# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>xviii</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Elements of a Transportation System for Spent Nuclear Fuel</td>
<td>3</td>
</tr>
<tr>
<td>2.1 Experience with SNF Shipments in the United States</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Regulatory and Legal Framework</td>
<td>6</td>
</tr>
<tr>
<td>2.2.1 Federal Role and Requirements</td>
<td>6</td>
</tr>
<tr>
<td>2.2.2 State, Tribal, and Local Government Roles and Requirements</td>
<td>11</td>
</tr>
<tr>
<td>2.3 Industry Standards</td>
<td>12</td>
</tr>
<tr>
<td>2.4 Key Entities for Executing Shipments</td>
<td>13</td>
</tr>
<tr>
<td>2.5 Advance Planning and Stakeholder Engagement</td>
<td>14</td>
</tr>
<tr>
<td>2.6 SNF Transportation Packaging</td>
<td>17</td>
</tr>
<tr>
<td>3. Key Issues for the Transportation of SONGS SNF</td>
<td>19</td>
</tr>
<tr>
<td>3.1 Responsibility for Shipments</td>
<td>19</td>
</tr>
<tr>
<td>3.1.1 Considerations if the Federal Government Ships SONGS SNF</td>
<td>20</td>
</tr>
<tr>
<td>3.1.2 Considerations if a Private Entity Ships to a Non-Federal CISF</td>
<td>22</td>
</tr>
<tr>
<td>3.1.3 Considerations if a Private CISF Owner Ships SONGS SNF</td>
<td>23</td>
</tr>
<tr>
<td>3.1.4 Considerations if SONGS Assets, Including SONGS SNF, Are Sold to a New Owner</td>
<td>24</td>
</tr>
<tr>
<td>3.2 Coordination with Destination Facility</td>
<td>24</td>
</tr>
<tr>
<td>3.3 Mode and Route Selection</td>
<td>25</td>
</tr>
<tr>
<td>3.4 Time Required to Clear the SONGS Site Once a Receiving Facility Is Available</td>
<td>27</td>
</tr>
<tr>
<td>3.5 Potential for Early Shipment of SONGS GTCC Waste</td>
<td>30</td>
</tr>
<tr>
<td>4. Site Considerations and Readiness to Ship</td>
<td>34</td>
</tr>
<tr>
<td>4.1 Canister Preparation and Documentation Requirements</td>
<td>35</td>
</tr>
<tr>
<td>4.2 Rail Infrastructure at SONGS</td>
<td>35</td>
</tr>
<tr>
<td>4.3 Canister Transfer from Storage Modules to Transportation Casks</td>
<td>35</td>
</tr>
<tr>
<td>4.4 Transfer of Transportation Casks to Rail Cars at SONGS</td>
<td>35</td>
</tr>
<tr>
<td>4.5 Other Assets and Equipment Needs</td>
<td>36</td>
</tr>
<tr>
<td>4.5.1 Transportation Casks and Impact Limiters</td>
<td>36</td>
</tr>
<tr>
<td>4.5.2 Rail Cars</td>
<td>37</td>
</tr>
<tr>
<td>4.5.3 Transfer Equipment</td>
<td>38</td>
</tr>
<tr>
<td>4.5.4 Slings and Strongbacks</td>
<td>38</td>
</tr>
</tbody>
</table>
4.5.5 Leak Testing Equipment ................................................................. 39
4.5.6 Emergency Recovery and Response Equipment ............................... 39
4.5.7 Security .......................................................................................... 39
4.5.8 Satellite Tracking ........................................................................... 39
4.5.9 Movement Control Center ............................................................. 39
4.6 Equipment Maintenance .................................................................. 40
4.7 Inventory Management ..................................................................... 41
4.8 On-Site Training Programs ............................................................... 41
4.9 Summary of Site Readiness Considerations and Needs ...................... 42

5. Phase I: Near-Term Actions to Prepare for Transporting Songs SNF ........ 43
5.1 Overview of Phase I .......................................................................... 44
5.2 Management Organization/Transportation Planning and Management Organization ..... 45
5.3 SONGS Administrative Activities and Regulatory Compliance ............... 46
5.4 Site Infrastructure ............................................................................. 47
5.5 Communication with States and Tribes Along Potential Routes .................. 48
5.6 Costs for Phase I .............................................................................. 49

6. Phase II: Actions After a Destination is Known ..................................... 52
6.1 Overview of Phase II ......................................................................... 52
6.2 Activities Related to the Transportation Planning and Management Organization .... 53
6.3 Systems Analysis, Logistics, and Project Planning Needs ....................... 54
6.4 Acquisition Strategy ......................................................................... 54
6.4.1 Package Licensing ......................................................................... 54
6.4.2 Transportation Cask and Rail Car Procurement ................................. 54
6.4.3 Other Rolling Stock Procurement ..................................................... 56
6.5 Readiness to Prepare SNF and GTCC Waste for Shipment at SONGS ........ 56
6.5.1 Update of Canister Inventory, Inspections, and Maintenance of CoCs and Documentation Packages ......................................................... 57
6.5.2 Transfer Equipment Procurement .................................................... 57
6.5.3 Crane Procurement ........................................................................ 57
6.5.4 Site Infrastructure Upgrades ............................................................ 57
6.5.5 Site Procedures and Maintenance Program ........................................ 58
6.5.6 Site Training .................................................................................. 58
6.5.7 SCE Quality Assurance Program and Operating Procedures ................... 58
6.6 Carrier Selection .............................................................................. 58
6.7 Interactions with States, Tribes, Local Authorities, and Public Safety Personnel.............. 59
  6.7.1 Preliminary Route Planning................................................................. 60
  6.7.2 Emergency Preparedness and Response Training ................................... 60
6.8 Costs for Phase II .................................................................................. 63
7. Phase III: Actions Within a Five-Year Timeframe for Transporting Songs SNF ............... 67
  7.1 Equipment Receipt and Inventory ........................................................... 67
  7.2 Site Operating Procedures and Loading Plans ........................................... 67
  7.3 Coordination, Logistics, and Carrier ....................................................... 67
  7.4 Route Approval .................................................................................... 68
  7.5 On-site and Offsite Training ................................................................. 68
  7.6 Security Planning ................................................................................. 69
  7.7 Readiness Reviews .............................................................................. 69
  7.8 Engagement with States and Tribes ......................................................... 69
  7.9 Training of Emergency Responders Along Routes ...................................... 69
  7.10 Public Communication and Engagement ................................................. 69
  7.11 Comprehensive Dry Run ....................................................................... 70
  7.12 Preparations to Ship and Shipping .......................................................... 70
    7.12.1 Cask Loading ................................................................................. 70
    7.12.2 Pre-shipment Regulatory Inspections ............................................... 71
    7.12.3 Material in Transit ........................................................................... 71
    7.12.4 Arrival at Destination ..................................................................... 72
    7.12.5 Equipment Inspection and Maintenance ........................................... 72
  7.13 Phase III Cost ..................................................................................... 72
8. Key Steps Toward Transportation Readiness ....................................................... 75
  8.1 Overarching Priorities for the SONGS Co-Owners Across All Phases ................. 75
  8.2 Priorities for Phase I of Transportation Planning (near term) .......................... 75
  8.3 Priorities for Phase II of Transportation Planning (begins once a destination for SONGS SNF is known) ................................................................. 77
  8.4 Recommendations for Phase III of Transportation Planning ......................... 78
  8.5 Conclusion ............................................................................................ 79

FIGURES

Figure 1. Notional Schedule of Activities in Each Planning Phase ................................ xvi
Figure 2.1. Rail Routes Used to Ship Navy SNF to Idaho National Laboratory ............... 5
Figure 2.2. Entities and Relationships in the SNF Shipment Planning Process ............... 15
Figure 2.3. SNF Transportation Package Tests for Accident Conditions ........................................... 18
Figure 6.1. Major Rail Routes Near SONGS .................................................................................. 61
Figure 6.2. Major Rail Routes from SONGS to the Southwestern United States ......................... 62
Figure 8.1. Notional Schedule of Activities in Each Planning Phase .............................................. 76

TABLES
Table 3.1. Regulatory Requirements for SNF Shipments for NRC Licensees Compared to Shipments by DOE Under the NWPA .................................................................................... 21
Table 4.1. Summary of Equipment Quality Assurance or Certification Standards .................... 40
Table 5.1. Rough-Order-of-Magnitude (ROM) Phase I Cost Estimates ........................................ 50
Table 6.1. Rough-Order-of-Magnitude Phase II Cost Estimates .................................................... 63
Table 7.1. Rough-Order-of-Magnitude Phase III Cost Estimates .................................................... 73

APPENDICES
Appendix A – North Wind Team Biographies
Appendix B – Regulatory and Legal Framework for Commercial Spent Nuclear Fuel Transportation
Appendix C – Site Considerations and Readiness
Appendix D – Highway and Barge as Modes of Transportation for Relocating SONGS SNF
Appendix E – Template for a Typical, Shipment-Specific Transportation Plan
Appendix F – Readiness Review
Appendix G – Shipment Security Considerations
Appendix H – Generic Shipment-Specific Emergency Response Plan Table of Contents
Appendix I – Emergency Management and Training Guidance
SUMMARY

This Conceptual Transportation Plan for the Relocation of SONGS Spent Nuclear Fuel is a companion document to the Strategic Plan for the Relocation of SONGS Spent Nuclear Fuel to an Offsite Storage Facility or a Repository. Both documents (which constitute Volumes III and II of this compendium, respectively) inform SCE’s Action Plan for the Relocation of SONGS SNF (Volume I). The Conceptual Transportation Plan (CTP) focuses on specific steps and strategic considerations in planning for and executing the shipment of spent nuclear fuel (SNF) from the San Onofre Nuclear Generating Station (SONGS) to an offsite location. Both plans must address the terms and constraints of a Settlement Agreement reached in 2017 between Southern California Edison, the majority owner and decommissioning agent for SONGS, and a group called Citizens’ Oversight.

A detailed assessment of transportation issues was warranted because shipping SNF is a multifaceted activity that requires advance planning; a thorough understanding of applicable regulatory, technical, and logistical requirements; and extensive engagement with stakeholders. To be clear, the capability and know-how to transport SNF safely and efficiently is already well developed—as evidenced by extensive experience with these types of shipments, which have amassed an exemplary and largely incident-free safety record, in the United States and elsewhere, over many decades. This positive record is due in part to the robust safety regulations and requirements for coordination with public safety officials that apply to SNF shipments. Nonetheless, public interest in these shipments will be high and the steps involved will require the coordination of multiple entities. And in all scenarios for the offsite disposition of SONGS SNF, including those scenarios where the federal government or another entity takes title to the fuel at the plant-site boundary, the SONGS co-owners will—at a minimum—have to prepare for and fund the on-site activities necessary to prepare SNF canisters for shipment.

Like the Strategic Plan (Vol. II), this document was prepared by a team of subject matter experts at North Wind, Inc. with input from an Experts Team composed of six nationally recognized experts in nuclear waste management, and in close collaboration with SCE (more information about the Experts Team and its role is provided in the Strategic Plan). Secured Transportation Services, LLC contributed expertise as a subcontractor to North Wind. Appendix A lists the individuals involved in developing the CTP and their affiliations.

Background and Context for the Conceptual Transportation Plan

The overarching objective of this document, and of the accompanying Strategic Plan, is to develop insights and information concerning necessary steps and potential actions that could be taken to advance one or more pathways for the safe removal of all SNF and greater than Class C (GTCC) radioactive waste from the SONGS site. Complete removal of this material is a necessary precondition to fully decommissioning and restoring the SONGS site so it can be returned to the U.S. Navy. For reasons detailed in the Strategic Plan, no offsite facility currently exists that can receive these materials. Until this changes, there is no near-term option to move the SNF. Understanding and planning for transportation is nonetheless important, however—both to ensure that SNF can be removed expeditiously as soon as a storage or disposal facility is available and because transportation considerations have to be factored into any strategy the SONGS co-owners might pursue in advancing an offsite disposition pathway for SONGS SNF.

\(^1\) As in the Strategic Plan and Action Plan, references to SONGS SNF should be understood to include SONGS GTCC waste, unless otherwise specified.
The CTP as a whole provides general information concerning key elements of any system for transporting SNF and specific information concerning actions that will need to be taken by the SONGS co-owners to ready the SONGS site for loading SNF and GTCC waste. In addition, we examine the requirements and potential costs involved if a generic private entity executes SNF shipments. We limit this part of our analysis to a generic private entity because, in scenarios where the federal government takes title to SNF at the plant site (as it is currently obligated, by law and contract, to do), the federal government also assumes all responsibility for transportation and bears all associated costs. Estimating the costs for a private entity to ship SNF will help the SONGS co-owners assess the commercial reasonability of those offsite disposition alternatives discussed in the Strategic Plan (Vol. II) that assume an entity other than the federal government performs transportation. Further, our analysis assumes that rail will be the mode used to ship SNF away from the SONGS site. North Wind was also directed to assume that the destination facility for SONGS SNF would be located somewhere in the southwestern United States; we therefore assessed route options to this region. Much of the information and analysis presented in this report, however, would be common to any destination.

**Experience with SNF Shipments in the United States to Date**

Thousands of shipments of SNF have been successfully completed in the United States and abroad over the last 60 years, although SNF shipments have not occurred in significant numbers in this country over the last two decades (except for shipments of Navy SNF). In anticipation that commercial SNF would be reprocessed, large volumes of SNF were shipped during the 1960s and 1970s to facilities in West Valley, New York and Morris, Illinois. This included 270 fuel assemblies from SONGS Unit 1, all of which were shipped to the Morris facility and remain stored there.

In 2015, the U.S. Department of Energy (DOE) implemented a large-scale, highway-based shipping campaign to move SNF and liquid radioactive waste from Chalk River Laboratories in Ontario, Canada to the Savannah River Site in South Carolina. The SNF portion of this inventory was shipped, over a period of approximately four years, under the auspices of DOE’s Foreign Research Reactor Spent Fuel Acceptance Program. More than 66,000 miles of SNF transport were completed as part of this campaign. Regular shipments of a specific form of nuclear waste from defense activities, known as transuranic (TRU) waste, have been ongoing since 1999. TRU waste is shipped by truck from DOE’s national laboratories to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. While these shipments do not include SNF (WIPP cannot accept SNF), they do involve Type B waste packages being transported on public highways, the same type of packages used to ship SNF. Worth noting in the context of the WIPP and research reactor shipments, is the extensive advance planning that occurred, on a cooperative basis, between DOE, states, and tribes. The purpose of this planning was to develop procedures that would give local officials and the public confidence in the safety of SNF shipments, and thereby enable smooth execution of the shipping campaign when the time came.

Finally, the Navy Nuclear Propulsion Program has made almost 900 rail shipments of Navy SNF to Idaho National Laboratory since 1956. These shipments continue on a regular basis; in addition, DOE ships small amounts of foreign and research SNF. Internationally, SNF is transported among various countries for reprocessing.

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2 As opposed to heavy-haul truck or barge transport. See Chapter 3 and Appendix D of the full report for further discussion of mode and route considerations.
Responsibility for Transportation

As we have already noted, DOE is statutorily and contractually obligated to take title to SNF at plant sites and remove it for final disposition. If the immediate destination is a federal repository, transportation is the responsibility of the federal government. If Congress amends the Nuclear Waste Policy Act (NWPA) or through other legislation authorizes a federal consolidated interim storage facility (CISF) and/or federal use of a non-federal interim storage facility (as discussed in detail in Chapter 7 of the Strategic Plan), the federal government would also be responsible for acquiring transportation assets and funding the operational costs associated with transportation. Under the Standard Contracts that exist between DOE and nuclear utilities as a result of the NWPA, the primary responsibility of the SONGS co-owners is limited to making any on-site preparations needed to load transport casks with the SONGS canisters and place the loaded transport casks on the conveyance that the federal government provides.\(^3\) It has been suggested that a case could be made for federal reimbursement of certain on-site costs to prepare for shipping SONGS SNF if those costs would not have been incurred but for the federal government's failure to perform on its statutory and contractual obligations with respect to removing the fuel. The North Wind team did not explore this possibility because such recovery issues have not been presented and thus substantial uncertainties apply.

Our baseline analysis for other disposition pathways analyzed in the Strategic Plan—specifically, a non-federal CISF, a CISF for California SNF only, a multi-utility CISF at another nuclear plant site, and relocation of SONGS SNF to a new, offsite independent spent fuel storage installation (ISFSI)—does not assume any federal responsibility for transportation.\(^4\) In these scenarios, the SONGS co-owners, and ultimately their customers, could expect to incur costs for the private acquisition of transportation assets and for transportation operations, as well as costs to obtain third-party protection from financial and other liabilities if the SONGS co-owners retain title to the SNF after it leaves the SONGS site. These costs could be incurred directly, if the SONGS co-owners make transport arrangements, or they could be built into the fees the SONGS co-owners are charged if the CISF owner/operator handles transportation. Moreover, for reasons discussed in more detail in the Strategic Plan, prospects for recovering transportation costs to an offsite facility from the federal government, using the same Judgment Fund mechanism that is currently reimbursing utilities for ongoing on-site storage costs, are uncertain—particularly in any circumstance where there is no immediate safety rationale for moving the fuel. Thus, costs for transportation become a critical factor in determinations of commercial reasonableness in any scenario for relocating the SONGS fuel that does not include federal support and federal assumption of liability (the subject of commercial reasonableness, which includes many additional factors and considerations, is covered in detail in the Strategic Plan).

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\(^4\) We did consider variants in some cases that make different assumptions about responsibility for transportation.
Elements of a Transportation System for Spent Nuclear Fuel

This section briefly describes the core elements of a transportation system for SNF, regardless of the specific origin and destination site. The entity with primary responsibility for transportation, whether that is the federal government or another third-party, would need to ensure that all of these elements have been addressed before commencing to ship SNF.

**Legal and regulatory framework:** Shipments of SNF are covered by extensive regulatory and legal requirements that are intended to assure security and protect public health and safety, and the environment. The key federal agencies are the Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (DOT), and—to a lesser degree—DOE. An existing memorandum of understanding between the NRC and DOT outlines their respective roles in regulating the safety and security of radioactive materials transportation. NRC regulations specifically invoke relevant portions of the DOT regulations. DOE asserts its ability to ship SNF, independent of DOT or the NRC, under authority granted by the Atomic Energy Act (AEA). State and tribal governments also have a role in regulating SNF shipments; in addition, shippers and carriers are required to coordinate with states and tribes along transport routes prior to and during transport operations.

**Coordination among key entities:** The transportation of radioactive materials involves a web of entities, each with defined roles and responsibilities. Which entities are involved at different points in the process can vary depending on the circumstances governing particular SNF shipments. In most if not all cases, the list is likely to include DOE, the NRC licensee who possesses the SNF, private logistics companies, package owners, and carriers (such as railroads), as well as the owner of the licensed receiving facility (if not DOE), regulatory agencies, and other federal, state, and tribal entities. Together these entities must coordinate to execute the actual movement of SNF. That process typically includes (at a minimum) selecting transportation modes and routes, planning for safety, security and emergency response, training personnel, and communicating with stakeholders, as well as ensuring that necessary handling equipment and capabilities are in place at the source site and the receiving site. In many cases, logistics companies may be retained to integrate activities among the multiple entities executing the shipment; ensure regulatory compliance and safe, secure, and event-free shipments; and prepare a coordinated response in the event of any accidents or unforeseen incidents.

**Advance Planning and Stakeholder Engagement:** Even in the context of a strong safety record and strict regulatory environment, the transportation of SNF requires thoughtful and thorough planning because of the logistical coordination just described and the high level of interest and scrutiny SNF shipments can be expected to draw. Additional efforts are needed to communicate with entities that are interested in or potentially impacted by SNF shipments but that are not directly involved in shipping operations. These entities may include the public, communities along potential routes, other nuclear utilities and nuclear industry organizations, and the media. DOE has developed and continues to implement an extensive model for engagement with states, regional groups, and tribal governments around its ongoing shipments of defense and research reactor nuclear materials. Similar models exist for private shippers who can likewise benefit by initiating active engagement with communities and elected officials along planned routes well in advance of the minimum two-week notification required by the NRC before shipments commence.

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5 See 10 CFR 71.5(a).
Transportation Packaging: The transportation assets and equipment needed to safely handle and ship SNF and GTCC waste are a key element of the overall transportation system. Specifically, what types of assets are required, and in what quantity, will depend on the mode of transport used, the destination point and the routes selected to reach it, the shipping schedule, and other factors.

Regardless of mode, SNF must be shipped in specially designed and manufactured packaging. In the United States and internationally, these “Type B” packagings\(^6\) are designed and constructed to pass a series of tests that simulate severe accident forces and a range of hazards, including puncture, fire, drop, and immersion hazards. U.S. DOT Class 7 “radioactive materials,” a category that includes SNF, is the only hazard class that requires packaging to be designed and tested to survive a severe hypothetical accident scenario.

