Plan .....                              | 10-16 |
| 10.1.2.2 Startup Plan .....   | 10-20 |
| 10.1.2.3 Evaluation Findings .....                                      | 10-20 |
| 10.1.3 Normal Operations .....  | 10-21 |
| 10.1.3.1 Procedures .....   | 10-21 |
| 10.1.3.2 Records .....  | 10-21 |
| 10.1.3.3 Evaluation Findings .....                                      | 10-21 |
| 10.1.4 Personnel Selection, Training, and Certification .....           | 10-22 |
| 10.1.4.1 Personnel Organization .....                                   | 10-23 |
| 10.1.4.2 Selection and Training of Operating Personnel .....            | 10-23 |
| 10.1.4.3 Selection and Training of Security Guards .....                | 10-26 |
| 10.1.4.4 Evaluation Findings .....                                      | 10-26 |
| 10.1.5 Emergency Planning .....   | 10-27 |
| 10.1.6 Physical Security and Safeguards Contingency Plans .....         | 10-27 |
| 10.2 References .....   | 10-28 |
| 11 RADIATION PROTECTION EVALUATION .....                                | 11-1  |
| 11.1 Conduct of Review .....  | 11-1  |
| 11.1.1 As Low As Is Reasonably Achievable Considerations .....          | 11-3  |
| 11.1.1.1 As Low As Is Reasonably Achievable Policy<br>and Program ..... | 11-3  |
| 11.1.1.2 Design Considerations .....                                    | 11-4  |
| 11.1.1.3 Operational Considerations .....                               | 11-5  |
| 11.1.2 Radiation Protection Design Features .....                       | 11-5  |
| 11.1.2.1 Installation Design Features .....                             | 11-5  |
| 11.1.2.2 Access Control .....   | 11-6  |
| 11.1.2.3 Radiation Shielding .....                                      | 11-6  |
| 11.1.2.4 Confinement and Ventilation .....                              | 11-7  |



## TABLE OF CONTENTS (Continued)

| Section  | Page     |
|--|----------|
| 11.1.2.5 Area Radiation and Airborne Radioactivity<br>Monitoring Instrumentation ..... | 11-7     |
| 11.1.3 Dose Assessment .....   | 11-8     |
| 11.1.4 Health Physics Program .....  | 11-8     |
| 11.1.4.1 Organization .....  | 11-8     |
| 11.1.4.2 Equipment, Instrumentation, and Facilities .....                              | 11-9     |
| 11.1.4.3 Policies and Procedures .....   | 11-10    |
| 11.2 Evaluation Findings .....   | 11-11    |
| 11.3 References .....  | 11-11    |
| <br>12 QUALITY ASSURANCE EVALUATION .....  | <br>12-1 |
| 12.2 Quality Assurance .....   | 12-1     |
| 12.2 Evaluation Findings .....   | 12-1     |
| 12.3 References .....  | 12-2     |
| <br>13 DECOMMISSIONING EVALUATION .....  | <br>13-1 |
| 13.1 Conduct of Review .....   | 13-1     |
| 13.1.1 Facility Design Features .....  | 13-1     |
| 13.1.2 Facility Operational Features .....   | 13-2     |
| 13.1.3 Decommissioning Plan .....  | 13-2     |
| 13.2 Evaluation Findings .....   | 13-5     |
| 13.3 References .....  | 13-5     |
| <br>14 WASTE CONFINEMENT AND MANAGEMENT EVALUATION .....                               | <br>14-1 |
| 14.1 Conduct of Review .....   | 14-1     |
| 14.1.1 Waste Sources .....   | 14-1     |
| 14.1.2 Off-Gas Treatment and Ventilation .....   | 14-2     |
| 14.1.3 Liquid Waste Treatment and Retention .....                                      | 14-3     |
| 14.1.4 Solid Wastes .....  | 14-5     |
| 14.1.5 Radiological Impact of Normal Operations .....                                  | 14-6     |
| 14.2 Evaluation Findings .....   | 14-8     |
| 14.3 References .....  | 14-9     |
| <br>15 ACCIDENT ANALYSIS .....   | <br>15-1 |
| 15.1 Conduct of Review .....   | 15-1     |
| 15.1.1 Off-Normal Events .....   | 15-4     |
| 15.1.1.1 Misventing of Transfer Cask .....   | 15-4     |
| 15.1.1.2 Cask Drop Less Than Design Allowable Height .....                             | 15-5     |
| 15.1.1.3 Attempt to Lower Fuel Container into Occupied<br>Fuel Station .....           | 15-5     |

## TABLE OF CONTENTS (Continued)

| Section  | Page  |
|--|-------|
| 15.1.1.4 Attempt to Load Fuel Element into Full ISF Basket . . . .                               | 15-6  |
| 15.1.1.5 Failure of Fuel Element During Handling . . . . .                                       | 15-6  |
| 15.1.1.6 Drop of Fuel Element During Handling . . . . .  | 15-7  |
| 15.1.1.7 Fuel Container Binding or Impact During Handling . . . .                                | 15-7  |
| 15.1.1.8 Malfunction of the ISF Canister Heating System . . . . .                                | 15-8  |
| 15.1.1.9 Malfunction of the ISF Canister Vacuum<br>Drying/Helium Fill System . . . . .           | 15-8  |
| 15.1.1.10 Loss of Confinement Barrier . . . . .  | 15-9  |
| 15.1.1.11 Binding or Impact of the ISF Canister During<br>Hoisting/Lowering Operations . . . . . | 15-10 |
| 15.1.1.12 ISF Canister External Contamination in Excess<br>of Limits . . . . .                   | 15-11 |
| 15.1.1.13 Extended Operations with the ISF Canister in<br>the CHM . . . . .                      | 15-11 |
| 15.1.1.14 Malfunction of Storage Tube Evacuation/Helium<br>Fill System . . . . .                 | 15-12 |
| 15.1.1.15 Partial Air Inlet/Outlet Vent Blockage . . . . .                                       | 15-12 |
| 15.1.1.16 Breach of Waste Package in the Radioactive<br>Waste Area . . . . .                     | 15-13 |
| 15.1.1.17 High Dose Rate to Radioactive Waste Area . . . . .                                     | 15-13 |
| 15.1.1.18 Ventilation System Failure . . . . .   | 15-14 |
| 15.1.1.19 Loss of External Power Supply for a Limited Duration .                                 | 15-15 |
| 15.1.1.20 Off-Normal Ambient Temperatures . . . . .  | 15-15 |
| 15.1.2 Accidents . . . . .   | 15-16 |
| 15.1.2.1 Vehicular Collision with Transporter . . . . .  | 15-17 |
| 15.1.2.2 Transfer Cask Drop During Hoisting Operations . . . . .                                 | 15-17 |
| 15.1.2.3 Transfer Cask Tipover . . . . .   | 15-18 |
| 15.1.2.4 Cask Trolley Collision . . . . .  | 15-18 |
| 15.1.2.5 Drop of U.S. Department of Energy Fuel<br>Container During Handling . . . . .           | 15-19 |
| 15.1.2.6 Drop of the ISF Basket During Handling . . . . .  | 15-19 |
| 15.1.2.7 Canister Trolley Movement in Raised Position . . . . .                                  | 15-20 |
| 15.1.2.8 ISF Canister Drop . . . . .   | 15-21 |
| 15.1.2.9 Transverse Movement of the CHM with an<br>ISF Canister Partially Inserted . . . . .     | 15-21 |
| 15.1.2.10 Adiabatic Heatup . . . . .   | 15-22 |
| 15.1.2.11 Loss of Shielding . . . . .  | 15-22 |
| 15.1.2.12 Building Structural Failure onto Structures,<br>Systems, and Components . . . . .      | 15-23 |
| 15.1.2.13 Fire and Explosion . . . . .   | 15-24 |
| 15.1.2.14 Maximum Hypothetical Dose Accidents . . . . .  | 15-35 |
| 15.1.2.15 Loss of External Power for an Extended Period . . . . .                                | 15-35 |
| 15.1.2.16 Earthquake . . . . .   | 15-36 |
| 15.1.2.17 Flood . . . . .  | 15-39 |