Activities Related to Site Readiness

Under current law, DOE’s legal obligation is to take possession of, and title to, the SNF in its packaged configuration at the SONGS gate and support the shipment of this material to Yucca Mountain.\(^7\) Thus, activities related to site readiness would be the responsibility of the SONGS co-owners in any scenario for transporting the SONGS SNF off site. In brief, these activities include the following:

**Canister preparation and documentation requirements.** Prior to shipping, the SONGS co-owners will need to review and document the compliance status of each SNF and GTCC canister and its contents against the revision of the applicable transportation certificate of compliance (CoC) active at the time of shipment (which includes specific revisions to the package drawings).

**Assessment of on-site infrastructure needs, including for rail access.** A more detailed technical evaluation is needed to determine whether the rail spurs and sidings that will be constructed as part of the current decommissioning plan for SONGS Units 2 and 3 should be left in place to be utilized for SNF transportation in the future. Additional studies will also be needed to understand and optimize the operational aspects of SNF removal (e.g., throughput rate) and to inform decision-making concerning on-site infrastructure needs and related procurements.

**Preparations for canister transfer from storage modules to transportation casks.** Two separate sets of arrangements will be needed for the TN canisters, which are stored horizontally, and the Holtec canisters, which are stored vertically. The SONGS co-owners will need to identify and acquire the specific lifting and handling structures and equipment needed in each case. Some of this equipment is only available from the storage technology suppliers while other types of lifting and rigging equipment are standard and available from other vendors. Appendix C provides a detailed description of these operations.

**Securing equipment for unexpected contingencies, emergency recovery, and other on-site needs.** Common items that may be needed include spare lifting and rigging equipment, additional radiation

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\(^6\) In the industry and throughout this report, a distinction is made between transportation “packaging”, which contains the SNF during transport, and transportation “packages”, which consist of the packaging with its SNF contents.

\(^7\) The NWPA currently requires that the SONGS SNF be disposed of in a repository at Yucca Mountain, Nevada. The SONGS co-owners take no position with respect to the suitability of the Yucca Mountain site or with respect to any decision that might be taken regarding whether to continue the licensing process for Yucca Mountain and/or pursue another repository site.
detectors, shielding devices such as lead blankets, and lead bricks. Emergency response personnel on site will require personal radiation detection equipment as well as portable radiation detectors to support a response to a radiological incident.

**On-site personnel and coordination with shipping entity.** The SONGS co-owners will need to ensure that personnel with the appropriate skills are on site to oversee and conduct activities related to preparing for and executing shipments. They will also need to work with the shipper to develop a site de-inventory plan and coordinate on a schedule for shipments.

**Site security.** When shipments commence, the site security protected area at SONGS will have been reduced to essentially the ISFSI footprint. To prepare for shipments, a temporary security barrier may be required to enclose rail cars while a consist is being built or an alternate means of complying with NRC security regulations must be developed. (Note that the term “consist”, used throughout this Plan, refers to a set of rail cars that together form a train or a unit of a train.)

**Activities Related to Executing Shipments**

Activities related to executing shipments would be the responsibility of the shipper. The shipper could be the federal government or a private third-party, if issues related to SCE’s position pertaining to title transfer, liability, and cost for shipping operations are resolved. In brief, these activities include the following:

**Mode and route selection.** Safety and security are primary considerations in selecting the mode of transport to be used in relocating SONGS SNF to an offsite facility. Mode choice(s) and route selection(s) are directly related, and both will influence transportation decisions. In most cases, the total amount of material to be shipped is a major factor in determining the mode of transport that presents the lowest risk. As already noted, this plan assumes that rail will be the mode used to transport SONGS SNF. This means that the shipper will have to work with private rail companies to select routes; proposed routes will also have to follow DOT hazard analysis requirements and be approved by the NRC.

**Outreach to stakeholders along routes.** As already noted, engagement with stakeholders to address their concerns about SNF shipments is crucial to the execution of a successful shipping campaign. In addition, states have indicated their expectation that both the federal government and private entities will work cooperatively with them to develop policies and protocols for shipments. Failure to plan in advance or to actively engage with and consult stakeholders, on the other hand, creates a substantial risk of eroding public confidence and seeding opposition to future SNF shipments.

**Acquisition of shipping assets.** The shipper, whether a private or federal entity, will need to acquire rail cars, transport casks with impact limiters, cradles, and specialized handling equipment in a quantity and within a timeframe that matches the rate at which canisters are scheduled to be moved off site. (Cradles provide support for the transportation cask and secure the cask to the rail car.) The manufacture of transportation casks and railcars, as specialty manufacturing items, can take two to three years. Costs for these items are also significant. As an example, a three-package consist will require three transportation casks, three cask cars, two buffer cars, and one escort car (the locomotive would be provided by the railroad).

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8 Package designers may use varying terminology for the cradle, such as “transport skid.” Cradle is used in this CTP for simplicity.
Casks with cradles and impact limiters and other ancillary equipment, for example, are estimated to cost approximately $6 million each.\(^9\) Rail cars to carry the casks are estimated to cost approximately $1.5 million each, assuming that they are required to meet a specialized standard, known as S-2043, that sets additional strict performance requirements beyond those that apply to conventional rail cars (the S-2043 standard is published by the Association of American Railroads and has been adopted by DOE for DOE shipments of SNF).\(^10\) Buffer cars are estimated to cost approximately $350,000 each,\(^11\) while escort cars are estimated to cost approximately $4.5 million each.\(^12\)

*Shipment tracking and movement control center.* “Telemetric tracking” is required for any SNF shipment and is most commonly provided using GPS. A number of commercial satellite tracking options are available that can be installed on rail cars or trucks and monitored via a secure web portal. DOE uses TRANSCOM which states and tribes along the shipment corridor can access while a DOE shipment is within their jurisdiction; private shippers would need to reach agreement with states and tribes about how the appropriate real-time tracking information would be shared (private shippers may also be able to negotiate with DOE for the use of TRANSCOM). Regulations also require the use of a movement control center (MCC) to serve as the communications hub for any shipment that is in motion. All communications to and from the shipment would be routed through this center (with the exception of carrier-specific communications needs such as vehicle operator logs and mechanical status updates). The MCC should be equipped with computer stations and two forms of communication, staffed by personnel trained to initiate or coordinate a security response in the event of an incident, and located in a secure area that is not accessible to the public.

*Personnel training.* Any personnel who perform important-to-safety activities pertaining to shipments must be appropriately trained and qualified. Specialized training is also required for security escort personnel; because laws governing armed civilians differ between states, it is often advisable in these cases to seek a security subcontractor who can provide these services and is already licensed to operate within the transit states along the route. Alternatively, federal agents can provide security if DOE is the shipper.

*Emergency response preparations.* States, tribes, and local communities have primary responsibility for providing emergency response capabilities to protect public health and safety in the event of an incident during transport. They also have extensive experience with preparedness and planning efforts for hazardous material transportation incidents within their jurisdictions through various state and federal programs, including programs under the Emergency Planning and Community Right-to-Know Act. However, the shipper will want to engage with state and local officials to address emergency response concerns. In addition, considerable federal assistance is available to help train state and local emergency management personnel to support a response to a radiological incident, including an SNF transportation incident.

*Coordination with receiving facility.* The shipper, the SONGS co-owners, and the owner/operator of the destination facility will need to ensure that equipment and assets used to load and unload canisters

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\(^9\) Based on NWT’s expert judgment.

\(^10\) The AAR S-2043 standard is discussed in Section 4.5.2 of the full report. For the $1.5-million rail car cost estimate see: DOE Office of Nuclear Energy, Report No. DE-NE0008390, Atlas Railcar Phase 2 Final Report | Department of Energy, Appendix K.


from transportation packages are compatible. This will allow sufficient time for design parameters to be fully coordinated before equipment is fabricated. Another area of coordination will be the implementation of information security requirements for the shipments as detailed in the Nuclear Materials Management and Safeguards System (NMMSS) which tracks the fuel inventory balances. This includes establishing systems for tracking each transfer of SNF and verifying that the amount of SNM received at the destination site exactly matches the amount of SNM shipped from the origin site.\textsuperscript{13} The information necessary for these transactions must be transmitted in a manner that complies with NRC regulations for Safeguards Information.

**Phases of Transportation Planning**

To assist the SONGS co-owners in planning for future shipments of SONGS SNF, the CTP details activities and provides cost and schedule estimates for three distinct phases of preparation. These phases are not necessarily time sequential and may overlap to some extent; they will also vary in length depending on whether a private entity or DOE is conducting the shipping campaign. In addition, the different entities involved may not all be operating in the same phase at the same time. For example, the SONGS co-owners, the shipper, and the operator of the destination facility are likely to have different schedules for reaching various milestones as they prepare for shipments to commence. Rough order-of-magnitude cost estimates for each phase are discussed in Chapters 5–7 of the full report; Figure 8.1 provides a notional schedule estimate for the three phases.

**Phase I**, for the SONGS co-owners, involves those activities that can be undertaken before a destination site is identified. Most if not all of these activities will be needed regardless of destination, will not be affected by the passage of time, and may be performed at any time prior to establishing a definite timeline for shipments. The primary focus in this phase is understanding the regulatory and socio-political context for future shipments, as best this can be anticipated in advance, and identifying near-term actions the SONGS co-owners can take to be prepared to ship when a destination site becomes available. The total cost to SCE of Phase I is $750,000. We do not anticipate a private shipping entity would incur costs before a site is selected; we do not estimate costs for the federal government as the shipper. Table 5.1 provides a breakdown of estimated Phase I costs.

**Phase II** involves those activities that the SONGS co-owners and the shipper can undertake after a destination is identified and a contract with the receiving facility owner/operator is in place. This can include long-lead items (on the order of years), as well as items that will not be affected by the passage of time but are dependent on having an identified destination (though some general sense of the shipping timeline would be important to know). The focus in this phase is on analyzing specific transportation needs, including potential routes, affirmation of end-to-end transportation mode(s), specialized equipment needs, early coordination with states and tribes along potential routes, and public outreach. If the federal government is the shipper, all of these activities and any associated costs will also be the federal government’s responsibility; in that case, the SONGS co-owners would not be involved to any significant extent.

NWT’s rough order-of-magnitude cost estimate for this phase is approximately $59 million for SCE to undertake on-site infrastructure upgrades and related preparation activities. We estimate costs to a

\textsuperscript{13} Safeguards against the theft or diversion of SNF during transport are provided by the use of tamper-indicating devices on the packaging, as well as continuous visual surveillance of the cargo in transit.
private shipper for Phase II activities at approximately $33 million. Table 6.1 provides a breakdown of estimated Phase II costs.

*Phase III* detailed planning activities would begin once a target ship date has been identified and end once the first shipment is underway. (Although many activities will continue beyond this point, they will be part of transportation operations and will no longer be considered part of transportation planning.) Phase III can be expected to begin three to five years prior to the first shipment. It includes action items with known expiration dates and will require significant investments in equipment and preparation.

We estimate the cost of on-site activities to SCE during this phase at $2.4 million. We estimate costs to a private shipper during Phase III at approximately $6.1 million. However, costs could vary significantly depending on the quantity and types of transportation equipment and other assets the shipper acquires. Table 7.1 provides a breakdown of estimated Phase III costs.

**Key Considerations in Planning for the Transportation of SONGS SNF**

This section highlights selected “takeaways” from the CTP that should help inform transportation planning for the SONGS SNF. Specific activities and priorities for the SONGS co-owners and a future shipper in different phases of preparation for transport are summarized in Chapter 8. All of these points inform the specific transportation-related actions identified in SCE’s Action Plan (Vol. I of this compendium).

**General considerations:**

- Shipments of SNF have been successfully carried out in the United States and internationally for decades and continue today. The U.S. Navy transports SNF regularly and the transportation and nuclear industries have the knowledge, experience, and technical capability to transport SNF safely and securely with robust regulatory oversight by multiple entities.
- SNF shipments from any site can nonetheless be expected to draw significant public interest. In the case of SONGS SNF, these shipments will involve canisters that have been in storage for a number of years and that are heavier and of larger capacity than in past SNF shipments in the United States.
- The transportation of SNF across state or tribal boundaries becomes a regional or even national issue (if DOE is the shipper), especially as people learn that shipments may pass near or through their communities.
- For reasons detailed in the Strategic Plan (Vol. II), it could be decades before all of the SNF is removed from SONGS. This gives rise to the need for planning to assure the retention of critical institutional knowledge and human resources related to SNF handling and transportation.

**Considerations with respect to cost:**

- Significant capital and operating costs are associated with the transport of SNF. Who bears these costs and how costs might be shared—whether, for example, the federal government bears these cost or whether costs are shared between one or more private entities or between a public and a private entity—will be a critical issue for the SONGS co-owners and a major factor in determining the commercial reasonableness of any offsite disposition pathway for the SONGS SNF.
- Under current law and contracts between DOE and nuclear utilities, DOE is responsible for taking title to, and removing SNF from nuclear plant sites for disposal at the Yucca Mountain repository, including all transportation costs. DOE currently has no legislatively or contractually defined role in
any scenario that involves first relocating the SONGS SNF to an offsite facility other than a federal repository. Without DOE taking title and assuming responsibility at the SONGS site boundary, transportation costs, together with the need to obtain protection against risks and liabilities once the SNF leaves the SONGS site, pose a major barrier to the commercial reasonableness of any of the non-federal disposition pathways North Wind analyzed. These include the non-federal CISF, California-only CISF, multi-utility CISF, and relocation of SONGS SNF to a new ISFSI alternatives considered in the Strategic Plan (Vol. II). Action by the federal government, potentially at the direction of Congress, to provide support for transportation and to address title and liability concerns may be critical in helping to satisfy the condition of commercial reasonableness for any of these alternatives.

- The cost of spent fuel casks, cask cars, and other rail assets (buffer and escort cars) is the main driver of overall transportation costs. These costs are in the high tens of millions of dollars for a fully-functioning, multi-consist transportation system.

- Costs to implement the SONGS site infrastructure improvements needed to support the movement of SNF canisters from storage to transportation are also significant (in the mid-tens of millions of dollars). However, these costs will be incurred in any scenario for clearing the site.

- Although not required by current statute, states and tribes expect private shippers to provide emergency response training along routes, similar to the training that DOE is obligated to provide when it ships SNF. Private shippers may want to consider helping states and tribes access existing federal training resources and working cooperatively to coordinate that training with shipment schedules.

- If the SONGS co-owners retain title to the SNF after it leaves SONGS, additional costs could be incurred because of the potential need to obtain additional liability insurance to protect the co-owners and their customers against financial risks and to satisfy insurance requirements imposed by the railroads and/or the NRC (the Strategic Plan discusses title and liability issues in some detail as a crucial element of commercial reasonableness). Whether such third-party insurance could be obtained and at what price is uncertain because no precedent exists. Hence, North Wind did not include liability insurance in its estimates of SNF transport costs. However, we believe these costs could be significant in any scenario where the federal government does not take title to the fuel at the SONGS site boundary.

\textit{Considerations for engaging with states and tribes along transportation routes:}

- Cooperative models for transportation planning have a successful track record that includes large numbers of shipments to WIPP, shipments under the Foreign Research Reactor program, and other

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\textsuperscript{14} As already noted, these costs are the responsibility of the SONGS co-owners under the existing Standard Contract and would be covered out of decommissioning trust funds. However, it has been suggested that federal reimbursement could be sought for on-site preparation costs that would not have been incurred but for the federal government’s failure to perform on its statutory and contractual obligations with respect to removing the SNF. The North Wind team did not explore this issue.

\textsuperscript{15} Earlier shipments of commercial SNF as part of reprocessing plans in the 1960s and 1970s do not offer a precedent since they involved shipments of fuel from still operating plant sites and thus were adequately covered by the liability protection provided under the Price Anderson Act (see Chapter 6 of the Strategic Plan for further discussion of financial protection, indemnification, and liability issues).
federal shipping campaigns. Private shipping campaigns have sometimes included engagement with states and tribes, although these efforts have not been nearly as extensive as DOE’s.

- Any transportation planning effort will benefit from early engagement and cooperative work with states and tribal governments, and with state regional groups, which play an important coordination and communications role in many parts of the country.

**Considerations for transport operations:**

- Rail will almost certainly be the mode of transportation used to remove SNF from SONGS.
- There are technical hurdles to overcome in undertaking a large-scale rail shipping campaign. Important questions have to be answered, such as whether to use specialized rail cars, and significant planning must occur.
- Inspection protocols will need to be developed to ensure that canisters previously in storage service can be transferred from the ISFSI to the transportation casks, shipped, and accepted at the receiving facility.

**Considerations with respect to site readiness:**

- The scope of transportation CoC amendments needed for SONGS SNF and GTCC waste will have to be evaluated in detail to ensure compliance with shipping requirements for as-fabricated and aged canisters, “as-loaded” SNF canister contents, and GTCC waste canisters.
- Rail infrastructure and space needs for facilities to move SNF canisters from storage modules to rail cars will need to be evaluated, including to determine whether the additional rail spurs and sidings to be used for SONGS Unit 2 and Unit 3 decommissioning should be retained. (The existing on-site rail spur north of Beach Club Road to the main rail line appears adequate to handle the loads of a consist moving SNF cask cars.) Depending on the outcome of this evaluation, the SONGS co-owners may want to make changes to “as-left” conditions after nearer-term decommissioning activities (prior to removing the SNF) are complete.
- Transferring the Holtec canisters to transportation casks will require an on-site cask transfer facility (CTF) or equivalent capability. A system for placing the loaded transportation casks onto the conveyance is needed (either portable cranes or a purpose-built system).
- TN canisters can be transferred to transportation casks horizontally, directly from the storage modules, but a system for placing loaded transportation casks onto the conveyance is needed.
- Other issues to be addressed include options for a temporary security protected area during the period when canisters are being transferred to rail cars and determining whether new or amended coastal development permits will be required to support a future shipping campaign.

**Considerations with respect to schedule:**

- Long lead times to manufacture transport casks and rail cars (if the AAR S-2043 standard is used) are a critical driver of the schedule for planning SNF shipments.
- Decisions regarding site infrastructure need to be made early because they will drive subsequent strategic decisions and other long-lead elements of the schedule.
Conclusion

The analysis developed for this CTP gives grounds for confidence that the technical and organizational demands of implementing a safe, efficient shipping campaign for SONGS SNF can be met with judicious advance planning and resource commitments. To that end, it will be important to develop a clear and early understanding of transportation needs and challenges, both because transportation will be a critical strategic consideration in pursuing any effort to relocate the SONGS SNF and GTCC and because, given the costs and the complexity of the issues involved, the potential benefit of retaining certain resources and assets to support a future shipping campaign, and the long lead times associated with many preparatory activities, planning ahead can help ensure that SONGS SNF will be removed expeditiously once a receiving facility is available.

Meanwhile, the most important question that remains unanswered at present concerns the federal role. Absent progress toward resolving the political impasse that has so far prevented DOE from meeting its waste management obligations, it is likely to be extremely challenging for private SNF owners to develop (or contract with) an offsite facility, and address significant issues of title and liability, and cover the costs of transporting SNF to an offsite facility in a commercially reasonable manner. Continued effort to push for swift resolution of the national-level issues is therefore needed to achieve the shared objective of relocating the SONGS SNF and enabling the full restoration and return of the site.

Irrespective of who the shipping entity is, the SONGS co-owners will be responsible for preparing the site and developing detailed procedures to move SNF canisters from the ISFSI to the SONGS gate. Although several actions can be taken immediately, the timing of these future actions will be primarily driven by the availability of a receiving facility. As time goes on, especially after the deconstruction of SONGS Units 2 and 3 is complete, it will be important to preserve crucial knowledge and documentation of SNF-related activities. This includes maintaining ready access to detailed information describing how the SNF canisters were prepared for ISFSI storage and maintained during storage operations. The ability to tap personnel with requisite expertise in the handling and shipping of radioactive materials will also be essential to implement transportation efficiently and effectively in the future.
Figure 1. Notional Schedule of Activities in Each Planning Phase

PHASE I
Timeline Unknown
- Design Management Organization
- Communication with Local Communities and Tribes

PHASE II
~ 5-10 Years Before Shipments Commence
- Systems Analysis, Logistics, and Planning
- Infrastructure and Logistics Analyses
- Transportation Mode and Route Analysis
- Interaction with State, Tribal, and Local Governments Along Route

PHASE III
<5 Years Before Shipments Commence
- Site Operating Procedures and Loading Plans
- On- and Off-Site Training
- Carrier Selection
- Emergency Responder Training Along Routes
- Logistics Coordination with Carrier

LEGEND
- SONGS Co-Owners Responsibility
- Shipper Responsibility*
- SONGS Co-Owners + Shipper Responsibility

*Because of the regulatory difference in responsibilities between DOE and a private entity as shipper, the tasks assigned in this notional schedule are not definitive. Who has responsibility, and when each activity would begin, would change depending on who ships the SNF.
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1. Introduction

This Conceptual Transportation Plan for the Relocation of SONGS Spent Nuclear Fuel is a companion document to the Strategic Plan for the Relocation of SONGS Spent Nuclear Fuel to an Offsite Storage Facility or a Repository. The Conceptual Transportation Plan (CTP) provides additional details and findings pertaining to specific steps and strategic considerations in planning for and executing the shipment of spent nuclear fuel (SNF) from the San Onofre Nuclear Generating Station (SONGS) to an offsite location. Both documents (Volumes II and III of this compendium, respectively) inform Southern California Edison’s Action Plan for the Relocation of SONGS Spent Nuclear Fuel (Volume I).

The overarching objective of all three plans is to develop insights and information concerning actions that could be taken to advance one or more commercially reasonably pathways for the safe removal of all SNF and greater than Class C (GTCC) radioactive waste from the SONGS site. The complete removal of these materials is a necessary precondition to fully decommission and restore the current site prior to returning it to the U.S. Navy. The motivations for pursuing this objective are discussed in depth in the Strategic Plan, which also provides a detailed description of the quantity and type of nuclear materials currently being stored at SONGS. In the simplest sense, achieving the overarching objective requires two things: (1) an offsite storage or disposal facility that can receive the SONGS SNF and GTCC waste and (2) the ability to transport these materials to an offsite facility in a manner that is safe, secure, commercially reasonable, and acceptable to the public. Since no offsite facility currently exists that could accept SONGS SNF, the Strategic Plan focuses on the first requirement. This CTP addresses the second.

The development of the CTP, like the development of the Strategic Plan, was initiated by Southern California Edison (SCE), the majority owner and chief decommissioning agent of SONGS, and undertaken with the assistance and guidance of an Experts Team. The Experts Team consists of six nationally recognized professionals with extensive background and experience in nuclear waste management and regulation. The underlying analysis and assessment, and the writing of both reports, was conducted by a team of similarly qualified consultants assembled by North Wind Inc., under contract to SCE.

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16 Edison International, Southern California Edison’s parent company, holds 78.2% ownership in the plant; the other owners are San Diego Gas & Electric Company (20%) and the City of Riverside Utilities Department (1.8%). The City of Anaheim, a former SONGS owner, is also participating in the decommissioning process. Because SCE is the sole named defendant in the lawsuit and associated settlement that gave rise to this Conceptual Transportation Plan (as described later in the main text), North Wind, the author of this report, generally refers to “SCE” or “SONGS co-owners” throughout this document.

17 The development of both documents follows from the terms of a Settlement Agreement reached in 2017 between SCE and a group called Citizens Oversight.

18 To be clear, the same Experts Team oversaw the development of both documents (the Strategic Plan and the CTP). The composition of the North Wind team was somewhat different for the CTP and included additional consultants, STS Nuclear Services, and Kelly Horn from the state of Illinois. Individual participants in the development of the Strategic Plan and CTP, respectively, are identified in Appendix A of each document. The individual members of the Experts Team are listed in the Strategic Plan and in the acknowledgement sections of both documents.
Because the Strategic Plan provides extensive information about SONGS and about the broader policy, regulatory, and legal context for managing SNF in the United States, the discussion in this document is confined to issues that directly relate to the transportation of SNF and to the steps involved in executing SNF shipments off site. In addition, the Settlement Agreement directed the CTP be developed assuming a destination for SONGS SNF in the southwestern United States. Accordingly, we assess route options to the southwestern United States but also provide information and analysis that would apply to any destination for SONGS SNF.

A clear and in-depth understanding of transportation issues will allow the SONGS co-owners to plan for the organization, financial resources, and infrastructure needed to prepare SONGS SNF and GTCC canisters for shipment as soon as a receiving facility becomes available. Thus, a key focus of this CTP concerns the timing of actions that the SONGS co-owners would need to take immediately or in the near future to prepare for transportation. The CTP also identifies steps that may be taken at a later date, closer to the time when shipments can be anticipated to commence. Ultimately, this document serves to complete some of the initial work required to develop a formal transportation plan in the future once an offsite facility is available to take the SONGS SNF. Until a destination site becomes available and its capabilities are known, however, this plan will remain conceptual in nature.

The remainder of this document can be divided into two parts. The first part, comprising Chapters 2 and 3, is written for a general audience. Chapter 2 describes the history of SNF shipments in the United States and identifies key elements of a transportation system for SNF, from the regulatory framework that applies to the transportation casks that must be used. Chapter 3 discusses key issues for the transportation of SONGS SNF, including responsibility for shipments, mode selection, and time to clear the SONGS site.

The second part of the document, comprising Chapters 4 through 7, is written for a more technical audience and offers specific analysis and information to aid in planning for the transportation of SONGS SNF to an offsite facility. Chapter 4 focuses on the issue of site readiness, describing the kinds of infrastructure, equipment, and capabilities needed at SONGS to safely and efficiently load SNF shipments. Chapter 5, 6, and 7 describe in detail three phases of planning leading up to the transportation of SNF.

Chapter 8 reviews key steps toward ensuring transportation readiness and offers concluding remarks.
2. Elements of a Transportation System for Spent Nuclear Fuel

This chapter reviews previous experience with SNF shipments in the United States; describes the regulatory, legal, and policy context for such shipments; and identifies the basic elements of a system for transporting SNF. Many of these elements are discussed again in more detail and with more specific reference to SONGS in later sections of the CTP. The aim here is to provide an overview and to impart a sense of the challenges involved in planning for SNF shipments.

2.1 Experience with SNF Shipments in the United States

Thousands of shipments of SNF have been successfully completed in the United States and abroad over the last 60 years, although SNF shipments within the United States have not occurred in significant numbers in the last two decades (except for shipments of Navy SNF). For example, in anticipation that commercial SNF would be reprocessed, large volumes of SNF were shipped during the 1960s and 1970s from various nuclear power plants to facilities in West Valley, New York and Morris, Illinois. In fact, 270 SNF assemblies from SONGS Unit 1 were shipped to the G.E. Morris facility during this time. With the adoption of a federal moratorium on reprocessing in 1977, hundreds of return shipments of SNF were made from West Valley and G.E. Morris back to nuclear generating sites or DOE facilities.\textsuperscript{19}

In total, 2,576 shipments of commercial SNF were conducted by rail and highway over the period from 1964 to 1989. Today, more than 3,200 commercial SNF assemblies remain in wet-pool storage at the Morris facility, including 270 assemblies from SONGS Unit 1.\textsuperscript{20}

After the accident at the Three Mile Island (TMI) Unit 2 nuclear generating station in 1979, damaged SNF assemblies and core debris from the partial reactor meltdown were shipped to Idaho National Laboratory (INL). The material was packaged at the TMI site in custom-engineered canisters and then placed in specially designed casks for transportation.\textsuperscript{20}

Shipments of SNF have been successfully carried out in the United States and internationally for decades and continue today. The U.S. Navy transports SNF regularly and the transportation and nuclear industries have the knowledge, experience, and technical capability to transport SNF safely and securely with robust regulatory oversight by multiple entities.

\textsuperscript{19} G.E. Morris continued to receive SNF shipments from Cooper Nuclear Generating Station in Nebraska and Monticello Nuclear Generating Station in Minnesota, until 1989. “Historical Overview of Domestic Spent Fuel Shipments – Update,” Science Applications International Corporation. Today, more than 3,200 commercial SNF assemblies remain in wet-pool storage at the Morris ISFSI facility, including the 270 assemblies from SONGS Unit 1 (NRC Special Nuclear Materials License 2500, Docket 72-001). While the SONGS co-owners retain title to these assemblies, requirements to ship them from Morris to another storage location or repository are not within the scope of this CTP because the assemblies will not be returned to the SONGS site prior to disposal.

\textsuperscript{20} https://tmi2xml.inl.gov/Documents/4f-DOE/EGG,%20Vol.%206,%20No.%201,%20TMI,%20Unit-2,%20Technical%20Information%20and%20Examination%20Program,%20Update%20(1986-
The TMI-2 canisters were shipped from Pennsylvania to INL by rail starting in 1986 and ending in 1989. Over this time period, 22 rail shipments, each transporting three NuPac 125B packages, were completed.\textsuperscript{21}

In another example, Progress Energy shipped SNF from H.B. Robinson Station to Brunswick Station and from both H.B. Robinson and Brunswick stations to Shearon Harris Station over a period spanning from the mid-1970s to the mid-2000s.\textsuperscript{22} In total, 210 inter-site SNF shipments occurred as part of this campaign over nearly three decades. Duke Energy has also made several shipments of SNF from its Oconee site to its McGuire site. All of the Progress Energy and Duke Energy shipments used bare fuel cask transportation packagings loaded with SNF that was taken directly from spent fuel pools. Unlike the SONGS SNF, the SNF in the Progress Energy shipments was not previously stored at an independent spent fuel storage installation (ISFSI) at the originating site nor was it transported in a packaging that incorporated a separate, internal SNF canister. By contrast, the SONGS fuel is already in canisters, which will be inserted into transportation casks to create a “transportation package.” Thus, when the SONGS SNF is transported it will be protected within not one, but two engineered boundaries: a seal-welded canister and, around the canister, a bolted-lid metal cask.

As an example of a large-capacity SNF transportation packaging similar to what would be used to ship the SONGS SNF, several SNF shipments using the NAC-STC transportation packaging have occurred in China. Although the NAC-STC packaging can be used to ship a SNF canister, these shipments involved bare (i.e., uncanistered) fuel. As we have already noted, this would not be the case for SONGS SNF, which will be shipped in canisters that are placed inside transportation casks.

In 2015, DOE implemented a large-scale, highway-based shipping campaign to move SNF and liquid radioactive waste from Chalk River Laboratories in Ontario, Canada to the Savannah River Site in South Carolina. The SNF portion of this inventory was shipped over a period of approximately four years under the auspices of DOE’s Foreign Research Reactor Spent Fuel Acceptance Program. More than 66,000 miles of SNF transport were completed as part of this campaign.\textsuperscript{23} Transportation of the liquid waste portion of the inventory was completed in 2020.

\textsuperscript{21} The Transnuclear (TN) dry shielded canisters (DSCs) used at the TMI-2 storage facility at INL were designed and certified to store up to 12 of the smaller TMI-2 canisters each. The TMI-2 DSCs are vented to the interior of the NUHOMS storage module, unlike the SONGS DSCs, which are fully seal-welded. The TMI-2 damaged SNF and core debris are stored in 29 DSCs and NUHOMS\textsuperscript{®} modules. See: NRC Special Nuclear Materials License No. SNM-2508, Docket 72-020.

\textsuperscript{22} These shipments were necessary because the originating sites needed to create room for additional SNF storage in their spent fuel pools to support continued plant operation. The Shearon Harris plant was chosen as the destination to take advantage of the four spent fuel pools at the site, where there is only one operating reactor.

Regular shipments of a specific form of nuclear waste from United States defense activities, known as transuranic (TRU) waste, have been ongoing since 1999. TRU waste is shipped by truck from the Los Alamos, Argonne, Idaho, Lawrence Livermore, and Oak Ridge National Laboratories, and from the Savannah River Site, to the Waste Isolation Pilot Plant (WIPP) geologic repository near Carlsbad, New Mexico. While these shipments do not include SNF (WIPP cannot accept SNF), they do involve Type B waste packages being transported on public highways.

Finally, the Navy Nuclear Propulsion Program has made almost 900 rail shipments of Navy SNF to Idaho National Laboratory since 1956. These shipments continue on a regular basis (Figure 2.1); in addition, DOE ships small amounts of foreign and research SNF. Internationally, SNF is transported among various countries for reprocessing; the reprocessed fuel is then returned to reactor sites for re-use in power generation.

This summary, while not exhaustive, demonstrates that the United States has amassed considerable experience with safe, secure, and uneventful SNF shipments over the last six decades.

**Figure 2.1. Rail Routes Used to Ship Navy SNF to Idaho National Laboratory**

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24 Transuranic radioactive waste is waste that contains manmade elements heavier than uranium on the periodic table. It is produced during nuclear fuel irradiation, nuclear weapons research and production, and is separated during the reprocessing of spent nuclear fuel. Transuranic waste consists of materials containing alpha-emitting radionuclides, with half-lives greater than twenty years and atomic numbers greater than 92, in concentrations greater than 100 nanocuries per gram of waste. The WIPP Land Withdrawal Act specifically excludes high-level waste and spent nuclear fuel from the definition of TRU waste, as neither is allowed to be disposed of at WIPP.

25 Historically, shipments were also made from the Rocky Flats site near Denver, Colorado. The cleanup of that site has been completed and the land is now a wildlife refuge.

2.2 Regulatory and Legal Framework

Shipments of SNF are subject to extensive regulatory and legal requirements that are intended to protect public health and safety, and the environment. This section describes the regulatory and policy context for SNF transportation.\(^{27}\) Strict federal and state oversight have helped create an exemplary safety record for shipments of these kinds of materials: to date, thousands of SNF shipments have been made and none has resulted in a release of radioactive contents due to the failure of a cask, despite the fact that accidents have happened.\(^{28}\)

The federal agencies with primary responsibility for regulating SNF transport are the Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (DOT), and—to a lesser degree—the U.S. Department of Energy (DOE). Given their joint regulatory responsibilities in this area, the NRC and DOT signed a memorandum of understanding (MOU) in 1979 that outlines their respective roles regarding the safety of radioactive materials transportation. The NRC regulations invoke specific DOT regulations.\(^{29}\) DOE asserts its ability to ship SNF, independent of DOT or the NRC, under authority granted by the Atomic Energy Act (AEA). DOE shipments to a facility operating under the auspices of the Nuclear Waste Policy Act (NWPA) must meet additional requirements as discussed in Section 2.2.1 below; DOE shipments of SNF for research and development purposes, on the other hand, are not bound by NWPA requirements.

State and tribal governments may be viewed as co-regulators of SNF transportation since they have the responsibility to enforce certain aspects of the federal regulations. Further and just as important, many states have statutes specific to SNF transportation.

Finally, public confidence that transportation is being conducted in compliance with robust regulatory and legal requirements is a critical element of a successful campaign for shipping SNF.

2.2.1 Federal Role and Requirements

This section describes the specific roles and responsibilities of the three federal agencies that have primary responsibility for regulating SNF shipments in the United States: the NRC, the DOT, and DOE.

**Nuclear Regulatory Commission:** The NRC has regulatory authority for the packaging and transportation of radioactive material by licensees who are authorized by the NRC to receive, possess, use, or transfer licensed radioactive material [10 CFR 71]. These regulations apply if the licensee delivers the material to a carrier for transport, transports the material outside the site of usage specified in the NRC license, or transports the material on public highways. The NRC also has regulatory authority over the physical protection of licensed radioactive materials against theft or sabotage (see Box 2.1) [10 CFR 73]. Specific areas of NRC regulation that apply to the transportation of SNF include:

\(^{27}\) A lengthy discussion of the policy and regulatory context for SNF management more generally, including the evolution of the nation’s nuclear waste program and the broader challenge of siting and developing viable disposal and consolidated storage facilities for SNF, is provided in the Strategic Plan (Vol. II).


\(^{29}\) See 10 CFR 71.5(a)
• Establishing regulatory requirements for Type B package designs, including fissile material packages.\textsuperscript{30,31}

• Certifying the manufacture, use, and maintenance of Type B packages.

• Inspecting the preparation of transportation packages prior to shipment and for compliance with NRC regulations en route.\textsuperscript{32}

• Approving quality assurance programs for package design, manufacture, and use.

• Developing physical protection requirements for SNF in transit.

• Approving routing and safe haven criteria for truck shipments of SNF.

• Approving security plans for rail and highway routes.

• Establishing requirements for advance notification to governors and their designees for states and tribes impacted by SNF shipments.\textsuperscript{33}

• Conducting inspections in accordance with NRC requirements.\textsuperscript{34}

• Providing technical support to DOT in accordance with inter-agency agreements.

\textsuperscript{30} See Appendix B, Section 2.1.1, for definitions of “transportation package” and “transportation packaging.”

\textsuperscript{31} 10 CFR 71.4 defines “fissile material” as material containing the radionuclides uranium-233, uranium-235, plutonium-239, and plutonium-241, or any combination of these radionuclides.

\textsuperscript{32} En route shipment inspections would not be performed by NRC for DOE shipments made pursuant to the NWPA.

\textsuperscript{33} 10 CFR 71.97 requires the licensee responsible for a shipment to provide advance notification to the governor of a state (or designee) of the shipment of licensed material within or across the boundary of the state before initiating transport of the material outside the confines of the licensed facility. Another section of the same regulation also requires advance notification of the tribal official (or designee) of the shipment of licensed material within or across the boundary of a tribal reservation. Recipients of these notifications must attend training on the identification and control of safeguards information related to transportation and other pertinent nuclear security requirements.

\textsuperscript{34} The NRC inspects holders of NRC licensees and NRC-issued certificates of compliance (CoCs). The NRC would not inspect DOE-certified packages or DOE activities governed by the NWPA as it would an NRC licensee because DOE would not be considered an NRC licensee for shipments made under the NWPA.
Box 2.1: Security Requirements for SNF Shipments

In addition to extensive safety requirements, NRC, DOT, and DOE have established enhanced security requirements specific to SNF shipments. These efforts are consistent with current international initiatives and Department of Homeland Security (DHS) activities to prevent threats to public safety from malicious acts (e.g., sabotage or diversion of radioactive materials).

Existing security requirements for commercial and research SNF shipments include:

- Armed escorts that accompany every shipment
- Training of escorts on threat recognition, response, and management
- Special security procedures to safeguard the shipment in emergencies
- Advance arrangements with law enforcement agencies along routes
- Notification to governors and tribal designees along the routes before transport begins
- Requirements that escorts maintain visual surveillance of the shipment at all times
- Status reporting by the escorts every two hours
- An NRC-inspected and approved capability to immobilize the vehicle (for highway shipments)
- Protection of specific information about any shipment
- Satellite tracking of shipments, with access to tracking information by appropriate federal, state, and tribal officials

Applicable security requirements for rail and highway shipments are very similar, with differences due to needs and limitations related to the mode of transport. For instance, because rail shipments cannot be taken off route or out of commerce in the same manner as a highway shipment, they do not require the designation of safe havens. Further, for highway shipments, the transport vehicle is required to have an immobilization feature which would deny control of the vehicle to anyone who attempted to commandeere the shipment. This immobilization feature must be inspected and approved by the NRC. Another difference is that railroads must evaluate the safety and security of potential routes using the 27 factors required by 49 CFR 172.820. There is no corollary to that regulation for highway shipments. Part of this difference is that railroads operate on private land while highways are public property.

Security requirements also include coordination with states and tribes along transport routes. This coordination, which would involve significant communication with public safety officials, would be part of the advance planning efforts discussed in Section 2.4.

U.S. Department of Transportation: Title 49 of the U.S. Code of Federal Regulations includes all federal regulations pertaining to transportation. Subchapter C of Title 49 addresses the transportation of hazardous material, which includes radioactive material. Within DOT, the Pipeline and Hazardous Materials Safety Administration (PHMSA) and its modal partners—the Federal Railroad Administration (FRA), the Federal Aviation Administration (FAA), and the Federal Motor Carrier Safety Administration (FMCSA)—implement DOT’s authority for ensuring the safe and secure transportation of hazardous materials, including radioactive materials, in commerce. DOT’s regulation of hazardous materials, including radioactive materials, encompasses several responsibilities including:

- Requirements for shipping papers, package marking, labeling, and transport-vehicle placarding applicable to the transport of hazardous materials.
• Requirements for preparing hazardous materials for shipment by air, highway, rail, or water, or any combination thereof; and identification of inspection and testing requirements for containers used in the transportation of hazardous materials. It is worth noting that there are no provisions in DOT regulations for air shipment of SNF, and no packages have been certified for air shipment of SNF in the United States.

• Requirements for training personnel involved in hazardous materials shipments.

• Additional requirements specific to rail, motor carrier, air, or vessel transport.

• Requirements for pre-shipment and en-route safety inspections by carriers.

• A requirement that railroads select rail routes for SNF and high-level waste (HLW) shipments based on an annual assessment of safety and security along their routes. The railroads are required by statute to use specific safety and security criteria, including 27 attributes, in selecting rail routes for the shipment of highway route controlled quantities of radioactive material (SNF and HLW) and other highly hazardous wastes.35

• Development of the FRA’s Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel (SCOP).36 The SCOP was first adopted as policy in 1998 and is currently undergoing revision.

• The FMCSA’s requirement for Level VI inspections for truck shipments of “highway route controlled quantity”37 (HRCQ) materials.38

U.S. Department of Energy: Under the AEA, as amended, DOE has authority to regulate all aspects of activities involving radioactive materials that are undertaken by DOE or on DOE’s behalf, including the transportation of radioactive materials. For shipments made under the auspices of the NWPA, additional legal requirements for the transportation of SNF and HLW to a repository or interim storage facility are set forth under Sections 180 and 181 of the NWPA and Section 131, which resulted in the Standard Contracts (10 CFR 961) between DOE and the utilities.

Internally, DOE governs its own shipments of radioactive material through DOE Orders 460.1C, Packaging and Transportation Safety, and 460.2A (current as of the writing of this document), Departmental Materials Transportation and Packaging Management. Under these orders, DOE committed to meet or exceed any requirements in equivalent DOT and NRC regulations for the transport of radioactive materials.