## TABLE OF CONTENTS (Continued)

| Section   | Page     |
|---|----------|
| 15.1.2.18 Extreme Wind .....  | 15-41    |
| 15.1.2.19 Lightning .....   | 15-46    |
| 15.1.2.20 Accidents at Nearby Sites—Offsite<br>Explosion Hazards .....                | 15-46    |
| 15.1.2.21 Accidents at Nearby Sites—Offsite Toxic Gas<br>Release Hazards .....        | 15-51    |
| 15.1.2.22 Accidents at Nearby Sites—Radiological Hazards ....                         | 15-53    |
| 15.1.2.23 Aircraft Crash Hazards .....  | 15-54    |
| 15.1.2.24 Volcanism .....   | 15-58    |
| 15.2 Evaluation Findings .....  | 15-61    |
| 15.3 References .....   | 15-63    |
| <br>16 EMERGENCY PLAN .....   | <br>16-1 |
| 16.1 Conduct of Review .....  | 16-1     |
| 16.1.1 Facility Description .....   | 16-1     |
| 16.1.2 Types of Accidents .....   | 16-2     |
| 16.1.3 Classification of Accidents .....  | 16-2     |
| 16.1.4 Detection of Accidents .....   | 16-2     |
| 16.1.5 Mitigation of Consequences .....   | 16-3     |
| 16.1.6 Assessment of Releases .....   | 16-3     |
| 16.1.7 Responsibilities .....   | 16-4     |
| 16.1.8 Notification and Coordination .....  | 16-4     |
| 16.1.9 Information to be Communicated .....   | 16-5     |
| 16.1.10 Training .....  | 16-5     |
| 16.1.11 Safe Condition .....  | 16-6     |
| 16.1.12 Exercises .....   | 16-6     |
| 16.1.13 Hazardous Chemicals .....   | 16-6     |
| 16.1.14 Comments on the Emergency Plan .....  | 16-7     |
| 16.1.15 Offsite Assistance .....  | 16-7     |
| 16.1.16 Offsite Information .....   | 16-8     |
| 16.2 Evaluation Findings .....  | 16-8     |
| 16.3 References .....   | 16-8     |
| <br>17 FINANCIAL QUALIFICATIONS AND DECOMMISSIONING<br>FUNDING ASSURANCE .....        | <br>17-1 |
| 17.1 Conduct of Review .....  | 17-1     |
| 17.1.1 Background .....   | 17-1     |
| 17.1.2 Financial Assurance for the Design, Construction<br>and Operation Phases ..... | 17-2     |
| 17.1.3 Financial Assurance for the Decommissioning Phase .....                        | 17-4     |
| 17.2 Evaluation Findings .....  | 17-5     |
| 17.3 References .....   | 17-6     |

## TABLE OF CONTENTS (Continued)

| Section  | Page |
|--|------|
| 18 TECHNICAL SPECIFICATIONS EVALUATION .....               | 18-1 |
| 18.1 Conduct of Review .....                               | 18-1 |
| 18.1.1 Approved Contents .....                             | 18-1 |
| 18.1.2 Limiting Conditions/Surveillance Requirements ..... | 18-3 |
| 18.1.3 Design Features .....                               | 18-4 |
| 18.1.4 Administrative Controls .....                       | 18-5 |
| 18.1.5 License Conditions .....                            | 18-6 |
| 18.2 Evaluation Findings .....                             | 18-7 |
| 18.3 References .....                                      | 18-7 |

## TABLES

| Section  | Page  |
|--|-------|
| 2-1 Comparison of rock peak horizontal accelerations .....   | 2-30  |
| 4-1 General structures, systems, and components important to safety .....                                | 4-8   |
| 4-2 CRA structures, systems, and components important to safety .....                                    | 4-8   |
| 4-3 Transfer area structures, systems, and components important to safety .....                          | 4-10  |
| 4-4 Storage area classification of structures, systems, and components .....                             | 4-12  |
| 4-5 Shielding and confinement design criteria .....  | 4-22  |
| 5-1 Summary of transfer cask structural design criteria .....  | 5-9   |
| 6-1 Maximum SNF and relevant component temperatures during storage .....                                 | 6-4   |
| 6-2 Maximum transfer cask component temperatures for bounding environmental<br>and load conditions ..... | 6-18  |
| 6-3 Allowable temperature limits for storage area components .....                                       | 6-19  |
| 6-4 Storage tube component materials .....   | 6-20  |
| 6-5 ISF canister component materials .....   | 6-21  |
| 6-6 Peach Bottom SNF basket component materials .....  | 6-21  |
| 6-7 TRIGA SNF basket component materials .....   | 6-22  |
| 6-8 Shippingport SNF and reflector rod basket component materials .....                                  | 6-23  |
| 6-9 Allowable temperature limits for the CHM components .....  | 6-24  |
| 6-10 CHM and structural support materials .....  | 6-25  |
| 6-11 FHM and structural support materials .....  | 6-27  |
| 6-12 Cask receipt crane and structural support materials .....   | 6-28  |
| 6-13 Transfer and canister cask trolley materials .....  | 6-29  |
| 6-14 Transfer cask component materials .....   | 6-30  |
| 8-1 Maximum Keff in the DOE-ID Transfer Cask .....   | 8-8   |
| 8-2 Maximum Keff in the Fuel Packaging Area .....  | 8-9   |
| 8-3 Maximum Keff in the Storage Area .....   | 8-9   |
| 15-1 Off-normal events evaluated .....   | 15-67 |
| 15-2 Accident analysis for the proposed ISF Facility .....   | 15-70 |
| 18-1 ISF Facility technical specifications .....   | 18-2  |
| 18-2 Characteristics of materials to be stored .....   | 18-2  |
| 18-3 Heat load for the ISF Facility .....  | 18-2  |
| 18-4 Limiting conditions for operation/surveillance requirements .....                                   | 18-3  |
| 18-5 Design features for the ISF Facility .....  | 18-4  |
| 18-6 Codes governing ISF Facility storage components .....   | 18-5  |
| 18-7 Administrative controls for the ISF Facility .....  | 18-6  |
| 18-8 License conditions for the ISF Facility .....   | 18-6  |

## ACRONYMS

|        |  |
|--------|--|
| ACI    | American Concrete Institute  |
| AISC   | American Institute of Steel Construction                                   |
| AISI   | American Iron and Steel Institute  |
| ALARA  | As Low As Is Reasonably Achievable   |
| ANS    | American Nuclear Society   |
| ANSI   | American National Standards Institute                                      |
| ASCE   | American Society of Civil Engineers  |
| ASHRAE | American Society of Heating, Refrigeration, and Air-Conditioning Engineers |
| ASME   | American Society of Mechanical Engineers International                     |
| ASTM   | American Society for Testing and Materials                                 |
| AWS    | American Welding Society   |
| BCVs   | Bench Containment Vessels  |
| CCA    | Canister Closure Area  |
| CCTV   | Closed-Circuit Television  |
| CHM    | Canister Handling Machine  |
| CMAA   | Crane Manufacturers Association of America                                 |
| CoC    | Certificate of Compliance  |
| CRA    | Cask Receipt Area  |
| DBE    | Design Basis Earthquake  |
| DE     | Design Earthquake  |
| DOE-ID | U.S. Department of Energy—Idaho Operations Office                          |
| EP     | Emergency Plan   |
| ERDA   | Energy Research and Development Administration                             |
| FAA    | Federal Aviation Administration  |
| FHM    | Fuel Handling Machine  |
| FPA    | Fuel Packaging Area  |
| HEPA   | High-Efficiency Particulate Air  |
| HVAC   | Heating, Ventilation, and Air Conditioning                                 |
| IDCS   | Integrated Data Collection System  |
| INEEL  | Idaho National Engineering and Environmental Laboratory                    |
| INTEC  | Idaho Nuclear Technology and Engineering Center                            |
| ISF    | Idaho Spent Fuel   |
| ISFSI  | Independent Spent Fuel Storage Installation                                |
| I&C    | Instrumentation and Controls   |
| LCO    | Limiting Conditions for Operation  |
| MPU    | Mobile Pump Unit   |
| MRS    | Monitored Retrievable Storage  |
| Ms     | Surface Wave Magnitude   |
| MSMs   | Master/Slave Manipulators  |
| MTU    | Metric Tons of Uranium   |
| Mw     | Moment Magnitude   |
| NFPA   | National Fire Protection Association                                       |
| PGA    | Peak Ground Acceleration   |
| PLC    | Programmable Logic Controller  |
| PMS    | Power Manipulator System   |