The NWPA directs DOE to remove SNF and HLW39 from all originating sites in the United States. This includes commercial SNF at power plants such as SONGS, and DOE-managed SNF and HLW from research activities and weapons production facilities. The NWPA requires that these materials be disposed of in a repository at Yucca Mountain, Nevada. Section 137 of Subtitle B and Sections 180 and

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35 49 CFR 172.820.
36 The SCOP addressed mechanical equipment condition, infrastructure integrity, and highway-rail grade crossing safety. It was developed through a coordinated effort between the FRA, DOE, the Association of American Railroads (AAR), railroad labor organizations, and state and tribal representatives.
37 “Highway route controlled quantity” is defined as a quantity of radioactive material within a single package which exceeds: (1) 3,000 times the A1 value of the radionuclides for special form material or 3,000 times the A2 value of the radionuclides for normal form material; or (2) 1,000 TBq (27,000 curies), whichever is less.
38 49 CFR 385(4)(b)(1)
39 A subsequent court finding determined that GTCC waste disposal is also covered by the NWPA.
181 of Subtitle H of the NWPA address transportation. (Section 181 concerns airborne transportation of plutonium and is not relevant to this discussion.) Sections 137 and 180 contain three subsections that together establish several requirements for shipments of SNF and HLW governed by the NWPA:

- SNF shipments by DOE must use private industry to the fullest extent possible,
- SNF and HLW packages used for transportation by DOE must be certified by the NRC,
- DOE must follow NRC regulations pertaining to advance notification of state and local governments prior to transportation, and
- DOE must provide technical assistance and funds to states and Indian tribes to train public safety officials of appropriate units of local government through whose jurisdiction the Secretary plans to transport SNF or HLW. This training is required to cover procedures for dealing with safe routine transportation as well as emergency response situations.

Section 180(c) of the NWPA is of particular interest to corridor jurisdictions. It requires DOE to provide funding and technical assistance to train public safety officials along SNF shipping corridors, on procedures for both safe routine transportation and emergency response. DOE last published a draft of its Section 180(c) policy in 2008.\(^\text{40}\)

This draft proposed that the amount each state or tribe would be eligible for would consist of a base portion for planning purposes and a variable amount calculated by a formula that considered the number of shipments through a jurisdiction, the miles per shipment in that jurisdiction, and other factors. The same draft rule envisioned that a grant of up to $200,000 would be made to each eligible jurisdiction for a needs assessment. This would include a $100,000-per-year base grant, plus a grant for the variable amount. Tribal governments would receive a base grant and could apply for funds after conducting a needs assessment. There is no explicit, equivalent requirement that private shippers provide similar funding for training, but some states and tribes have expressed their expectation that assistance will be provided in a private shipping scenario.\(^\text{41}\)

Subtitle A of the NWPA, Section 136(a), directs the Secretary of Energy to enter into contracts with the owners of commercial SNF to take title to SNF at the owner’s site, transport the SNF to a federal facility, and store it pending further processing, storage, or disposal. Section 136 also authorizes the Secretary to establish a fee for SNF management that goes into the federal Nuclear Waste Fund (NWF) (the NWF fee and other aspects of the Standard Contract are discussed in detail in Appendix B of this CTP and in Chapter 5 of the Strategic Plan).

To comply with Section 136 of the NWPA, DOE promulgated a rule to establish a Standard Contract between DOE and all civilian owners of SNF. The Standard Contract obligated DOE to take title and remove SNF from reactor sites in return for payments into the NWF.\(^\text{42}\) Because it required DOE to take title to SNF at originating sites and remove it, the Standard Contract necessarily required DOE to possess and transport SNF.


\(^{42}\)As detailed at 10 CFR 961, Subpart B, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste.”
The Standard Contract details the specific responsibilities of the “United States Government” (represented by DOE) and the utility (“The Purchaser”). The Purchaser’s responsibilities pertaining to transportation are found in Article IV.A.2 of the Standard Contract (see Appendix B).

2.2.2 State, Tribal, and Local Government Roles and Requirements

State, local, and tribal governments have primary responsibility for protecting the health and safety of citizens, and for protecting the environment, within their respective jurisdictions. As such, they have some level of authority over shipments of radioactive materials within and through their jurisdictions. This includes a regulatory role, an emergency management and response role, and—though not generally required by law or regulation—a role in communicating with the public about the safety measures taken for these shipments.

States often adopt federal (DOT) regulations by statute and often function as part of the DOT’s inspections and enforcement apparatus. Governments below the federal level (state, tribal, county, and municipal) cannot prohibit the transport of SNF and HLW through their jurisdictions. However, they can enact laws or ordinances, provided these are not in conflict with federal laws, that address areas not otherwise covered by federal regulation. For example, states have used this authority to ensure safe operation of motor vehicles and compliance with hazardous materials transportation regulations through inspection and enforcement activities for highway and rail shipments consistent with federal regulations.43 Tribal governments have similar enforcement authorities, if they choose to exercise them. Local government authority is generally limited to emergency planning and response.

Specific areas of state inspection and enforcement include:

- Registration and permit programs that include fees for shipments that traverse state jurisdictions, as long as the fees are reasonable and can be justified as providing funding for emergency planning and preparedness activities related to SNF transport.44
- Inspection and enforcement activities for highway shipments that exit, enter, or traverse states; states must have inspectors qualified to Level VI inspection standards for highway shipments (see Appendix B) and an active FRA State Rail Participation Program in order to inspect rail shipments.
- Notification requirements and logistical planning with entities that are involved in shipments.
- Financial liability in the event of an accident.
- Emergency preparedness training, planning activities, and response to an incident or accident involving radioactive materials.

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44 DOE has questioned whether states can both receive fees and receive funding for activities that are also covered by Section 180(c) of the NWPA since that could mean the federal government is paying twice for the same preparedness. A final decision on this issue was not reached before DOE’s Office of Civilian Radioactive Waste Management was disbanded. [https://www.govinfo.gov/content/pkg/FR-2008-10-31/pdf/E8-26018.pdf](https://www.govinfo.gov/content/pkg/FR-2008-10-31/pdf/E8-26018.pdf).
The NRC requires that state governors be notified in advance of SNF shipments through their jurisdictions. These notifications are typically made to the “governor’s designee” who is typically an employee of the state’s emergency management, state law enforcement, or radiological health program. The California governor’s designee is on the staff of the California Energy Commission. A list of these individuals and their contact information is maintained by the NRC. Shipments made under the auspices of the NWPA are similarly required to provide the same advance planning and 10-day prior notification as required by the NRC.

Federally recognized Native American tribes can “opt in” to the NRC’s list of governor designees to receive advance notification of nuclear shipments that pass through their sovereign territory. This process involves the tribe making a request to the NRC and complying with the information protection and storage requirements for Safeguards Information (SGI) as prescribed in 10 CFR 73. Once a tribe opts in, they must receive the same advance notice of shipments as affected states. A tribe that has not opted in is prohibited by law from receiving advance notice of shipments because it lacks permission to access SGI-protected information. No tribal authorities currently assess a fee or impose permit requirements on nuclear material transiting their territory.

As already noted, state, local, and tribal authorities also play an important emergency response role in the event of an accident involving a SNF shipment. In general, state and local governments have extensive experience with preparedness and planning efforts for hazardous material transportation incidents within their jurisdictions through various state and federal programs. Once they know that shipments are planned through their jurisdictions, they must have the training and preparedness in place to respond to an accident or incident involving SNF. As detailed in Box 2.2, considerable federal assistance is available to help train local emergency responders. In addition, training is also available from private organizations with experience in radioactive material shipments; such organizations can be hired to develop and deliver training specific to SNF shipments to a private facility. Appendix H contains more information about emergency response training requirements and the emergency response structure for shipments involving SNF.

2.3 Industry Standards

The Association of American Railroads (AAR) is the standard-setting organization for all of North America’s freight railroads. For hazardous materials, the AAR publishes and periodically updates Circular OT-55 “Recommended Railroad Operating Practices for the Transportation of Hazardous Materials.” This circular defines terms such as “key trains,” the designation of “key routes,” and “yard operating practices” for shipments of hazardous materials, which includes shipments of SNF.

The AAR also developed Standard-2043 which specifically applies to rail cars used to transport high-level radioactive material, such as SNF. This standard sets additional strict performance requirements beyond those that apply to conventional rail cars.

45 Per 10 CFR 71.4, “Indian Tribe” means an Indian or Alaska Native Tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian Tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 5130.
The transportation of radioactive materials is a complex process involving a web of entities, each with defined roles and responsibilities. Which entities are involved at different points in the process can vary depending on the circumstances governing particular SNF shipments. In most if not all cases, the list is likely to include DOE, the NRC licensee who possesses the SNF prior to transport (in this case, the SONGs co-owners46), private logistics companies, package owners, and carriers (i.e., railroads), as well as the owner of the licensed receiving facility (if not DOE), regulatory agencies, and other federal, state, and tribal entities.

46 Currently, the SONGs co-owners both possess and hold title to the SONGs SNF. Holtec and Interim Storage Partners (ISP) are two private companies that are currently seeking licenses for consolidated interim storage facilities (CISFs) in New Mexico and Texas respectively. (Both projects are discussed at length in the Strategic Plan.) The draft licenses for both facilities would require clients who hold title to SNF at originating sites to retain title while the SNF is in storage at the proposed facilities. For the private owners of these CISFs to take title to the SONGs SNF for storage at their facilities, they would have to either amend the CISF licenses to remove the client title retention condition or acquire the three SONGs Part 50 licenses and take ownership of the SONGs SNF at the SONGs site. This is the approach that Holtec has taken at Oyster Creek and Pilgrim and ISP has taken at Crystal River and Vermont Yankee (in both cases, via separate but affiliated companies). Holtec and ISP could, in theory, take possession of SNF in its packaged configuration at the SONGs gate without taking title or acquiring the SONGs Part 50 licenses, but that would require licensing action beyond their current CISF license applications. These details are discussed in the Strategic Plan, Volume II.
Together these multiple entities must coordinate—often well in advance—to execute the actual movement of SNF. That process typically includes (at a minimum) selecting transportation modes and routes, planning for security and emergency response, training personnel, and communicating with local communities and stakeholders, as well as ensuring that necessary handling equipment and capabilities are in place to load the SNF at the source site and to unload it at the receiving site.

In many cases, logistics companies may be retained to integrate activities among multiple stakeholders; ensure regulatory compliance; expedite movements; ensure safe, secure, and uneventful shipments; and prepare a coordinated response in the event of any accidents or unforeseen incidents.

Figure 2.2 illustrates the web of interactions that may occur among key entities involved in SNF transportation. Specific roles and responsibilities under different scenarios for transporting SONGS SNF are discussed elsewhere in this document.

2.5 Advance Planning and Stakeholder Engagement

In a 2006 report on the transportation of nuclear waste, the National Academies of Science (NAS) found “[n]o fundamental technical barriers to the safe transport of spent fuel.” However, the same report also concluded that “there are a number of social and institutional challenges to the successful initial implementation of large-quantity programs” and cautioned that “the challenges of implementation should not be underestimated.”

The NAS report thus highlights a dilemma: Even in the context of a strong safety record and strict regulatory environment, the transportation of SNF can be expected to draw a high level of interest, concern, and scrutiny from the public, particularly in communities along planned transportation routes. This interest and scrutiny, not only from the public but also from the nuclear industry, elected officials, and regulators, requires thoughtful and thorough planning on the part of the shipper. In addition, several features of a shipping campaign for SONGS SNF may be expected to heighten interest and concern among stakeholders (see further discussion in Chapter 4).

To address the high level of interest in SNF shipments, DOE has developed a system of cooperative planning over the years. Its model has been used for many shipping campaigns but perhaps most notably for shipments to WIPP and for shipments from California and South Carolina to Idaho under the Foreign Research Reactor program.

The DOE model begins engagement sooner and involves a greater number of entities than private shippers have typically engaged. For example, DOE works with state and tribal governments and state regional organizations such as the Western Interstate Energy Board, the Southern States Energy Board, and the Councils of State Governments – East and Midwest Regions, to design regulatory policies and procedures, address issues that are not covered by regulations (e.g., qualifications for WIPP drivers), and communicate with the public and emergency response personnel along routes.

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Figure 2.2. Entities and Relationships in the SNF Shipment Planning Process
Even the Naval Nuclear Propulsion Program, which for security reasons cannot release much information publicly, works extensively with state and tribal governments and local emergency responders. The Navy holds joint emergency response exercises every other year with state and tribal emergency response personnel, briefs state and tribal officials and relevant state regional groups, and presents briefings at industry and public meetings. The Navy does not, however, provide support for emergency response training or technical assistance to safety officials along transport routes for Navy spent fuel.

Although private entity shippers are not subject to the same legislative requirements for engagement and route preparedness as DOE (e.g., private shippers are not required to support training for emergency responders), some companies such as Duke Energy and Progress Energy have found that close engagement with state and local officials leads to greater cooperation and fewer issues when SNF shipments start. In summarizing “lessons learned” from an inter-site shipping campaign, Duke Energy identified coordination and planning with stakeholders as key elements of success for any large-scale effort to ship commercial SNF. Similarly, Orano, in preparing to transport low level radioactive waste from the Vermont Yankee plant site to the Waste Control Specialists (WCS) facility in Texas in 2020, engaged with stakeholders approximately a year and a half prior to the first shipment.

Both private entity shippers and the federal government have found that public confidence in shipments is considerably higher if people know that their state, tribal, and local public safety officials are prepared for these shipments and if they understand the precautions that are taken to ensure that shipments are safe, secure, and uneventful. Some states have also indicated that they expect to work cooperatively with any shipper, whether the shipper is DOE or a private entity, to develop policies and protocols for SNF shipments. These states view such collaboration as essential to successful transportation planning. With funding from a cooperative agreement with DOE, the Western Interstate Energy Board

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**Western Governors’ Association Program Implementation Guide**

*In 1989, the WGA established a Technical Advisory Group consisting of representatives from seven western states along the initial transportation corridor to the WIPP. The group was formed to work with DOE to develop procedures on the safe and uneventful transportation in the following areas:*

- Accident prevention
- High-quality drivers and carrier compliance
- Independent inspections
- Bad weather and road conditions
- Safe parking during abnormal conditions
- Advance notice of shipments
- Access to information on shipment status
- Emergency preparedness
- Mutual aid agreements
- Emergency response plans and procedures
- Training and retraining
- Emergency response equipment
- Public involvement and information

*Working cooperatively with WIPP, the Technical Advisory Group developed the WIPP Transportation Safety Program Implementation Guide. The guide contains a significant number of extra regulatory requirements to address the areas listed above.*

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48 Progress Energy, which shipped SNF among its nuclear sites, merged with Duke Energy in 2012.
has developed 12 policies that federal and private entities would be expected to follow when executing SNF shipments in the western United States.\(^{52}\) In sum, a proactive approach that engages stakeholders early in the planning process can help ensure that challenges or issues are identified well in advance. This is particularly important in the context of a large-scale shipping campaign.\(^{53}\)

National and local organizations have sometimes emphasized transportation safety concerns to fuel public opposition to the siting of new nuclear waste facilities. This can be very effective in alarming the public even when these characterizations have little basis in fact or experience. All entities involved in SNF transportation therefore need to be thoughtful in addressing public concerns and questions and in sharing accurate and timely information before misperceptions take root. Accurate information, in particular, is critical to develop and sustain public acceptance, along with a willingness to hear and address public and stakeholder concerns.

### 2.6 SNF Transportation Packaging

Regardless of mode, SNF must be shipped in specially designed and manufactured “Type B” packagings. These packagings perform several key design functions during shipment, including heat removal, radiation shielding, and protecting the structural integrity of the canister and internal fuel basket, which provide criticality control and containment for the SNF. In the United States and internationally, Type B packaging is designed and constructed to pass a series of tests that simulate severe accident forces. The NRC reviews packaging designs to ensure they meet applicable safety standards and test conditions. Type B packaging is subject to the highest safety standards of any transportation packaging. Type B packagings exceed even the packaging requirements for transporting Hazmat Class 2.3 toxic gases (i.e., chlorine gas), Class 6 poisons, and Class 1 explosives.

Specifically, Type B packaging must withstand four tests conducted in sequence to simulate hypothetical accident conditions. During and after the tests, the casks must contain the nuclear material, limit radiation doses (to levels defined as acceptable by regulation), and prevent a criticality event. Class 7 “radioactive materials,” a category that includes SNF, is the only hazard class that requires specialized packaging be designed and tested to survive severe hypothetical accident conditions. The four tests are depicted in Figure 2.3.

The requirements for packaging and security of SNF are the most stringent in the transportation industry. No other hazardous material, such as chlorine gas or explosives, are required to use Type B packaging or follow strict safety and security precautions.

The NRC allows the use of state-of-the-art computer models, as well as scale model tests by applicants, to demonstrate that package designs meet regulatory requirements for certification. Transportation casks are designed to be re-used for multiple shipments and receive NRC-required periodic maintenance before and during shipping campaigns.

When DOE ships domestic or foreign reactor research SNF, it uses either an NRC-certified package or a Type B packaging. Transportation concerns have often been invoked to build national or regional opposition to the siting of facilities for the consolidated storage or disposal of SNF away from a reactor site (this was the case for Private Fuel Storage, a utility-led effort to site a consolidated storage facility in the 1990s, and Yucca Mountain, the proposed site for a federal repository).
package certified under its own (DOE) package design requirements, depending on the details of the specific shipment. These requirements closely mirror the NRC requirements. However, if DOE ships SNF to a facility licensed and constructed under the NWPA (as would be the case for shipments to a repository at Yucca Mountain, for example), DOE must use NRC-certified packages.

Figure 2.3. SNF Transportation Package Tests for Accident Conditions

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54 NUREG-2125, Figure 1-1.
3. **Key Issues for the Transportation of SONGS SNF**

While this CTP specifically addresses the shipment of SONGS SNF and GTCC waste, the discussion of key issues in this chapter is not unique to SONGS or the SONGS co-owners. In fact, most utilities that are storing SNF at plant sites will have to deal with these same issues to some degree in order to ship SNF to an offsite facility.

3.1 **Responsibility for Shipments**

The Strategic Plan (Vol. II) provides a detailed assessment of seven possible pathways for the offsite disposition of SONGS SNF. Broadly speaking, these pathways can be divided into two categories: (1) pathways in which the federal government takes title to the SNF at SONGS and removes it for storage or disposal at an offsite facility and (2) pathways in which a non-federal entity—whether the SONGS co-owners or another third party—removes the fuel. Alternatives in the first category include federal repository, federal consolidated interim storage facility (CISF), and federal use of a non-federal CISF. Alternatives in the second category include private CISF (specifically, the Holtec and ISP facilities currently being proposed for New Mexico and Texas, respectively), CISF for California SNF only, multi-utility CISF at another nuclear plant site, and relocating the SONGS SNF to a new independent spent fuel storage installation (ISFSI) at another site.

The key distinction between these two categories, as discussed at length in the Strategic Plan, centers on the role of the federal government, which remains obligated—by current law and contract—to remove commercial SNF from nuclear plant sites using funds that have already been collected from nuclear utility customers. Under any scenario where the federal government performs on this obligation, responsibility for implementing transportation and for covering all related costs would fall to the federal government. Accordingly, the responsibility of the SONGS co-owners would be limited to preparing the SNF for transport and delivering it to the “front gate” of the plant site. In the four non-federal disposition pathways NWT assessed, by contrast, transportation becomes a major challenge, and a very substantial challenge, from the standpoint of the utility owner of SNF seeking options to move fuel off site.

In part because of that challenge, a central finding from NWT’s assessment is that federal action offers the most reliable and practically viable path forward for clearing SNF from nuclear plant sites. This finding applies not only at SONGS but at growing numbers of shutdown plant sites across the country. All of the disposition pathways NWT considered that are not predicated on federal action, face formidable and perhaps insurmountable obstacles in terms of cost (including transportation costs), liability considerations, and overall commercial reasonableness. To the extent any of these pathways would require the siting of new facilities, they also face additional hurdles of public and stakeholder acceptance.

This chapter focuses on the transportation implications that follow from different assumptions about the federal role. Section 3.1.1 covers the relatively straightforward case (from the SONGS co-owners’ perspective) where the federal government takes title and assumes responsibility for transportation at the SONGS site boundary. It corresponds to the federal repository, federal CISF, and federal use of a

35 As we note in the Summary, it has been suggested that a case could be made for federal reimbursement of certain on-site costs to prepare for SNF transportation that would not have been incurred but for the federal government’s failure so far to perform on its statutory and contractual obligations. NWT did not explore this possibility.
non-federal CISF alternatives in the Strategic Plan. All sections through 3.1.4 discuss scenarios that do not presume federal responsibility for transportation; they correspond to the non-federal CISF, California-only CISF, multi-utility CISF, and relocation of SONGS SNF to a new ISFSI alternatives in the Strategic Plan. We consider three possibilities for non-federal transportation to an offsite facility. Each applies different assumptions about ownership of the SONGS SNF and about the commercial arrangements with the owner/operator of the receiving facility.

The question of which entity has responsibility for transporting SNF is important both because it has significant cost and liability implications, and because there are regulatory differences between shipments made by DOE and those made by NRC licensees. Because DOE has statutory authority to possess and transport SNF, DOE does not require an NRC license to ship SONGS SNF to a new location. Thus, the simplest and most cost-effective path forward for a utility is for the federal government to fulfill its statutory and contractual obligations.

If a non-federal entity executes shipments, the path forward becomes much more uncertain with regard to costs, risks, and liabilities. The Settlement Agreement that gave rise to the Strategic Plan and this CTP explicitly stipulates that any strategy the SONGS co-owners implement for relocating the SONGS SNF “must result in the transfer of liability for and title to the SONGS spent fuel to a third party unless SCE obtains contract terms from the third party, such as, but not limited to, indemnities and insurance provisions, that offer commercially reasonable protection from liabilities and risks that may arise from SCE's retention of title to the SONGS spent fuel.”

Table 3.1 compares the regulations that DOE as shipper would follow versus shipments made by an NRC licensee.

### 3.1.1 Considerations if the Federal Government Ships SONGS SNF

If DOE takes title and possession of SONGS SNF at the SONGS gate, transportation is straightforward, at least from a regulatory standpoint. Under the provisions of the Atomic Energy Act (AEA), DOE has historically maintained that it is authorized to “self-regulate” when it comes to transporting SNF and other radioactive materials. DOE’s internal orders governing transportation activities are set forth in DOE Order 460.2A and its Radioactive Material Transportation Practices Manual (DOE Manual 460.2-1A). The Order is currently under revision. Additionally, in the last draft of OCRWM’s “National Transportation Plan” (issued in 2009), DOE committed to meeting or exceeding NRC and DOT requirements for commercial nuclear waste shipments regulated by those agencies. Therefore, if DOE transported the SNF from SONGS or another site, DOE would self-regulate except for those provisions of the NWPA that require DOE to use NRC-certified packages and abide by NRC regulations regarding advance notice to states and tribes.

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56 All of these alternatives are discussed in detail in Chapter 7 of the Strategic Plan. Federal repository, federal CISF, and federal use of a non-federal CISF, specifically, are covered in Sections 7.3, 7.4, and 7.5 of that document, respectively.

57 Specifically, Sections 7.6, 7.7, 7.8, and 7.9 in the Strategic Plan, respectively.

58 It is important to note that if DOE does not execute shipments under NWPA authority, the SONGS co-owners would be the shippers under 10 CFR 71, absent some other entity acquiring an NRC license to perform this function. The SONGS co-owners would likely contract to subject matter experts for the actual planning and execution of the shipments.
Table 3.1. Regulatory Requirements for SNF Shipments for NRC Licensees Compared to Shipments by DOE Under the NWPA

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<th>Shipped by DOE under the NWPA</th>
<th>Comment</th>
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<td>DOE</td>
<td>10 CFR 961</td>
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<td>Packaging Requirements</td>
<td>NRC</td>
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<td>10 CFR 71</td>
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<td>DOT-PHMSA</td>
<td>49 CFR Parts 100-185</td>
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<td>Route identification (rail)</td>
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<td>DOT-PHMSA</td>
<td>49 CFR Part 172.820(c) requires rail carriers to identify annually hazmat routes with input from states</td>
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<td>Training public safety officials along routes</td>
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<td>NWPA</td>
<td>Section 180(c) NWPA</td>
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<td>Safety Compliance Oversight Plan (SCOP)</td>
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<td>Route approval</td>
<td>NRC</td>
<td>DOE / DOT / Railroads</td>
<td>10 CFR 73.37(b)(1)(vi)</td>
</tr>
<tr>
<td>Preplan and coordinate with states</td>
<td>NRC</td>
<td>DOE</td>
<td>10 CFR 73.37(b)(1)(iv) and (v) DOE 460.2-1A</td>
</tr>
<tr>
<td>Curfews/key dates to avoid</td>
<td>Shipper and States/Tribes</td>
<td>DOE and States/Tribes</td>
<td>NUREG-0561 Rev2/DOE has traditionally accepted state input.</td>
</tr>
<tr>
<td>En route rail inspection requirements</td>
<td>FRA/States who participate in SPP59</td>
<td>FRA/States who participate in SPP60</td>
<td>State-specific</td>
</tr>
<tr>
<td>Armed Security Escort</td>
<td>NRC</td>
<td>DOE</td>
<td>10 CFR 73.37(b)(1)(v) /DOE 460.2-1A</td>
</tr>
<tr>
<td>Additional escort requirements</td>
<td>States</td>
<td>States</td>
<td>State-specific</td>
</tr>
<tr>
<td>Advance notification</td>
<td>NRC</td>
<td>NRC per the NWPA</td>
<td>10 CFR 73.37(b)(2) or DOE 460.2-1A</td>
</tr>
<tr>
<td>State fees</td>
<td>States</td>
<td>States</td>
<td>State-specific, paid either before or after shipment</td>
</tr>
<tr>
<td>State Regional Group coordination</td>
<td></td>
<td>DOE</td>
<td>DOE cooperative agreement with states groups</td>
</tr>
<tr>
<td>Continuous Security and Systems monitoring</td>
<td>NRC &amp; AAR S-2043</td>
<td>DOE &amp; AAR S-2043</td>
<td>10 CFR 73.37(c)(6)/DOE 460.2-1A</td>
</tr>
<tr>
<td>Lessons Learned</td>
<td>N/A</td>
<td>DOE</td>
<td>DOE cooperative agreement with states groups</td>
</tr>
</tbody>
</table>

**Truck Shipments**

<table>
<thead>
<tr>
<th>Item</th>
<th>States</th>
<th>States</th>
<th>State-specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight permits for highway shipments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe havens/safe parking (truck only)</td>
<td>NRC</td>
<td>DOE M460.2A-1</td>
<td>Does not apply to rail shipments</td>
</tr>
<tr>
<td>CVSA Level VI Inspection (truck only)</td>
<td>DOT-FMCSA</td>
<td>DOT-FMCSA</td>
<td>49 CFR 385.415(b)(1), conducted by state inspectors</td>
</tr>
</tbody>
</table>

59 SPP is the FRA’s State Participation Program. States that do not participate in the SPP cannot inspect en route rail shipments.

As already noted, the federal government is responsible, under current law and the Standard Contract, for transporting commercial SNF from nuclear plant sites to Yucca Mountain for disposal. The originating site licensee is responsible for on-site infrastructure upgrades, preparing transport packages, and loading packages on the conveyance. New or amended legislative authority would be required to allow the federal government to move SNF to an interim storage facility or a repository other than Yucca Mountain.

Presumably, the same legislation would define DOE’s responsibilities with respect to SNF transportation for a destination other than Yucca Mountain. It would be reasonable to expect that these responsibilities would mirror those that exist under the current NWPA, which requires DOE to acquire needed transportation assets (e.g., casks, rail cars, etc.) and execute offsite transport operations (including providing security and emergency operations support for SNF shipments).

New legislative authority, it should be noted, would also be required to allow the federal government to contract with a private storage facility or to enter into another form of public–private partnership to provide storage services. How new or amended legislation might outline roles and responsibilities with respect to SNF transportation in this scenario is likewise uncertain, but any action that enabled substantial federal support for transportation activities would be significant in terms of improving the viability and commercial prospects of non-federal storage alternatives.

A DOE-funded SNF transportation campaign, whether conducted in accordance with the existing NWPA and Standard Contract or subject to guidance established under new or amended legislation, would unfold on a national level. This means that the schedule for removing SNF at SONGS could be subject to the constraints and priorities of the national-level program for SNF acceptance. As discussed at length in the Strategic Plan, existing Standard Contracts establish a framework for allocating acceptance rights that would govern the schedule removing SNF from different plant sites based on the oldest fuel in storage at these sites. This is often called the “queue.” However, DOE also has discretion to prioritize SNF removal from shutdown sites. A federal approach that prioritized shutdown sites could substantially reduce the length of time required to clear SNF from the SONGS site. An additional schedule consideration in the context of a national-level, DOE-funded transportation campaign concerns the additional advance planning time that would be required to coordinate among multiple sites and transport routes.

3.1.2 Considerations if a Private Entity Ships to a Non-Federal CISF

If DOE does not execute SNF shipments, an NRC licensee authorized to possess the material at the origination point must be the shipper under the general license provisions of 10 CFR 71.17. Such shipments would be subject to different regulations than shipments made by DOE (Table 3.1). The SONGS co-owners currently hold the three Part 50 specific licenses for the SONGS site. If the co-owners were to consider contracting for offsite storage services with a non-federal entity, transport considerations would be an important element in negotiating the distribution of costs, roles, responsibilities, risks, and liabilities among the parties.

For example, draft licenses for the proposed Holtec and ISP CISFs require that the client (in this case, the SONGS co-owners) retain title to the SNF while it is stored at the CISF. Based on NWT’s discussions with Holtec and ISP, both prospective private storage providers also expect that clients will arrange for the

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61 See Appendix F of the Strategic Plan (Volume II) for a more-detailed discussion of the Standard Contract queue and for SNF removal that prioritizes shutdown plant sites.
transportation of SNF to their respective facilities. This means that the SONGS co-owners, as title holders to the SNF and as the originating NRC Part 50 licensees, would be responsible for the safety and security of SNF shipments. Once the SNF is accepted at the CISF, the SONGS co-owners would retain title to the SNF but possession would transfer to the CISF owner. At that point, a shared liability agreement between the CISF owner/operator and the SNF owner, which is required as a condition of the CISF licenses, would govern.

Transportation costs in this scenario would likely run well over $100 million and would be borne, at least initially, by the client. The SONGS co-owners or another private entity could seek recovery of these costs from the federal government through litigation, but unless a prior agreement is in place with the government, even costs that were ultimately reimbursed through the Judgment Fund mechanism discussed in the Strategic Plan would need to be initially paid by the SONGS co-owners. Such outlays would need prior approval from the California Public Utilities Commission (CPUC) before they could be covered out of the SONGS decommissioning trust fund. Any subsequent reimbursement from the federal government could then be returned to customers when it is received.

The private shipper alternative also does not resolve issues of protection against financial and other liabilities while the SNF is in transit. The Settlement Agreement that triggered the development of this CTP and the Strategic Plan requires the SONGS co-owners to obtain protection against such risks on commercially reasonable terms in all cases that do not involve the federal government or another entity taking title to the SNF at the SONGS site boundary. Moreover, even if this condition can be met, and even if transport operations are contracted out to a third party, the utility owner(s) of the SNF will still be closely associated with the fuel and viewed as responsible for future shipments so long as they still hold title to the fuel.

Alternatives such as a multi-utility CISF discussed in the Strategic Plan could create opportunities for economies of scale on the purchase of transportation equipment and services. However, the costs would still be in the tens to hundreds of millions of dollars and are unlikely to meet the criterion of commercial reasonableness as defined in the Settlement Agreement.

3.1.3 Considerations if a Private CISF Owner Ships SONGS SNF

One variant of the non-federal CISF alternative considered in the Strategic Plan involves a scenario where the CISF owner/operator provides transportation as well as storage services. For this variant, we assume that the CISF owner takes possession of the SNF at the SONGS site in its packaged configuration and transports it to the CISF. The SONGS co-owners retain title. As discussed in the Strategic Plan, the NRC would first have to grant approval beyond the CISF owner’s Part 72 CISF license for the CISF owner to possess SNF outside the physical boundaries of the CISF site. However, if this and other hurdles related to title and liability can be overcome, it is possible to posit a scenario in which the CISF owner takes responsibility for acquiring transportation assets and for planning and executing shipments. From a regulatory perspective, the key difference between this scenario and one in which the SONGS co-owners implement transportation is that the CISF owner’s license (rather than the SONGS licenses) would confer the Part 71 general license to ship SNF.

In this scenario, the CISF owner would likely contract out for transportation planning and execution to subject matter experts and companies that have experience shipping radioactive material. However, as

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62 As described in the Strategic Plan, this could take the form of an amendment to the Part 72 CISF license or a separate Part 70 license acquired by the CISF owner.
the licensee for this material as soon it leaves the SONGS site, the CISF owner would be responsible for the safe and secure completion of SNF shipments to the CISF. Because title to the SNF does not transfer with possession in this case, the discussion above pertaining to financial protection against liability during transport, and shared liability while SNF is in storage at the CISF, applies here as well.

Additionally, because the SONGS co-owners retain title during shipping, they will need to consider their potential exposure to reputational risk if an accident or other event occurs while the SNF is in transit.

If the CISF owner is the shipper, transportation costs could be charged separately or built into storage fees for use of the CISF. As in the previous example, total costs for a large-scale, multi-client operation could run into the hundreds of millions of dollars. Whether this type of arrangement would be advantageous for the SONGS co-owners would likely depend on economies of scale in the event that the CISF owner can strike similar arrangements with other clients. If SONGS is the only client, on the other hand, then economies of scale do not apply and it might be less costly for the SONGS co-owners to retain responsibility for transportation. In either case, the SONGS co-owners face costs for transportation and the considerations noted in the previous example, with respect to uncertain prospects for recovering costs, as well as the need to obtain protection against financial risks and other liabilities, apply.

### 3.1.4 Considerations if SONGS Assets, Including SONGS SNF, Are Sold to a New Owner

In this scenario, a private entity purchases SONGS; NRC approves transfer of the three Part 50 SONGS licenses, together with the remainder of the decommissioning trust fund, to the purchaser; and the purchaser takes title to the SNF at the site. Such sales have been concluded at a number of other shutdown plant sites around the country, including at the Vermont Yankee, Pilgrim, Oyster Creek, and Crystal River plant sites. In this scenario, the sale of the SONGS site and its assets effectively transfers all responsibility and liability to complete site decommissioning to the buyer. Whether this option might present itself in the case of SONGS, and on what terms, is difficult to predict. In past sales of this type, the buyer’s ability to acquire the site decommissioning trust fund, along with responsibility for implementing decommissioning, as part of the sale has been an important element.\(^63\) At SONGS, the decommissioning process is already well along under an agreement between SCE (the decommissioning agent) and SCE’s decommissioning contractor, SONGS Decommissioning Services. This makes the sale of SONGS assets to an outside party much less likely, in NWT’s judgement.

### 3.2 Coordination with Destination Facility

At the earliest stages of planning, the shipper and the owner/operator of the destination facility will need to ensure that the technology or equipment used to load and unload SNF canisters from transportation packages is compatible. This will allow sufficient time for design parameters to be fully coordinated before equipment is fabricated.

Another area of coordination involves maintaining information security requirements for SNF shipments as detailed in the Nuclear Materials Management and Safeguards System (NMMSS). The NMMSS serves two functions. First, it is used by the U.S. government and the International Atomic Energy Agency (IAEA) to monitor inventories of special nuclear material (SNM), as a guard against the proliferation of

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\(^63\) It is worth noting that in this scenario, unless the SONGS Unit 1 SNF that is currently being stored at the Morris Illinois ISFSI is included in the sale, the SONGS co-owners would still own that fuel, at least until title transfers to the federal government or to another entity.
nuclear materials and to ensure that these materials remain under regulatory control. Accordingly, the shipper of SONGS SNF and the owner/operator of the receiving facility will have to establish a system for tracking each transfer of SNF. The NRC maintains a database of the location and licensee responsible for all SNM in the United States. This database must also be updated after each shipment via the exchange of Nuclear Inventory Reports or “741” forms. Information contained in these forms is subject to NRC requirements for the protection of Safeguards Information, so coordination between SONGS and the owner/operator of the destination site must comply with all applicable NRC requirements in this regard.

The NMMSS also serves a security function, which essentially consists of verifying that the amount of SNM received at the destination site exactly matches the amount of SNM shipped from the origin site. A mismatch between these numbers triggers an investigation and a report to the NRC. Discrepancies that cannot be explained by clerical error may indicate that a theft has occurred, as unlikely as that may be for SNF shipments. Such shipments provide rigorous safeguards against theft or diversion, including the use of tamper-indicating devices on packaging, as well as continuous visual surveillance of the cargo in transit.

3.3 Mode and Route Selection

Safety and security are primary considerations in selecting the mode of transport to be used in relocating SONGS SNF to an offsite facility. Mode choice(s) and route selection(s) are directly related, and both will influence transportation decisions. In most cases, the total amount of material to be shipped is a major factor in determining the mode of transport. The fewer the shipments required overall, the lower the likelihood of accidents, impacts to infrastructure and other risks. Note that if the federal government is the shipper, this aspect of transportation planning—like coordination with the destination facility, discussed in the foregoing section—would be the responsibility of the federal government. The SONGS co-owners would have no direct role in related decision-making.

As we have already noted, this CTP assumes that any transport of SONGS SNF to an offsite location will occur by rail. NWT’s assessment, which is shared by SCE and the Experts Team, is that rail offers the most practical and safest transport option for SONGS SNF. Other modes, such as heavy haul shipments on highways and by barge, can be used to move SNF, but are not preferable in this instance given that the SONGS site has existing rail access. There are no navigable inland waterways between the SONGS site and the southwestern United States, where a receiving facility for the SONGS SNF might be located.

In addition, barge transport from SONGS would present logistical challenges that could have implications for worker safety and create additional security requirements. Since one barge can carry several transportation packages, there would be multiple trips from SONGS to a barge slip. Loading each barge would then take several days, with protections for worker safety and security measures required throughout. Heavy haul truck shipments are likewise not practical because this mode choice significantly increases the number of shipments required to de-inventory the SONGS site. Heavy-haul truck transport also presents significant logistical challenges because it necessitates the temporary closure of public

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65 The theft of SNF is highly unlikely because of the very large and heavy nature of the packages and the significant technical capability required to handle them. These packages are not easily hidden or moved, and the contents are “self-protecting” due to their high radiation levels. In addition, and notwithstanding these self-protecting features, the packages are also subject to stringent security protocols to ensure that they are protected against theft and sabotage.
roadways and allows for travel only at low speeds. Other considerations for barge and highway transportation are discussed in Appendix D.\textsuperscript{66}

Rail transport differs from highway transport because the routes are owned by private rail companies and are not considered public rights-of-way. Rail line usage is subject to the terms and conditions of the rail companies and their requirements and cannot be dictated by a private shipper. Railroad shipping rates issues are adjudicated by the Surface Transportation Board, an independent federal agency. The selection of rail routes is the responsibility of the carrier but is also highly regulated by the NRC and DOT. Under 49 CFR 172.820, rail carriers that transport “highway route controlled quantities” (HRCQ) of radioactive material, which would include SNF and HLW, are required to perform comprehensive safety and security analyses of rail routes on an annual basis to identify and select routes, and alternative routes, that pose the least overall safety and security risk.

Appendix D to 49 CFR Part 172 identifies 27 risk factors that the rail carrier must consider in selecting routes and in assessing their safety and security. As part of the process, rail carriers are required to seek input from state, tribal, and local officials regarding security issues and high-consequence targets along the route. The NRC recommends proposed routes be submitted for consideration at least six months before the first planned shipment.

Like many nuclear power plant sites, SONGS is served by a single rail access point to the site. This rail line is co-owned by two entities: The San Diego Northern Railway Corporation and the BNSF Railway. In the case of rail shipments of SONGS SNF, one or both of these corporations would be designated as the originating railroad and as such would make an overall determination regarding how the shipment is routed, subject to NRC approval.

Rail shipping operations will encompass movements of loaded and unloaded casks as well as transportation hardware (cask cars, buffer cars and escort cars). Buffer cars and escort cars will be included in consists of rail cars carrying loaded casks. (A “consist” is a group of rail cars that together form a train or a unit of a train.) When moved to the shipping site, the buffer and escort cars may move separately from the rail cars that carry unloaded casks to the site.

Shipment of SNF through rail networks is disruptive to rail operations. Trains carrying SNF are speed-limited to 50 miles per hour,\textsuperscript{67} which slows down the throughput of other freight that is allowed to travel at 80 miles per hour. The movement of “exclusive use” consists and dedicated trains, while not required by regulation, is beneficial in speeding shipments from the originating point to the receiving site because, in “common carrier freight service,” rail cars bound for different destinations are

\textsuperscript{66} For example, each mode has unique requirements and involves different regulatory agencies and other entities. Highway shipments involve federal, state, and tribal authorities; barge shipments involve the U.S. Army Corps of Engineers and the U.S. Coast Guard; and rail involves private railroad companies, the Federal Railroad Administration (FRA), and state and tribal entities. States also have regulatory authority, consistent with NRC and DOT regulations governing hazardous materials transportation, that apply to each mode.

\textsuperscript{67} AAR Circular OT-55. \url{https://public.railinc.com/sites/default/files/documents/OT-55.pdf}
com mingled in the train. At each interchange railyard, all of the cars in the train are re-sorted and connected to different locomotives for the next step of their journey. This sorting process can take days. In dedicated train shipments, all of the rail cars in the consist are headed to the same destination, so no sorting of rail cars is required at interchange yards. This can save considerable time if multiple interchanges are involved. Significant planning and engagement with rail systems, track owners, and rail operators will be required to manage the use of rail to efficiently transport SNF to a destination.

In the case of SONGS SNF, the rail line that services the SONGS site is also heavily used for commuter trains. Thus, careful consideration will need to be given to the optimal times for SNF movements to occur on this line.