## **ACRONYMS (Continued)**

|        |  |
|--------|--|
| PSHA   | Probabilistic Seismic Hazards Analysis                             |
| PWR    | Pressurized Water Reactor  |
| RWMC   | Radioactive Waste Management Complex                               |
| SAR    | Safety Analysis Report   |
| SCBA   | Self-Contained Breathing Apparatus                                 |
| SER    | Safety Evaluation Report   |
| SMACNA | Sheet Metal and Air-Conditioning Contractors' National Association |
| SNF    | Spent Nuclear Fuel   |
| SR     | Surveillance Requirements  |
| SWPA   | Solid Waste Processing Area  |
| TEDE   | Total Effective Dose Equivalent                                    |
| TMI    | Three Mile Island  |
| TRIGA  | Training, Research, and Isotope reactors built by General Atomics  |
| UPS    | Uninterruptible Power Supply                                       |

## EXECUTIVE SUMMARY

On November 19, 2001, the Foster Wheeler Environmental Corporation (FWENC) submitted a license application to the U.S. Nuclear Regulatory Commission (NRC), in accordance with 10 CFR Part 72, to construct and operate an independent spent fuel storage installation, called the Idaho Spent Fuel (ISF) Facility. The application consists of the following documents:

- (1) A **License Application**, in which the applicant provides general information and includes as appendices
  - A request for exemption from the seismic design requirement
  - An operator training and certification plan
  - A proposed decommissioning plan
  - Proposed technical specifications;
- (2) A **Safety Analysis Report (SAR)**, in which the applicant describes plans for building, operating, and maintaining the proposed ISF Facility, and an evaluation of the U.S. Department of Energy (DOE) transfer casks to be used to transfer the spent nuclear fuel (SNF) to the ISF Facility;
- (3) An **Emergency Plan**, in which the applicant describes plans for resolving any emergencies that may happen during ISF Facility operation;
- (4) A **Safeguards and Physical Security Plan** (this document will not be released to the public), in which the applicant describes plans for ensuring the ISF Facility and nuclear material are appropriately protected; and
- (5) An **Environmental Report**, in which the applicant provides information to the NRC staff to use to perform an environmental review of the proposed ISF Facility.

The U.S. Nuclear Regulatory Commission staff has documented its review and conclusions about the safety-related aspects of the license application in this Safety Evaluation Report (SER). This SER provides the NRC staff's evaluation concerning the first three documents of the application for the ISF Facility, as revised and supplemented. This executive summary provides a brief overview and summary of this SER. The NRC staff's approval of the ISF Physical Protection Plan, including the Safeguards Contingency plan and the Security Training and Qualification Plan was previously documented in a letter dated September 15, 2004. The NRC staff's environmental review is documented in NUREG-1773, "Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility," dated January 2004. The Quality Program Plan (QPP) for the ISF Facility was initially submitted to the NRC on March 31, 2001, and subsequently revised through Revision 6, dated May 28, 2004. The staff approved the QPP through Revision 6 in a letter dated August 5, 2004.

The proposed ISF Facility will store three types of SNF: (i) spent fuel elements from the Peach Bottom Unit 1 high temperature gas-cooled reactor, (ii) spent fuel elements from the Training, Research, and Isotope reactors built by General Atomics (TRIGA) from TRIGA research reactors worldwide, and (iii) the reactor reflector modules and loose reflector fuel rods from the Shippingport light water breeder reactor. The bulk of this spent fuel is currently in storage at



the Idaho National Engineering and Environmental Laboratory (INEEL) site. After the ISF Facility is operational, DOE will transfer the SNF from its current storage locations to the ISF Facility, also on the INEEL site. The SNF transfer will occur completely within the boundaries of the INEEL site. Once received at the ISF Facility, FWENC will repackage the SNF and place it in interim storage. The loaded and sealed ISF canisters are to be stored in individual metal storage tubes located in a passively cooled concrete vault (housing 246 metal storage tubes).