### 3.4 Time Required to Clear the SONGS Site Once a Receiving Facility Is Available

Because the full decommissioning of the SONGS site cannot be completed until all the SNF and GTCC waste is removed, the question of how long it will take to fully clear the site is an important one. The answer will depend on many factors, the most significant of which is the availability of a receiving facility. The Strategic Plan discusses in detail the substantial uncertainties that surround alternative disposition pathways for the SONGS SNF. Once a receiving facility is available and licensed to store or dispose of SONGS SNF, and once the transportation infrastructure needed to move SNF to that facility is in place, the time required to fully clear the SONGS site will depend on a number of factors, including:

1. The number of cask cars per consist and associated maintenance needs for transportation casks;
2. The number of consists and associated maintenance needs for rail cars;
3. The efficiency and speed of rail operations, for both loaded and unloaded shipments;
4. The acceptance and unloading rate of the receiving facility or facilities;
5. The number of clients competing for storage or disposal services at the receiving facility; and
6. The order of receipt at the receiving facility or the acceptance “queue” for shipments that are executed by the federal government

Each of these factors adds uncertainty to any estimate of the time needed to remove all SNF from SONGS. In a scenario where the shipper is a private entity (as opposed to the federal government), that entity will have considerable control over the first two factors, but the rate of shipments will still be constrained by factors 3 through 6. Uncertainties pertaining to those factors are unlikely to be resolved until:

- One or more facilities are operating and the level of federal involvement is determined. Both the facility acceptance rate, and the acceptance queue, if applicable, will affect the SONGS SNF shipping rate.
- The customer base for the receiving facility (or facilities) is defined.
- The rail system demonstrates it can deliver casks to match the acceptance rate as SNF transport consists compete with normal freight operations.

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68 Bypassing switchyards also has safety benefits since these yards are where most derailments occur. In addition, the fact that a common procedure known as “humping” could not be used to switch rail cars carrying SNF would add further time delays.
The cumulative effect of these uncertainties means that any overall estimate of the time needed to fully clear the SONGS site must be couched in terms of decades, not years. Nevertheless, some simplifying assumptions can be made to “book-end” the likely timeframe for clearing the site under different scenarios. In each of the case studies that follow, we assume (1) that all 136 SNF and GTCC canisters at SONGS will be shipped off site in a continuous campaign and (2) that the resources needed to support that effort are available. Other key assumptions are specified in each case study.

**Case Study 1: Unlimited Rail Assets Available/Private Receiving Facility**

In this example, SCE can prepare, the railroads can ship, and the receiving facility can accept SONGS packages in the most reasonably efficient manner possible. We further assume that sufficient SNF transportation casks and rail assets are available to support a consist leaving the SONGS site every two to three weeks. We assume that each of the first two shipments conveys a single transportation package, and that preparing each package requires three weeks. After the first two shipments are complete, we assume that subsequent shipments could utilize two different consist sizes, with either two or three cask cars. We further assume that sufficient rail and cask assets are available to allow the receiving facility to accept each arriving consist without delay, offload the canisters, and return the empty transportation casks to SONGS for reloading in an essentially continuous fashion. With no defined queue and assuming no downtime for maintenance, the schedule implications of these assumptions are as follows:

- First two packages: 6 weeks
- Remaining 134 packages (ordered by duration):
  - Three-cask consists leaving every two weeks = 134/3 × 2 = 89 + 6 = 95 weeks (1.8 years)
  - Two-cask consists leaving every two weeks = 134/2 × 2 = 134 + 6 = 140 weeks (2.7 years)
  - Three-cask consists leaving every three weeks = 134/3 × 3 = 134 + 6 = 140 weeks (2.7 years)
  - Two-cask consists leaving every three weeks = 134/2 × 3 = 201 + 6 = 207 weeks (4.0 years).

In this example, the time required to clear the SONGS site ranges from roughly two to four years. It is important to emphasize, however, that this result is based on a set of highly optimistic assumptions and thus represents the extreme low end of the range of timeframes involved.

**Case Study 2: Single Consist/Private Receiving Facility**

In this example, SCE has one consist available with three cask cars. This means that the consist has to travel to the receiving site, offload the canisters, and return to SONGS with empty transportation casks before it can be loaded again. As in Case Study 1, we assume that the first two shipments convey a single package. In this case, however, eight weeks are assumed to be required for the consist to make the round trip from SONGS to the receiving facility and back. Again, the receiving facility can accept and offload each consist without delay, there is no defined queue, and no maintenance downtime is assumed.

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69 For a frame of reference, the time it took each SNF canister to be loaded in the SONGS spent fuel pool, prepared for storage, and moved to its storage vault was about one week. Three weeks was chosen here because it will be first-of-a-kind work. Efficiencies may reduce this time requirement as personnel gain experience preparing packages, but we retain three weeks as a simplifying assumption.
• First two packages: 16 weeks
• Remaining 134 packages:
  - Three-cask consists leaving every 8 weeks = \( \frac{134}{3} \times 8 = 357 + 16 = 373 \) weeks (7.2 years)

This time estimate is different than the estimate for Case Study 1 because of the eight-week assumption with respect to turnaround time. Turnaround time could be reduced, of course, if the shipper had access to more than one consist. The time estimate can also be affected by how the railroad companies prioritize SNF shipments compared to other types of freight (see Section 3.3 for further discussion).

Case Study 3: Federal Destination Facility or Federal Use of a Non-Federal Facility

In this example, the federal government removes the SNF from SONGS and performs all necessary transportation functions, including asset acquisition. The federal government has either developed a CISF or repository, or has contracted for storage services with a non-federal facility on a fee-for-service basis. As in Case Studies 1 and 2, SCE is assumed to be able to prepare transportation packages, and the railroads and receiving facilities are assumed to be able to move and receive the packages, consistent with the acceptance rate at the destination facility.

In any example where the federal government takes responsibility for removing the SNF, the matter of the Standard Contract queue (discussed in Section 6.3.5 of the Strategic Plan) becomes paramount in estimating the time needed to clear the SONGS site. Alternatively, if DOE chooses to prioritize the removal of SNF from shutdown plant sites, significant transportation efficiencies can be gained (see Appendix F of the Strategic Plan for details). As discussed in the Strategic Plan, under the current oldest-fuel-first (OFF) ordering of the queue, the federal government would be expected to remove about 500 metric tons uranium (MTU) of SONGS SNF—out of a total SONGS SNF inventory of approximately 1,600 MTU—in the first 10 years of operation of a federal repository. Acceptance of the remaining 1,100 MTU at a federal facility could be expected to take another 20 years or more because of the quantity of SNF from SONGS and other plants that will occupy queue slots as time goes on. Thus, NWT’s worst-case estimate is that it could take as long as 50 years70 (see Appendix F of the Strategic Plan) after the federal government begins accepting SNF for storage or disposal to fully clear the SONGS site under the current Standard Contract queue.

How the queue or other removal sequence guidelines might evolve in the future may be the single most important source of uncertainty in estimating the time needed to clear the SONGS site if the federal government is involved. Even if DOE exercises the discretion it already has under the existing Standard Contract to prioritize removal of SNF from shutdown plant sites, the order of removal remains at DOE’s discretion and SONGS would be competing against other shutdown sites for earlier removal of SNF. As of the end 2020, there are ISFSIs at 19 shutdown plant sites around the country, storing over 1,000 canisters of SNF. Three of those sites, La Crosse, Big Rock Point, and Humboldt Bay have fewer than ten canisters of SNF or GTCC waste each. Thus, those sites could receive priority if the federal government decides its primary goal is to clear sites of all SNF as quickly as possible, irrespective of issues related to site location such as seismicity, proximity to population centers, etc. An additional complication is that the number of shutdown sites will only grow over time and owners of operating reactors may object to being moved lower in the queue without compensation.

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70 There is significant uncertainty in this value depending on whether the Standard Contract queue will apply at all and, if it does, how it might be modified in the future. Fifty years is intended to be a worst-case value to provide the second “bookend” to complement the optimistic duration discussed in Case Study 1.
Case Study 3 is the least optimistic due primarily to uncertainties surrounding the national removal sequence. Of course, if SONGS is moved to the front of the line, it could be cleared in much less time. However, in NWT’s expert judgment, and taking into account past experience, it is difficult to see how the time needed to clear the site could be reduced to much less than around 30 years after a federal facility begins receiving material.

In sum, NWT believes that a private facility model—if a commercially reasonable private option were to become available—could theoretically allow for the full clearing of the SONGS site within ten years of when the receiving facility begins operating. This estimate is highly dependent on the number of other clients competing to use the private facility. However, in an open marketplace, priority for fuel receipt at a private facility would be negotiable. Clearing the site could take considerably longer if the SNF is going to a federal facility, in which case we assume that the rate of acceptance would be governed by the framework for allocating acceptance rights established in the Standard Contract or by a revised framework (see further discussion of these issues in Chapter 6 and Appendix F of the Strategic Plan). This schedule could be shorter if DOE exercises its existing authority to prioritize the removal of SNF from shutdown plant sites. But as growing numbers of plants retire in coming years, any schedule advantage conferred by the prioritization of shutdown sites may diminish. In that case, the ability to make faster progress toward removing all SNF and GTCC waste from SONGS would depend on the success of efforts to move SONGS closer to the front of the line.

3.5 Potential for Early Shipment of SONGS GTCC Waste

The completed deconstruction of SONGS Units 2 and 3 is expected to result in 12 TN canisters containing GTCC waste. In addition to the one canister from SONGS Unit 1 deconstruction that is already being stored at SONGS, this leaves a total of 13 GTCC canisters to be shipped. All of these canisters, which are externally identical to the TN SNF canisters, will be stored at the TN ISFSI on site awaiting future disposal. Operations to transfer the GTCC canisters from storage modules to transportation casks are identical to those for the TN SNF canisters.

Given the nature of GTCC waste, however, the possibility exists that these canisters could be shipped off site significantly earlier than the SONGS SNF canisters. This is because GTCC waste, because of its form and isotopic makeup, is classified as low-level radioactive waste (LLRW). According to the NRC:

“LLRW streams that contain radionuclide concentrations exceeding the limits for Class C waste are referred to as ‘greater-than-class-C’ (GTCC) waste. Some GTCC waste streams also contain radionuclides that are characterized as ‘special nuclear material’ (i.e., enriched uranium or plutonium).”

“The NRC’s 10 CFR Part 61 regulations authorize the disposal of Class A, Class B, and Class C waste streams in land disposal facilities. Under the NRC’s current regulations at 10 CFR 61.55, GTCC waste must be disposed of in a geologic repository unless a proposal for disposal of such waste in a land disposal facility licensed under 10 CFR Part 61 is approved by the Commission. Currently, there is no land disposal facility licensed to accept GTCC waste.”

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72 Ibid.
The NRC is currently contemplating a rulemaking to modify 10 CFR 61 to allow disposal of GTCC waste in land disposal facilities. At the direction of the Commission, NRC staff published a request for public comment on the draft technical basis for a potential rulemaking in 2019. Such a rulemaking would take several years to complete, but once approved, land disposal facilities meeting contemporaneous Part 61 requirements and the additional site-specific technical and performance attributes described in the draft regulatory basis could be licensed by the NRC, or by an agreement state, to accept GTCC waste (including the SONGS GTCC canisters). The WCS LLRW disposal facility in Andrews, Texas, which is adjacent to the proposed WCS CISF, is one such facility. WCS has indicated preliminary interest in accepting GTCC waste for disposal in the future if the state of Texas and the NRC amend their regulations to allow it.

The timeline for approval could be shortened through a request for a case-by-case review, rather than waiting for a rulemaking to be completed and formal guidance to be developed. This approach is already provided for in 10 CFR 61.55(a)(2)(iv); it is also reiterated in Section 4.2 of the draft regulatory basis for the proposed rulemaking. The Commission has yet to provide guidance to NRC staff on whether to proceed with this rulemaking.

As already noted, the SONGS GTCC canisters will initially be stored on site at the SONGS TN ISFSI under the three 10 CFR Part 50 licenses for the former operating facilities. Because there is no currently licensed land disposal facility that can accept GTCC, the SONGS GTCC canisters have historically been considered part of the SONGS SNF inventory—that is, material destined for offsite interim storage and, ultimately, geologic disposal. There are benefits to demonstrating the shipping process early, but costs might also be incurred that would be better merged with the costs of shipping SNF. In that case, cost considerations could affect the timing of GTCC shipments. For instance, shipping GTCC waste early could incur costs for acquiring transportation casks and other equipment, and training personnel that might then go unused, perhaps for decades, before a destination facility for SNF becomes available. These types of costs, and other costs related to executing a shipping campaign, might then be incurred twice if there is a significant delay between shipping the SONGS GTCC waste and the SONGS SNF. This is a risk that the SONGS co-owners will need to factor into their decision-making.

The current draft license for the WCS CISF includes some GTCC waste from certain ISFSIs as material licensed to be stored at the facility. However, as of this writing, none of the SONGS GTCC canisters are included in the current WCS CISF draft license. The current draft license for the Holtec HI-STORE CISF includes no GTCC waste. Thus, both private CISF licenses will require license amendments to allow SONGS GTCC to be received and stored at the facilities. If the Part 72 licenses for one or both of the private facilities were amended to accept SONGS GTCC waste, the SONGS co-owners could potentially ship GTCC waste earlier than SNF. This would provide an opportunity to demonstrate the adequacy and readiness of SONGS equipment and processes in terms of preparing for and executing SNF shipments. The remainder of the discussion in this section is directed toward the ISP CISF because there currently exists a land LLRW disposal facility next door to the CISF that WCS (an ISP partner) currently operates. This is not the case with the Holtec HI-STORE CISF.

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73 Ibid.
74 Ibid.
75 The 10 CFR 72 general license does not include storage of GTCC waste at the ISFSI, but it may be stored there under the Part 50 licenses for the site. This is because the CoCs for SNF storage used under the SONGS general license do not, and, by regulation, are not permitted to include waste that is not SNF assemblies or integral to SNF assemblies (e.g., fuel assembly inserts). This exclusion applies to GTCC waste.
76 The SONGS GTCC waste will be stored exclusively in TN canisters. This fact adds another challenge for these canisters to be licensed for storage at the Holtec CISF, given intellectual property rights considerations.
The WCS LLRW disposal facility is licensed by the state of Texas under the NRC’s agreement state program. However, as noted previously, current NRC regulations do not permit GTCC LLRW to be disposed of in a land disposal facility. Thus, agreement states cannot license a facility to dispose of GTCC in a land disposal facility because they cannot exceed the authority allowed under NRC regulations. If the NRC completes the process of amending 10 CFR 61 to allow for the disposal of GTCC waste at a land disposal facility, WCS could seek approval from the state of Texas to dispose of GTCC waste, including the SONGS GTCC canisters, at its LLRW disposal facility. This whole process would likely take at least four to six years given the need for the NRC to complete the technical basis for rulemaking and to complete the rulemaking. Because the WCS LLRW disposal facility is adjacent to the proposed WCS CISF, ISP (the future WCS CISF licensee) could receive and store GTCC waste at the CISF until such time as disposal of the waste is permitted at the WCS LLRW facility.

If the NRC grants the ISP CISF license in 2021, as currently expected, ISP could immediately begin construction of the CISF to the extent necessary to receive and store GTCC waste. In parallel with CISF construction, ISP could seek NRC approval of a license amendment to store SONGS GTCC canisters at the CISF, which should be a relatively uncomplicated request. Assuming a late 2022 completion date for CISF construction and license amendment approval, the ISP CISF could be ready to accept SONGS GTCC waste as early as 2023, considerably sooner than SONGS SNF.

The current draft ISP CISF license conditions treat GTCC waste the same as SNF in terms of title, legal liability, and other obligations of the client with respect to paying for storage services. Therefore, the SONGS co-owners would need to consider those conditions in any commercial arrangement with ISP to store SONGS GTCC waste.

The SONGS GTCC waste would remain in storage at the ISP CISF until either DOE removes the material for disposal or WCS is able to license their nearby LLRW land disposal facility to accept GTCC. Neither of these disposal pathways will be available before the late 2020s. However, the land disposal option does have a defined success path, pending NRC completion of the necessary 10 CFR 61 rulemaking or approval of a case-by-case request to authorize disposal of GTCC waste, and approval from the state of Texas. Based on the language in the draft ISP CISF license and the uncertainty of disposal, the SONGS co-owners would need to retain title to, and some liability for, any GTCC stored at the ISP CISF until a disposal pathway is clear. Once a disposal pathway is clear, the SONGS co-owners could modify the storage contract with ISP or enter into a new contract to dispose of the GTCC waste and relinquish title.

Sending the SONGS GTCC waste to the ISP CISF would be a fee-for-storage commercial arrangement that could evolve into a fee-for-disposal arrangement. Unless ISP arranged to pick up GTCC canisters at SONGS, the SONGS co-owners would need to ship the GTCC canisters to the ISP CISF under their SONGS NRC licenses. ISP would be paid to receive, possess, and be responsible for the safe storage of the waste thereafter, until the waste is moved to a disposal facility. Once the SONGS co-owners transfer title to the GTCC waste, either to ISP or to WCS, in anticipation of disposal, the SONGS co-owners would have no further responsibility or liability for this material.

In summary, the SONGS co-owners have a potentially viable opportunity to execute an early shipment program for SONGS GTCC waste because this waste is not spent fuel. LLRW shipments, which are executed frequently, are more easily managed than SNF shipments due to the lower, non-fissile

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This timeline could be shortened significantly if WCS chose to pursue a case-specific NRC review to authorize disposal of GTCC waste in a land disposal facility pursuant to 10 CFR 61.55(a)(2)(iv) instead of waiting for the rulemaking to be completed.
radioactive material content of LLRW. Further, if GTCC waste can ultimately be disposed of at the WCS LLRW land disposal facility, associated legal, contractual, and liability entanglements with the federal government can be resolved. As noted above, however, these potential benefits need to be weighed against any cost risks flowing from uncertainty over the timing of future SNF shipments.

The next three chapters focus on the decisions, activities, costs, and schedule considerations that SCE and a shipper will need to consider in preparing to ship SONGS SNF off site. This content is fairly technical and specific and is likely to be of interest primarily to entities that would be directly engaged in shipping activities.
4. Site Considerations and Readiness to Ship

A number of site-specific considerations will be folded into planning and decision-making for shipping SONGS SNF and GTCC waste to an offsite facility. This section provides an overview of these considerations; additional details and analysis are provided in Appendix C. This section also offers several recommendations that are supported by the analysis in Appendix C.

Shipments of SNF from SONGS are likely to draw significant public interest because the shipping campaign (assuming SNF from another ISFSI is not removed first) will be on a larger scale, will be shipping aged canisters, and will entail heavier transportation packages than have been used to date to ship commercial SNF in the United States.

As discussed in Chapter 2, the United States has amassed significant experience with the safe transportation of SNF. It is worth noting, however, that any shipment of canisters containing commercial SNF that have been in storage at an ISFSI will differ from past shipments. Whether the first previously stored SNF canisters to be shipped come from SONGS or from another nuclear power plant, these differences will have to be considered in planning for shipments and coordinating with the shipper, whether that is the federal government or another entity. Three main features distinguish SONGS SNF from earlier shipments.

First, the transportation packages for SONGS SNF will be larger than the commercial SNF packages shipped most recently in the United States, which used the GE IF-300 design. Each SONGS package will contain a 24-assembly TN canister or a 37-assembly Holtec canister. This compares to the 7-assembly capacity of the IF-300 package used by Progress Energy and Duke. The gross weight each of the SONGS SNF packages will be well over 100 tons, whereas the GE IF-300 package weighed about 70 tons. 

For additional perspective, the Navy currently ships some naval spent fuel in a package weighing up to 290 tons.

Second, the SONGS canisters will have been in storage service for anywhere from ten years to several decades before shipment and the industry has no experience with shipping aged, large-capacity SNF canisters. The Electric Power Research Institute’s (EPRI’s) Extended Storage Collaboration Program is studying ways to detect canister degradation and repair any aging-related flaws that may be found during storage operations. Complementing EPRI’S efforts, the SONGS co-owners are implementing an inspection and maintenance program for the Holtec canisters and will be implementing NRC-required aging management programs for both the TN and Holtec canisters in the future. These inspections will allow for early detection of aging-related degradation during storage, including canister flaws, which can be repaired in situ, if required, to ensure that all canisters remain qualified for storage and subsequent transport. The Strategic Plan provides a more detailed discussion of canister integrity and the SONGS inspection and maintenance program.

Third, relocating all of the SNF and GTCC waste in storage at the SONGS site will ultimately involve the movement of 136 packages. (How many packages might be included in each individual shipment over the course of a campaign to clear the site would have to be determined as part of a detailed planning exercise.) A campaign to transport SNF on this scale has not been undertaken in the United States in many years.

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78 10 CFR 71 CoC 71-9373 (HI-STAR 190) and CoC 71-9001 (IF-300 [CoC is expired]).
79 This total includes 123 SNF canisters and 13 GTCC canisters.
4.1 Canister Preparation and Documentation Requirements

Before it can be moved off site, each SONGS SNF and GTCC waste canister and its contents must comply with applicable requirements in its respective 10 CFR 71 certificate of compliance (CoC). In addition, up-to-date CoCs need to be in place before package owners can fabricate transportation casks and impact limiters. As of this writing, the 10 CFR 71 CoCs for the canisters being used to store SONGS SNF and GTCC waste are as follows:

- SONGS-1 SNF Canisters (24PT1): TN MP187 Package (CoC 9255)
- SONGS-1 GTCC Waste Canister: None currently. SCE has contracted with TN to add the “as-built” Unit 1 GTCC waste canister to an existing transportation CoC.
- SONGS-2/3 SNF Canisters (24PT4): TN MP197/197HB Package (CoC 9302)
- SONGS-2/3 SNF Canisters (MPC-37): Holtec HI-STAR 190 (CoC 9373)
- SONGS-2/3 GTCC Waste Canisters: None currently. SCE has contracted with TN to add the Units 2 and 3 GTCC waste canisters to an existing transportation CoC.

Prior to shipping, SCE will need to review and document the compliance status of each SNF and GTCC canister and its contents against the revision of the applicable transportation CoC active at the time of shipment (which includes specific revisions to the package drawings). Appendix C, Section 4.1 discusses the details of this review and the development of associated documentation packages and canister inspection protocols.

4.2 Rail Infrastructure at SONGS

SONGS has an on-site rail spur that crosses the northern boundary of the site and connects with the main rail line. Several new rail sidings will be located on site to support the deconstruction of SONGS Units 2 and 3. The potential use of on-site rail spurs for future SNF shipments is discussed in Appendix C.

A detailed technical evaluation of site infrastructure needs should be conducted in the coming years to determine whether the rail spurs that will be constructed for decommissioning should be left in place to facilitate SNF transportation in the future. An early evaluation would also allow for the development of a more accurate cost estimate for site infrastructure needs.

4.3 Canister Transfer from Storage Modules to Transportation Casks

The procedure for moving storage canisters from ISFSI storage modules to transportation casks is significantly different between the TN canisters, which are stored horizontally, and the Holtec canisters, which are stored vertically. SCE will need to make separate logistical arrangements for these two types of transfers, including a plan to identify and acquire the specific lifting and handling structures and equipment needed in each case. Some of this equipment is only available from the storage technology suppliers while some of the other lifting and rigging equipment is standard and available from other vendors. Appendix C provides a detailed analysis of the on-site operations and infrastructure needed to carry out those operations for both types of canister designs.

4.4 Transfer of Transportation Casks to Rail Cars at SONGS

NWT considered two distinct approaches to moving SNF canisters, emptying transportation casks, and assembling transportation packages and equipment at the SONGS site during the loading process. As
noted previously, the two different SNF canister designs in use at SONGS require different equipment and facilities for loading operations. Once SNF canisters are placed in transport casks and prepared for shipment, the casks then have to be loaded onto rail cars for transport. The two scenarios we considered, along with possible loading concepts and site infrastructure arrangements, are discussed in Appendix C, which also suggests possible locations for necessary facilities. A more detailed technical evaluation is needed to determine which approach is the better option. As part of such an evaluation, grade and crane reach requirements would have to be evaluated to determine optimal locations for a cask transfer facility, a location to facilitate reorienting the cask from a vertical position to a horizontal position and vice versa (hereafter, “downending station”), and crane pad, as well as their relative proximity to the rail spur or suitable self-propelled modular transporter (SPMT).

In addition to evaluating whether the rail spurs built for decommissioning should be left in place, we also recommend that the SONGS co-owners evaluate the cost tradeoff between (1) recovering and extending the existing, asphalt-covered rail spur so as to allow for transportation rail cars to be placed adjacent to the ISFSI for direct loading versus (2) building a reinforced roadway from the ISFSI to the planned decommissioning spurs north of the ISFSI instead. The latter approach would entail adding a second crane pad and a second crane, as well as purchasing a suitable SPMT. Again, further details are provided in Appendix C.

### 4.5 Other Assets and Equipment Needs

#### 4.5.1 Transportation Casks and Impact Limiters

As discussed in Section 4.1, three different transportation package designs are associated with the types of canisters currently being used to store SONGS SNF and GTCC waste. The shipper, in conjunction with the SONGS co-owners, will need to develop a site de-inventory plan to determine the optimum rate at which these canisters can be shipped off site. This plan will determine the number of transportation casks, each with a cradle and a pair of impact limiters, required to ship all SONGS canisters over the time period contemplated. The timeframe for shipments will necessarily be driven by the ability of the receiving facility (or facilities) to accept shipments, as well as by the rate at which packages can be prepared for shipment at SONGS. With licensing action, it is possible that the TN canisters could be shipped in a single package design, as noted in Section 4.1 of Appendix C. Once the certification strategy is determined, the number of packages of each design needed to complete the entire shipping campaign can be determined.

The shipper has three options for acquiring transportation casks: purchase, lease, or use casks provided by the federal government. The federal government option is only available for shipments to Yucca Mountain currently, but a range of other options could open with new or amended legislation. Each of these approaches has advantages and disadvantages that the SONGS co-owners will need to evaluate with the benefit of further insights from this Plan.

The CoCs and safety analysis reports (SARs) for transportation packages include operational requirements for preparing casks for shipment once the canister has been inserted and the package lid has been bolted down with its lid seals installed. These preparations include drying the annulus between the cask inner shell and the canister, backfilling the annulus with helium, and leak testing the lid seals. The equipment to perform these tasks is generally provided by the entity responsible for package preparation. However, there are site interface items to be considered, including laydown space and power supply requirements. In addition, site personnel will require package-specific training to support transport cask loading operations.
4.5.2 Rail Cars

The shipper, whether a private or federal entity, will need access to special rail cars that are compatible with the transportation package cradles to be used. These rail cars will have to be available in a quantity and within a timeframe that matches the rate at which canisters are scheduled to be moved off site. (Cradles are procured with the transportation package. They provide support for the transportation package and secure the package to the rail car.)

Under a settlement agreement with three railroad companies and the Association of American Railroads (AAR), DOE has agreed to comply with the AAR S-2043 standard for rail cars used for SNF transport. According to DOE, S-2043 is the most comprehensive rail car standard published by the AAR and contains many performance requirements that are more restrictive than those for ordinary rail cars. It should be noted that the AAR S-2043 compliant railcars that DOE is developing have been designed to accommodate all types of domestic SNF packages and cradles that are currently certified for transportation, including the transportation packages that will be used to ship SONGS SNF off site (see Section 6.4.2 for more detail). The S-2043 standard also provides for enhanced stability and real-time fault monitoring systems, such as for bearing temperature, braking performance, and directional acceleration, that are not present on standard freight cars.

While DOE has committed to use only an AAR Standard S-2043 certified rail car design for SNF shipments, private industry has made no such commitment. However, because use of the S-2043 standard is part of AAR interchange rules for SNF and HLW shipments, railroads all along future SNF transport routes would have to have agreements in place with any shipper that did not use a S-2043-compliant rail car. This potential difference in rail car access and acquisition would need to be considered in the context of the expected cost and timeframe for SNF shipments.

As of this writing, the status of any discussions between private shippers and the railroads about the necessity of using S-2043-compliant rail cars for SNF shipments is unclear. There are opinions in the industry on both sides of the argument. Several factual observations may be relevant:

- The AAR, which developed and published the S-2043 standard, is an industry trade group and is not a regulatory body or governmental agency. However, the railroads have adopted the AAR standard.
- The Navy has already conducted SNF shipments using S-2043-compliant cask cars and intends to use full consists comprised of S-2043-compliant escort and buffer cars when they are available.
- DOE has entered into an agreement with three railroad companies that commits DOE to use the S-2043 standard; DOE is currently testing the prototype Atlas 12-axle rail car and developing the Fortis 8-axle rail car, which were designed to the S-2043 standard.
- Private shippers are not subject to the terms of DOE’s agreement with the railroad companies.
- Between 1964 and 1991, 248 rail shipments of commercial SNF occurred in the United States that did not use S-2043 rail cars.

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80 See: [https://www.csgmidwest.org/MRMTP/Meetings/Fall%202020/Bickford_SRG_FallMtgs_2020.pdf](https://www.csgmidwest.org/MRMTP/Meetings/Fall%202020/Bickford_SRG_FallMtgs_2020.pdf)
81 DOE is currently working to develop S-2043-compliant rail cars through its Atlas and Fortis Railcar Design Projects. As of early 2019, fabrication of a prototype Atlas rail car and two prototype buffer rail cars was nearly complete. These prototypes, along with a prototype rail escort car, were shipped to Colorado for testing, with approval from AAR expected sometime in 2022. U.S. DOE Office of Nuclear Energy presentation “DOE’s Atlas Railcar Design Project,” Waste Management 2019, Phoenix Arizona, March 2019.
82 NWT understands that consists using the AAR S-2043 design may be able to travel at significantly higher speeds.
• In 2017, DOE and its sister agency in Spain (ENSA) conducted a detailed, multi-modal study of moving SNF in a modern rail-sized transport cask. The rail portion of the study used a non-AAR S-2043 rail car and a very heavily instrumented cask. Data collected over 2,000 miles of rail shipping plus additional rail tests at a special AAR test track in Colorado showed extremely low stresses and strains on the contents. These data provide a compelling basis for concluding that rail shipment of SNF can be conducted safely even without using AAR-S-2043 railcars. See Appendix B for additional information.

• The full benefit of AAR S-2043 rail cars requires the use of locomotives that can connect to the operating data being generated by the rail cars. As of this writing, the NWT is unaware of any locomotives that are equipped with the S-2043 communications interface (locomotives are generally provided by the railroads, not the entity contracting with the railroad for services).

Until a private shipper finalizes negotiations with a rail company, it is difficult to speculate about the railroad industry’s position on the use of S-2043 railcars for private SNF shipments. If S-2043 standard rail cars are required to transport SNF, this could substantially increase the cost and lead-time involved in procuring the necessary rolling stock because a fleet of these cars does not yet exist. In general, the lead times for obtaining these transportation assets is two to three years, so appropriate planning will be required.

Regulations require that security personnel who accompany shipments of SNF be able to maintain visual contact with each car of a train consist. This is problematic due to FRA regulations, which place special restrictions on the location of passengers relative to the location of cargo. One possible resolution that DOE has utilized in the past is to provide a specially equipped escort car that allows security personnel to accompany the fuel shipment while satisfying NRC and FRA requirements. The entire train consist must be preplanned in detail and must be evaluated for compliance with both NRC and FRA regulations.

4.5.3 Transfer Equipment

Needed transfer equipment includes the specialized components and shielding required to move fuel canisters from the SONGS ISFSI to a transfer cask (Holtec canisters only), and then from the transfer cask to the transportation package. A transfer cask compatible with Holtec canisters is already at the SONGS site and in storage. We assume the other equipment for removing canisters from the ISFSI will be provided by SCE or by its logistics contractors, while the equipment for interfacing with the transportation package will likely be developed in collaboration with the transportation package owner. The TN canisters require a transfer trailer or SPMT and a hydraulic ram system to extract canisters from the Advanced NUHOMS® storage modules directly into transportation casks. Appendix C describes these two types of transfer operations in greater detail.

4.5.4 Slings and Strongbacks

Rigging equipment will be required to interface the crane hook with each piece of heavy equipment that must be moved. Each sling and strongback must be certified by the manufacturer, routinely inspected, and properly rated for the piece of equipment it is intended to lift plus a safety margin specified by the site safety procedures.

83 A strongback is a device used to evenly distribute a lift between two or more attachment points on the object being lifted and connect them both to the crane hood in a stable fashion. These devices are also called “spreader beams” and “single point lift beams.”
4.5.5  Leak Testing Equipment

The equipment used to test the transportation containment (the outer cask) to ensure it meets the design basis for leakage is highly specialized and sensitive. In addition, it must be certified according to the requirements of ANSI Standard N14.5. This equipment includes a vacuum pump, a leak testing unit (which detects helium at very low levels), a calibrated leak source, and miscellaneous tools, valves, and fittings. The leak test must be performed by a highly trained and certified individual.

4.5.6  Emergency Recovery and Response Equipment

Emergency recovery equipment is a non-specific category of equipment that will be defined by the emergency procedures and contingency plans for the SONGS site. Common items included in this category for radiological work include spare lifting and rigging equipment, additional radiation detectors, shielding devices such as lead blankets, and lead bricks. Emergency response personnel on site will require personal radiation detection equipment as well as portable radiation detectors to support a response to a radiological incident.

4.5.7  Security

The ISFSI is the only remaining onsite facility at SONGS with radioactive material that requires physical protection under the NRC’s 10 CFR 73.55 regulations. Thus, the site security protected area has been reduced to essentially the ISFSI footprint. To prepare for shipments, a temporary security barrier may be required to enclose rail cars while a consist is being built. Additionally, the carrier and dispatch centers along the route may require upgraded communications systems to comply with NRC regulations for redundant communications. Security needs during shipping operations should be part of the detailed technical evaluation.

4.5.8  Satellite Tracking

“Telemetric tracking” is specified as a requirement in 10 CFR 73.37(c)(6). Any system that provides near-real-time position updates will satisfy this requirement, however the most commonly used, readily available, and reliable technology in the United States is GPS telemetry or satellite tracking. GPS systems require a sending/receiving unit on the consist, a receptive satellite in orbit, and a monitoring station. A number of commercial satellite tracking options are available that can be installed on rail cars or trucks and monitored via a secure web portal. In general, the shipper must acquire the vehicle-mounted unit and the monitoring equipment. DOE uses TRANSCOM which states and tribes along the route can access while the shipment is within their jurisdiction. For private entity shippers, an agreement would need to be reached between states and tribes and the shipper about how and what real-time tracking information would be shared, since private carriers generally do not want (and are not required) to share information about their fleet management system. Because 10 CFR 73.37(b)(1)(C) requires the licensee to “arrange for positional information sharing when requested,” private shippers must coordinate with the carrier over the provision of positional information to states and tribes. In addition, a shipper may decide to negotiate with DOE for the use of TRANSCOM since states, and many tribal nations, already have the access, training, and familiarity to use this system.

4.5.9  Movement Control Center

A movement control center (MCC) serves a security function and is required by regulation to act as the communications hub for any shipment that is in motion. All communications to and from the
shipment/escorts should be routed through this center with the exception of carrier-specific communications such as vehicle operator logs and mechanical status updates. These latter items are not considered necessary for shipment security functions unless they require the shipment to stop or deviate from the planned route.

The MCC is provided by the licensee responsible for implementing NRC or DOE security regulations/orders. It should be equipped with a number of computer stations and two forms of communication, and it should be located in a secure area that is not accessible to the public. The MCC should be staffed by personnel with security clearances who are trained to monitor the shipment and to initiate or coordinate a security response in the event of an incident.

4.6 Equipment Maintenance

All important safety-related equipment needed to carry out a transportation campaign for SNF and GTCC waste is required by the package user’s quality assurance (QA) program to meet the NRC’s standards for use. Specific requirements for use, inspection, calibration, maintenance, documentation, and records retention can be found within the applicable package SAR, industry standards, or regulatory requirements for each equipment asset. Equipment that requires a QA or certification document package is identified throughout this CTP; Table 4.1 provides a summary.

Table 4.1. Summary of Equipment Quality Assurance or Certification Standards

<table>
<thead>
<tr>
<th>Asset</th>
<th>Quality Assurance or Certification Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport packages</td>
<td>10 CFR 71 Subpart H</td>
</tr>
<tr>
<td>Helium and leak test equipment</td>
<td>ANSI N 14.5</td>
</tr>
<tr>
<td>Transfer equipment</td>
<td>Package CoC, SAR, and SONGS site requirements</td>
</tr>
<tr>
<td>S-2043 Rail cars and buffer cars (if applicable)</td>
<td>AAR S-2043</td>
</tr>
<tr>
<td>Site cask handling cranes</td>
<td>NUREG-0612; ASME B30.5; package CoC and SAR; and SONGS site requirements</td>
</tr>
<tr>
<td>Radiation detection instruments</td>
<td>10 CFR 20.1501 for NRC or 10 CFR 835.401 for DOE</td>
</tr>
<tr>
<td>Lifting devices, slings, and rigging hardware</td>
<td>ANSI N14.6, ASME B30.9, ASME B30.26</td>
</tr>
</tbody>
</table>
Responsibility for performing prescribed maintenance and generating the necessary documentation and records is normally dictated by ownership of the asset. In cases where an asset is stored and operated by an entity other than the owner, a system of oversight is required to ensure that maintenance requirements are met. For example, in the case of transportation packages, which may be stored and used by SCE or SCE’s contractor, the SONGS decommissioning quality assurance program (DQAP) and procedures would be audited by the package owner to ensure compliance with applicable requirements of the package owner’s own NRC-approved QA program.

4.7 Inventory Management

An inventory management system for “quality parts” is required as part of an NRC-approved QA program. This management system must identify each spare part subject to the QA plan by a unique identification number and must limit access to those parts to only those individuals designated by the SONGS QA manager.

Periodic maintenance and inspection schedules required for non-quality parts and assets will have to be tracked. Parts that are critical to operational success at the SONGS site should be purchased in duplicate to ensure that the loss or failure of a single part cannot shut down the entire operation.

4.8 On-Site Training Programs

The package owner’s QAP and SCE’s DQAP require that personnel who perform important-to-safety activities pertaining to shipments be appropriately trained and qualified. Training of operational personnel must be approached systematically. Each job function must be analyzed for training needs, and a job description for each function should include associated training requirements. Additionally, positions that require special qualifications must be identified.

Training records must be maintained by each employer who is responsible to the overall project management organization for ensuring that supplied personnel meet the training and certification requirements specified in the job description. These training records must be verified by the overall project management organization to ensure uniformity and regulatory compliance.

In addition to operational personnel, specialized training is also required when the shipper uses private security escort personnel. However, due to the extensive nature of this training it is advisable to seek a subcontractor who provides these services and is already licensed to operate within the transit states along the route. The shipper would then be required to receive written verification that training requirements have been met; the shipper may also need to conduct an audit of the subcontractor’s training program. It should also be noted that active-duty law enforcement officers are exempt from these training requirements. However, the difficulties associated with relying on state or local law enforcement for a rail route that crosses multiple state jurisdictions may require the use of private security. If shipments are conducted by DOE, security may be provided by federal agents from DOE’s Office of Secure Transportation. As federal employees, these agents are allowed to work in any state and have extensive training as escorts for radioactive shipments.
4.9 Summary of Site Readiness Considerations and Needs

Key points from this chapter with respect to site readiness for transportation are summarized below:

1) Protocols for pre-shipment inspection and inspection at the receipt facility need to be developed to ensure that canisters can be shipped, accepted at the receiving facility, and, if destined for a storage facility, returned to storage service.

2) The scope of transportation certificate of compliance (CoC) amendments must be evaluated in detail to address:
   a. Shipping as-fabricated and aged SNF canisters,
   b. Shipping as-loaded SNF canister contents, and
   c. Shipping the SONGS GTCC waste canisters.

3) At SONGS, the on-site rail spur north of Beach Club Road to the main rail line appears adequate to handle the loads of a consist moving SNF cask cars.

4) The on-site rail spur south of Beach Club Road into the plant protected area will be upgraded and augmented as part of SONGS Unit 2 and 3 decommissioning. How much of this rail segment can be used (or further augmented) to support future SNF shipments is unclear at this time given that the final decommissioning design for the site is not yet complete in this regard.

5) Additional area immediately south of the ISFSI will be needed to accommodate facilities and equipment for moving SNF canisters from storage modules to rail cars. Existing structures currently occupy some of that space.

6) Options for a temporary security protected area during the period when canisters are being transferred to rail cars on site will need to be evaluated.

7) SCE needs to decide on an approach, and identify associated infrastructure needs, for moving transportation packages to rail cars on site. Depending on the outcome of a more-detailed technical evaluation, SCE may want to modify the work scope for its decommissioning infrastructure design and make changes to “as-left” conditions after nearer-term decommissioning activities (prior to removing the SNF) are complete.

8) The SONGS co-owners need to determine whether a new or amended coastal development permit will be required for updating SONGS infrastructure to support a future shipping campaign.

9) It may be possible to transport all SONGS TN canisters using a single TN transportation cask design, with minor modifications, rather than using two designs, as is currently the case. SCE should explore options for needed certification and design changes with TN.

10) Transferring the Holtec canisters to transportation casks will require an on-site cask transfer facility (CTF), or equivalent.

11) Decisions regarding site infrastructure need to be made early because they will drive subsequent strategic decisions and other long-lead elements of the schedule.
5. **Phase I: Near-Term Actions to Prepare for Transporting Songs SNF**

The next three chapters describe three distinct phases of planning and operations for SNF shipments. These phases apply to activities and decisions that SCE will undertake, which in turn are tied to the actions a shipper would take. However, a shipper’s activities might not follow the three-phase grouping outlined here. For this reason, all elements of the phases would not necessarily unfold sequentially in time and some activities may overlap. The phases also vary in length depending on whether the shipping campaign is privately conducted or sponsored by the federal government (whether DOE or another federal entity). The activities included in each phase reflect NWT’s expert judgment. In some cases, however, a shipper may choose to conduct an activity in a different phase than presented here based on business, logistical, and socio-political considerations at the time transportation planning begins. Figure 8.1 presents a notional schedule for the activities in each phase.