The INEEL site consists of 2,305 km<sup>2</sup> [890 mi<sup>2</sup>] of land located in southeast Idaho. The INEEL is a DOE-controlled site, and it consists of eight primary facility areas, typically less than a few square miles in size and separated from each other by miles of mostly undeveloped land. The proposed ISF Facility will occupy approximately 32,375 m<sup>2</sup> [8 acres] adjacent to the Idaho Nuclear Technology and Engineering Center. The proposed ISF Facility includes three principal areas

### **Description of the Proposed ISF Facility**

The ISF Facility is a fully enclosed building complex consisting of three principal areas: (i) the cask receipt area (CRA), (ii) the transfer area, and (iii) the storage area. The Transfer Tunnel will provide connections between these three areas of the ISF Facility. The SNF will be transported to the ISF Facility using transfer casks provided by the DOE. Following receipt at the CRA, the SNF will be moved to the transfer area for unloading and repackaging into specially designed canisters (called ISF canisters). After the SNF transfer is completed, the ISF canisters will be sealed and moved to the storage area for interim dry storage.

The proposed ISF storage system consists of three parts: ISF canisters, which will contain the SNF; metal storage tubes, which will contain the ISF canisters during storage; and the concrete vault, which will house the 246 metal storage tubes. After an ISF canister is placed vertically into a metal storage tube, a shield plug is installed and the metal storage tube is sealed with a cover plate with dual metallic seal rings. The storage tubes are filled with an inert gas to reduce potential corrosion of the ISF canisters during storage.

The ISF canisters are made of stainless steel and provide the confinement system for the SNF. The metal storage tubes with cover plates provide the redundant, outer confinement barrier. The transfer casks provided by the DOE also provide radiation shielding and structural protection of the SNF during transfer operations from the CRA to the fuel packaging area.

The U.S. Department of Energy–Idaho Operations Office (DOE-ID) is responsible for transporting the SNF from the current storage facilities on the INEEL site to the ISF Facility. The SNF will be transferred using two existing Peach Bottom transfer casks (PB-1 and PB-2). Both transfer casks were previously certified by the U.S. Atomic Energy Commission in accordance with the provisions of 10 CFR Part 71 for transportation, but those certifications expired in 1982. The casks have continued to be used by DOE under its own authority for a variety of shipments since that time. In order to demonstrate the acceptability of the PB-1 and PB-2 transfer casks for the limited movement of SNF to the ISF Facility, the DOE-ID evaluated the design and performance of both transfer casks, and this evaluation was incorporated by the FWENC as Appendix A in its ISF SAR.

## Safety of the Facility

In its evaluation of the application, the NRC staff has determined that FWENC has adequately demonstrated that the proposed ISF Facility, the storage system design, and the DOE transfer casks to be used are structurally sound, and will perform their intended design functions for all normal operating conditions.

FWENC, in its exemption request, proposed to use a probabilistic seismic hazards analysis (PSHA), rather than a deterministic method required by 10 CFR Part 72 regulations, to determine the design earthquake (DE), based on the 2,500-year return period ground motions and considering site-response effects at the ISF Facility site. After review of the applicant's exemption request, the staff agrees that the use of the PSHA methodology with a 2,500-year return period is acceptable and that there are sufficient technical and regulatory bases to grant an exemption to 10 CFR §72.102(f). The staff further concludes that the ISF Facility has been designed to withstand a 2,500-year return period ground motion.

The NRC staff also determined that FWENC has demonstrated that the SNF within the ISF canisters will remain subcritical (i.e., unable to sustain a nuclear chain reaction) during all phases of operation for both normal and credible accident conditions. FWENC provided radiation dose estimates for the surrounding public and personnel at the ISF Facility. The ISF canisters will be welded closed to prevent leakage of radioactive material. The ISF canisters will be placed in metal storage tubes housed in a concrete vault to shield the area outside the ISF canisters from direct radiation during storage.

The rate at which a person is exposed to radiation is called a dose rate. FWENC estimated that members of the public near the proposed ISF Facility would receive doses below the NRC regulatory requirements, which for normal conditions of operation is 0.25 mSv/yr [25 mrem/yr], and for credible accidents is 0.05 Sv/yr [5 rem/yr]. FWENC also calculated radiation dose rates within the vicinity of the stored canisters and transfer casks to demonstrate that personnel at the proposed ISF Facility will not receive doses that exceed 0.05-Sv/yr [5 rem/yr], the NRC annual regulatory limits for personnel at nuclear facilities. These radiation dose limits have been established by the NRC to prevent undue risk and to ensure the safety of all members of the public and personnel at a nuclear facility. FWENC also described its radiation protection program, which employs an "as low as is reasonably achievable" (ALARA) radiation protection principle. The operating ISF Facility staff will monitor radiation doses received by personnel and dose rates within the vicinity of the ISF Facility to verify radiation dose limits are not exceeded. The NRC staff reviewed the FWENC analyses and concludes that the ISF Facility and storage system design are radiologically safe and will meet regulatory requirements.

FWENC was required to demonstrate that all important parts of its proposed ISF Facility will continue to perform their design functions during normal conditions and during any accident that might reasonably be expected to occur. The staff concluded that, as required by 10 CFR Part 72, FWENC has provided acceptable analyses of the design and performance of these structures, systems, and components important to safety during credible off-normal and accident scenarios. Based on evaluations of these events, the staff concludes that these events do not pose a credible hazard to the ISF Facility. The staff further concludes that the FWENC analyses of off-normal and accident events demonstrate that the proposed ISF Facility will be sited, designed, constructed, and operated such that during all credible off-normal and

accident events, public health and safety will be adequately protected, and the capability to retrieve fuel from the ISF Facility will be preserved.

### **Other Requirements**

To demonstrate its financial qualifications, FWENC identified anticipated sources of funds to construct the ISF Facility. Appropriate license conditions have been developed and stated in this SER to provide reasonable assurance of the applicant's financial qualifications.

The staff finds the ISF emergency plan and the safeguards and physical protection plans acceptable. The emergency plan appropriately describes the applicant's program for responding to onsite emergencies. It also describes plans for seeking offsite assistance if needed. In addition, the safeguards and physical protection plan meets applicable NRC requirements, as documented in the NRC staff's approval letter dated September 15, 2004.

### **REFERENCES**

U.S. Atomic Energy Commission. *Certificate of Compliance, Peach Bottom 1 Cask*. CoC USA/6375/B()F. Docket No. 71-6375. Washington, DC: U.S. Atomic Energy Commission. September 1974.

## INTRODUCTION

On November 19, 2001, FWENC submitted a license application to the NRC in accordance with 10 CFR Part 72, to construct and operate an independent spent fuel storage installation, called the Idaho Spent Fuel (ISF) Facility. The ISF Facility will store three types of spent nuclear fuel (SNF): (i) Peach Bottom Unit 1 reactor fuel elements, (ii) fuel elements from the Training, Research, and Isotope reactors built by General Atomics from research reactors worldwide, and (iii) the Shippingport reactor reflector modules and fuel rods. To store the SNF, the proposed ISF Facility will use ISF canisters designed specifically for the proposed operation. The loaded and sealed ISF canisters are to be stored in individual metal storage tubes housed in passively cooled concrete vaults. Each metal storage tube will contain one ISF canister. The ISF canister is placed vertically in the metal storage tube.

In support of its application, FWENC submitted the following documents, which contain the information specified in 10 CFR Part 72, Subpart B, License Application, Form, and Contents:

- (1) **A License Application** (Foster Wheeler Environmental Corporation, 2001) which contains
  - General information required by 10 CFR §72.22
  - Applicant's technical qualifications required by 10 CFR §72.28
  - A request for exemption from the seismic design requirement
  - An operator training and certification plan required by 10 CFR §72.194
  - A proposed decommissioning plan required by 10 CFR §72.30
  - Proposed technical specifications required by 10 CFR §72.26
- (2) **A Safety Analysis Report (SAR)** (Foster Wheeler Environmental Corporation, 2003) for the ISF Facility required by 10 CFR §72.24
- (3) **An Emergency Plan** for the ISF Facility required by 10 CFR §72.32
- (4) **A Safeguards and Physical Security Plan** for the ISF Facility, which includes the safeguards contingency plan, as required by 10 CFR §72.180 and §72.184
- (5) **An Environmental Report** for the ISF Facility required by 10 CFR §72.34

This report documents the results of the safety evaluation review conducted by the staff. Documents reviewed by staff include (i) the ISF Facility SAR and License Application, (ii) supporting calculation packages, (iii) responses to staff requests for additional information, and (iv) other supporting documentation. The technical review was performed according to the applicable regulations in 10 CFR Parts 20 and 72 and supported by NUREG-1567, NUREG-1536, NUREG-0800, and Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 2000, 1997, 1987, 1989).

This Safety Evaluation Report (SER) documents the staff review of the design, operation, and other safety aspects of the proposed ISF Facility described in the preceding submittals, except for the Environmental Report, the safeguards and physical protection plan, and the Quality Program Plan. The Environmental Report is the subject of a separate Environmental Impact Statement, issued by the NRC staff in January 2004. The staff's safeguards review is

documented in the staff's security evaluation dated September 15, 2004. The Quality Program Plan through Revision 6 was approved by the staff in a letter dated August 5, 2004.

The staff's assessment in this SER is based on the regulatory requirements of 10 CFR Part 72. In its review, the staff evaluated: (i) the characteristics of the site; (ii) ISF Facility operations and operating systems; (iii) the design and design criteria for the ISF Facility and its structures, systems, and components important to safety; (iv) programs that support protection of public health and safety and worker health and safety; (v) the impact of potential off-normal and accident events on structures, systems, and components important to safety; (vi) the financial qualifications of the applicant; (vii) the proposed technical specifications; (viii) the emergency plan; and (ix) the seismic design exemption request.

To store the SNF, the applicant proposes to use ISF canisters designed specifically for the ISF Facility. The proposed ISF storage system consists of three distinct components: ISF canisters, metal storage tubes, and the concrete vault. The concrete vault houses 246 metal storage tubes. The ISF storage system is passive and does not rely on any active cooling systems to remove the SNF decay heat. The ISF canisters provide the primary confinement system for the SNF. The metal storage tubes provide an additional confinement barrier.

The Department of Energy-Idaho Operations Office (DOE-ID) is responsible for transporting the SNF from the current storage facilities at the Idaho National Engineering and Environmental Laboratory site to the ISF Facility. Two existing Peach Bottom transfer casks provided by the DOE-ID will be used for SNF transfer to the ISF Facility. The DOE-ID conducted an evaluation of these two casks, and the evaluation results were provided to FWENC and included as Appendix A of the ISF Facility SAR (Foster Wheeler Environmental Corporation, 2003). The staff reviewed Appendix A to confirm that the two Peach Bottom transfer casks are structurally sound and radiologically safe for transporting SNF to the ISF Facility. The staff also reviewed the SAR to verify that the ISF storage system design is radiologically safe and meets the radiological limits of 10 CFR §72.104.

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Foster Wheeler Environmental Corporation. *Idaho Spent Fuel Facility Safety Analysis Report*. ISF-FW-RPT-0033. Docket 72-25. Amendment 3. Morris Plains, NJ: Foster Wheeler Environmental Corporation. November 2003.

Foster Wheeler Environmental Corporation. *License Application, Idaho Spent Fuel Facility*. Docket No. 72-25. ISF-FW-RPT-0127. Rev. 0. Morris Plains, NJ: Foster Wheeler Environmental Corporation. November 2001.

U.S. Nuclear Regulatory Commission. NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities*. Final Report. Washington, DC: U.S. Nuclear Regulatory Commission. 2000.

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U.S. Nuclear Regulatory Commission. Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*. Washington, DC: U.S. Nuclear Regulatory Commission. 1989.

U.S. Nuclear Regulatory Commission. NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*. Washington, DC: U.S. Nuclear Regulatory Commission. 1987.