In addition, NWT developed rough order-of-magnitude cost estimates for each activity. This includes cost estimates for on-site preparations that would be the responsibility of the SONGS co-owners and activities that would be the responsibility of the shipper, whether the shipper is a third-party entity or the SONGS co-owners. These costs are differentiated in the cost tables that appear in this chapter and in Chapters 6 and 7. In each case, the column indicating “Cost to the SONGS Co-owners” includes activities that would be the responsibility of the SONGS co-owners regardless of whether shipments are executed by the federal government (as required under current law and contract) or by a non-federal entity (as in some of the disposition pathways considered in the Strategic Plan).

By contrast, the column indicating “Cost to Shipper” includes activities for which some portion of costs could accrue to the SONGS co-owners and their customers, depending on the details of the shipping model being implemented. SONGS co-owners’ share of these costs could vary widely, ranging from a scenario in which the SONGS co-owners are acting alone and therefore absorbing all shipping costs versus a scenario in which multiple private entities are shipping SNF and sharing costs. The latter scenario has so many possible permutations that it is impossible at this time to estimate the SONGS co-owners’ share without knowledge of the specific parameters that would apply.

It is important to be clear that we do not estimate costs for a scenario where DOE is the shipper because in that case SNF shipments would occur as part of a larger, likely national-level campaign and would presumably be funded by the Nuclear Waste Fund. As such, these costs would not affect the SONGS co-owners’ decision-making.

The following additional assumptions apply to all of NWT’s cost estimates for each phase:

- We estimated costs from the beginning of Phase I until the first shipment of SNF arrives at a destination site. We did not estimate the operating cost of the transportation system (which would factor in the optimum number of transportation casks of each design needed to clear the site) because that is beyond the scope of planning for the first shipment.  

  84 We note that the first two case studies in Section 3.4 that estimate the time to clear the SONGS site assume the first two shipments are single-cask shipments.
potential economies of scale and production schedule benefits associated with large equipment purchases and (b) operating considerations for the rail carrier (e.g., bridge ratings) that may affect the placement of buffer cars when consists include more than one cask car. There may also be cost/benefit analyses that show fewer shipments with more casks would be more cost-effective overall than more shipments with fewer casks.

- The schedule for each phase includes some items not listed in the cost-estimate tables. For example, the tables do not include staff level-of-effort activities for operating the ISFSI. They also do not include other items in the schedule graphic (Figure 7.1) that do not have a cost, or a significant cost, but that do have schedule impacts.
- Estimated costs are for the task, not annual costs.
- All costs are estimated in 2020 dollars.

A last but critical point is that these estimates are provided for informational purposes and to help inform the SONGS co-owners’ strategic decision-making going forward. The allocation of costs for different activities to different entities will depend on specifics of the disposition pathway being pursued and on the terms of arrangements between the entities involved. All of these issues are discussed at length in the Strategic Plan (Vol. II) and will affect future determinations of commercial reasonableness with respect to any costs and financial risks or liabilities that might be incurred by the SONGS co-owners, or by a private entity shipper and charged back to the SONGS co-owners, in scenarios that do not involve the federal government taking title and assuming responsibility for SNF transportation at the SONGS site boundary. As the estimates developed for this plan suggest, transportation-related costs could be significant, particularly in Phases II and III of preparing for SNF shipments.

5.1 Overview of Phase I

We include in Phase I those actions that the SONGS co-owners can take in the present to prepare for the transportation of SONGS SNF in the future. Phase I will end once a destination facility has been identified and a contractual arrangement has been reached with the facility owner/operator. Most Phase I actions have an indefinite shelf-life. In other words, these are planning activities and infrastructure development efforts that will definitely be needed, regardless of the details of a future shipping campaign, how much time elapses before the campaign begins, and the destination of SONGS SNF. In addition, any changes to associated work products as the time of shipment gets closer should be minor. As a result, these activities can be performed at any time prior to the identification of an offsite storage or disposal facility and before a timeline for shipping has been established.

The primary focus in Phase I is to examine the multitude of infrastructure and logistical needs that must be met to implement a shipping campaign and to plan for maintaining the most advantageous conditions at SONGS to facilitate the execution of future shipments. Given that any infrastructure changes at the site related to decommissioning may impact future SNF relocation efforts, it would be beneficial for the SONGS co-owners to ensure that decommissioning activities are performed in a manner that optimizes infrastructure for eventual use in transporting SNF.

In undertaking Phase I activities, it will be important to remain mindful that SCE’s direct organizational resources at SONGS will steadily diminish through the decommissioning process and that transportation-relevant institutional knowledge and information about the site must be preserved and transferred to the future workforce. Thus, site information must be compiled, consolidated, and archived during Phase 1 with the goal of providing a future transportation organization with the best available foundation from which to begin work. This would include establishing a site transportation
library, which includes all details about the current site infrastructure, the regulatory framework for transportation, this conceptual transportation plan, documentation concerning the canisters currently located at the SONGS ISFSI, and other relevant background sources such as the National Academy of Sciences Going the Distance report, Western Interstate Energy Board policy papers, and the report of the Blue Ribbon Commission for America’s Nuclear Future, among others.

5.2 Management Organization/Transportation Planning and Management Organization

A key step toward enhancing preparedness for SNF transportation is to develop the framework for the organizational capacity that will be needed in later phases to maintain information and institutional knowledge, manage SNF inventories on an ongoing basis, conduct a cost/benefit analysis of throughput rates to develop a negotiating position, and complete associated equipment acquisition and other activities outlined in Chapter 4 that are necessary to eventually move the SNF off site.

Both SONGS and the shipper will need a management structure. The shipper’s is sometimes called the transportation planning and management organization (TPMO). If the federal government is the shipper, its establishment of a TPMO will be governed by congressional direction and funding and will be independent of SCE actions. The management structure for a non-federal shipper (other than SCE) will likewise be independent of SCE actions.

The SONGS co-owners should be aware of the roles and responsibilities of the TPMO, anticipate the need to interact with the TPMO in advance and be prepared to maintain or create an on-site management organization to handle the administrative, regulatory, and infrastructure activities needed to prepare SONGS SNF for shipment off site. It is possible that the SONGS on-site management organization could conduct a transportation needs assessment, build the required infrastructure, and then go dormant until the time comes to start planning for actual shipments and/or conduct outreach activities.

The responsibilities of the shipper’s TPMO throughout all phases of transport preparations and operations would typically include completing project plans, conducting cost/benefit and engineering analyses for transportation acquisitions and infrastructure, developing schedule and cost estimates for various funding and shipping scenarios, and communicating with state and national regulators as well as communities and elected officials along potential routes. These tasks require staff or contractor expertise in the areas of SNF maintenance and management, transportation, quality assurance, canister handling, regulatory affairs, legal affairs, contracting, procurement, and stakeholder engagement and communications. The SONGS co-owners’ on-site management organization will need to conduct a number of similar or equivalent functions but from the perspective of the originating site. The work of the SONGS on-site management organization is discussed further in Section 5.3.

It could be many decades before all the SNF is removed from the SONGS site. This creates a need to ensure that the institutional knowledge and human resources needed to plan for and execute SNF shipments off site are not lost.

The mission of the shipper’s TPMO and the resources needed to stand up a TPMO will vary significantly depending on which entity is ultimately responsible for shipments. Once that determination is made, it drives the assignment of responsibilities to the TPMO and the size of the TPMO. The responsibilities of the SONGS on-site management organization are independent of whether a federal or non-federal entity is responsible for shipments.
5.3 SONGS Administrative Activities and Regulatory Compliance

The SONGS co-owners can take steps related to internal planning and management in Phase I that will leave them well positioned to make progress in Phase II, once a shipper’s TPMO is activated. An organizational structure capable of implementing the on-site activities and making the decisions described in Phase I will be needed and indeed, may already exist. This phase requires the internal capacity to conduct on-site preparations, conduct a cost/benefit analysis of the optimum throughput rate to empty the site, maintain information and institutional knowledge, interface with the shipper and destination site (once known), and engage with stakeholders along routes within California. These preparations will allow the SONGS co-owners to establish negotiating terms with a receiving facility (in a scenario where the federal government is not the shipper), ensure that site infrastructure is in a ready-to-ship state, and, in the event that shipments are many decades in the future, preserve the institutional knowledge needed to restart transportation planning efforts at the appropriate time.

To be ready to ship at the earliest opportunity requires actively monitoring external developments that could affect the timeframe for when a receiving facility becomes available (for example, legislative activity in Congress) and then ensuring that the requisite transportation expertise and infrastructure are in place at SONGS at the appropriate time. This could involve bringing in skilled personnel and maintaining or rebuilding infrastructure depending on what remains after current decommissioning activities are complete. In either case, retaining institutional knowledge of the site’s infrastructure and its history of materials handling will be critical.

Several early steps can be taken in Phase I to facilitate progress toward site readiness and establish the organizational capacity needed to oversee a future shipping campaign. These include:

- Developing an organizational framework for the SONGS management organization that will interact with the shipper’s TPMO. This framework would identify the organizational structure for all staff positions with a management or oversight role. Some of these positions would not be filled until Phase II, but the framework can be identified at any time and is a prerequisite to developing final implementation and oversight (QA) organizations.

- Expanding the high-level needs analysis provided in this CTP into a detailed analysis of the preparations that will need to be made at SONGS to ship SNF off site. The analysis would essentially become a draft, top-level “statement of work” that identifies all the tasks required for successful completion, but with no resource assignments. This document would have to be refined in Phase II, but it can be developed early on and used to inform a number of other tasks in Phase II. Sections of this CTP that describe the tasks a shipper must complete to commence the first shipment may be helpful in this regard. Considerable expertise and planning are needed to ensure a smooth interface between the on-site infrastructure and the shipper.

- Developing or maintaining a legal team and a regulatory affairs team to ensure compliance with NRC and other federal or state requirements for storage at the ISFSI and future transportation. These teams will need to work hand in hand to ensure that the master contract to transfer fuel, as well as all subcontracts, incorporate appropriate regulatory compliance flow-downs. The SONGS co-owners will continue to be responsible for overall compliance, and for the compliance of all lower-tier subcontractors and vendors, until the SNF and GTCC waste canisters are transferred off site. If

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85 Such negotiations would likely only be necessary in a scenario where the federal government is not removing the SNF. In scenarios predicated on the federal government performing its statutory and contractual obligations with respect to SNF disposition, the terms of acceptance and schedule for acceptance would be determined by the Standard Contract.
another entity is not taking title to these materials at the SONGS site boundary, this responsibility would continue to the point where the canisters are accepted at the receiving facility. At that point, compliance responsibility would transfer to the entity taking possession of the fuel under the receiving facility’s license. This transfer of regulatory responsibility would have to be carefully choreographed, particularly under any of the non-federal disposition pathways considered in the Strategic Plan, to address any identified gaps and facilitate a smooth transition from storage at SONGS to transportation, and back to storage or disposal at the offsite facility. A legal and regulatory affairs team familiar with transportation-specific issues represents a key capability that is needed in Phase I planning.

- Working with other utilities and within the constraints of the Standard Contract to arrange for the prompt removal of SONGS SNF should DOE exercise its authority to prioritize removal of SNF from shutdown plant sites (see Appendix F of the Strategic Plan for details). This task could fall within the purview of the legal and regulatory affairs team referenced in the prior bullet.

- Developing a high-level, dynamic schedule based on the conceptual schedule provided in this plan but augmented with more detailed inputs from vendors and stakeholders. This schedule can be used to judge the appropriate timing for implementing Phase II activities.

5.4 Site Infrastructure

Appendix C describes the operations and site infrastructure needed to move SNF and GTCC canisters from the ISFSI to rail cars for transport. Actions can be taken in the present to maintain or plan for on-site infrastructure that will benefit any future transportation project, provided that the analysis is informed by the participation of experts with a high level of relevant operational knowledge and expertise. The SONGS co-owners should conduct a detailed technical evaluation to produce a cost estimate and evaluate future infrastructure needs as well as specific elements of existing SONGS infrastructure that should be left in place, such as:

- The rail siding and trackage necessary to build a train consist on the site, with due consideration of future changes to the plant protected area that might arise from the contraction of the site footprint that requires the physical protection measures specified under 10 CFR 73.55 (i.e., the ISFSI). Building the consist within the boundaries of the site protected area will reduce the complexity and costs of maintaining an NRC-compliant security posture during loading operations. This will require a detailed analysis to determine the optimal layout for the loading and consist-building area.

- An extension of the on-site reinforced concrete roadway or the previously abandoned rail spur\(^\text{86}\) to the ISFSI area.

- A cask transfer facility (CTF), crane pad(s), and a station for re-orienting the cask from the vertical to horizontal orientation (and vice-versa) that is suitable for the package(s) and crane(s).

- Buildings or building shells for several purposes:
  - To support administration, human resources, and personnel needs (e.g., restrooms and break rooms).
  - To provide storage and maintenance space for leak-testing equipment, spare parts, lifting and rigging equipment, and to perform minor maintenance on rolling stock as needed.

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\(^\text{86}\) This section of on-site rail spur still exists but it is currently paved over with asphalt (see Appendix C).
To house a radiation, dosimetry, and radiochemistry lab.

To house an access-controlled warehouse for maintaining the spare parts associated with the quality assurance plan inventory.

SCE’s NRC-approved decommissioning QAP (or “DQAP”) will govern important-to-safety site activities and related procurements of items and services. The procurement process allows SCE to accept the manufacturer’s QAP for cask fabrication, provided SCE has approved the manufacturer’s QAP via audit. SCE should prepare and implement a procurement QAP for these purchases to ensure that the fabrication of the casks meets SCE’s specifications. SCE’s DQAP will also ensure that maintenance, spare parts, handling, assembly, storage, and use of the packages and associated equipment (including equipment used to prepare packages for transport) all accord with the package CoC and SAR. Section 3.1 of Appendix C provides additional details concerning QA requirements for cask fabrication, procurement, and site readiness for shipping.

5.5 Communication with States and Tribes Along Potential Routes

In the years before a destination for SONGS SNF has been identified, there will be few route preparedness activities that any entity can undertake. However, communities and tribes along the major rail routes close to stored SNF are generally aware that SNF transport routes might go through their jurisdictions and may have questions or concerns regarding future shipments. Enhancing relationships with these communities and tribes would provide a foundation for more interactive and coordinated planning efforts in the second phase of transport preparations. The SONGS co-owners can use public information practices and messages developed by state regional groups and DOE as a source of best practices to inform these efforts.

During this first phase, a non-federal shipper can define the scope and timing of route planning activities without knowing exact routes. Preparations may include plans for engagement with state, tribal, and local governments along the route and planned communications strategies. Activities that could inform this analysis include meeting with and developing positive working relationships with states, tribes, and local governments along likely routes, and meeting with the relevant state regional groups. Without a destination or known shipping entity, however, these discussions can be conducted only in general terms.

For a federal shipper, such as DOE, the scope of route preparedness activities in this early phase will depend on funding and direction from Congress and the administration. As noted in Box 5.1, DOE’s Office of Nuclear Energy (DOE-NE) continues to engage with states, tribes, and regional organizations to develop its “Stakeholder Tool for Assessing Radioactive Transport,” or START, and to undertake systems engineering work aimed at understanding the schedule and cost implications of various transportation system configurations, above-regulatory rail inspection procedures, and other issues. Agreements reached between DOE and states and tribes frequently raise states’ and tribes’ expectations with respect to extra-regulatory measures that may or may not be taken by a non-federal entity. In this way DOE’s actions and decisions around route preparedness may have impacts on future transport operations even if those operations are not conducted by the federal government.
5.6 Costs for Phase I

As indicated above, Phase I activities would include those activities that could be taken to ensure the SONGS site infrastructure and regulatory programs are ready for transportation when a viable receiving facility becomes available. These activities could be undertaken at any time but should be initiated at least 10 years before the date when a receiving facility is expected to be ready to receive SONGS SNF.

Table 5.1 provides rough order-of-magnitude (ROM) cost estimates for potential activities in Phase I. These estimates are based on NWT’s expert judgment and industry sources where available. Several Phase I activities could be accomplished within a couple of years if a destination site were to become available sooner than expected. Updates to site conditions and maintenance of container information and programs will be necessary throughout Phase I, regardless of the length of this period.

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87 Holtec and ISP can be considered to be in Phase II because they have a site and are seeking an NRC license. However, the SONGS co-owners would not be in Phase II until they have a negotiated agreement to send the SNF to a receiving facility.
### Table 5.1. Rough-Order-of-Magnitude (ROM) Phase I Cost Estimates

<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Cost to the SONGS Co-owners</th>
<th>ROM Cost to Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Develop Framework for On-Site Management Organization</strong></td>
<td>$100,000</td>
<td>$0</td>
<td>Costs to the SONGS co-owners would be minimal because this activity mainly requires staff time to create a template for an organization chart and understand the activities and responsibilities involved in preparing for future SNF shipments. The shipping entity would not set up a TPMO this early in the planning process, so only the cost to the SONGS co-owners is noted.</td>
</tr>
<tr>
<td><strong>Administrative and Regulatory Compliance</strong></td>
<td>$190,000</td>
<td>$0</td>
<td>SCE’s existing technology for records management may lower the cost of this activity. The shipping entity would wait until Phase II so only the cost to the SONGS co-owners is noted.</td>
</tr>
</tbody>
</table>
| • Develop a library of primer documents for the future transportation management organization. The library should include information detailing site conditions as well as information relevant to NRC and DOT regulations and guidance, this CTP, ASTM Standards, ANSI Standards, state regulations, the report of the Blue Ribbon Commission on America’s Nuclear Future, the National Academy of Sciences *Going the Distance* report, governors’ resolutions and policy papers, and transportation plans for previous SNF shipments.  
• Maintain legal counsel and a regulatory assurance team to ensure integration of NRC requirements for storage (at the ISFSI) and future transportation. |                                                                                                                                                                                                                       |
| **Project Planning**                                    | $200,000                         |                     | The schedule for a number of items will be determined by policy decisions and agreements negotiated by the SONGS co-owners. The co-owners should evaluate which Phase I tasks can be completed by in-house expertise versus contractors.                                                                                                                   |
| • Build a high-level dynamic schedule, based on preliminary input from stakeholders and time estimates with no dates.  
• Develop a comprehensive capability/equipment needs analysis for the project assuming 100% of experience and equipment capability lost.  
• Conduct a cost/benefit analysis of various throughput rates and associated equipment and infrastructure needs to better understand the SONGS co-owners’ preferred systems design. |                                                                                                                                                                                                                       |
Table 5.1. (continued)

<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Cost to the SONGS Co-owners</th>
<th>ROM Cost to Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Infrastructure Analysis and Development</td>
<td>$200,000</td>
<td>$0</td>
<td>This study requires an evaluation of post-decommissioning “as-left” physical infrastructure needs (such as rail sidings), the need for new capabilities (such as crane pads, road/ground loading engineering analyses, CTF, etc.), and a systems analysis on efficient yard layout vs. security boundary. The study should be performed before decommissioning is complete to identify any infrastructure that should be retained after decommissioning.</td>
</tr>
<tr>
<td>Annual Communication with Local Stakeholders and Tribes Along Nearby Rail Lines Within California</td>
<td>$60,000</td>
<td></td>
<td>These outreach efforts should include communities near SONGS along likely rail routes. Regular conversations to address questions or concerns will lay the groundwork for future cooperation.</td>
</tr>
<tr>
<td>Total Cost Estimate Phase I</td>
<td>Total: $750,000</td>
<td>Total: $0</td>
<td></td>
</tr>
</tbody>
</table>
6. Phase II: Actions After a Destination is Known

6.1 Overview of Phase II

Phase II (from the standpoint of the SONGS co-owners) would commence once a destination site has been licensed and an agreement or contract for acceptance of the SONGS SNF is in place (note that this would not be an issue in a scenario where the federal government is removing the fuel for transport to a federal storage or disposal facility). Since these two milestones may not line up—for example, ISP and Holtec anticipate that SNF shipments to their proposed private CISFs could start as soon as two to three years after the facilities are licensed—the SONGS co-owners will need to make a judgment call, based on negotiations and agreements with the owner/operator of the destination facility and the shipper, about when to begin Phase II activities. Which entity is responsible for shipping will vary for different disposition pathways; as discussed at length in the Strategic Plan, pathways that assume a central role for the federal government are much more likely to meet the test of commercial reasonableness, including with respect to title and liability considerations. For pathways that do not assume a central role for the federal government, negotiations with the shipper and with the owner/operator of the receiving facility would be necessary to determine whether a commercially reasonable arrangement can be reached. The remainder of this discussion assumes that such negotiations have occurred and that planning for transportation (in the context of a non-federal disposition pathway) can go forward under agreed and commercially reasonable terms.

In this phase, the shipper will want to begin taking action on long-lead-time items to prepare for a transportation campaign, such as ordering transportation casks and rail rolling stock, putting a transportation management organization in place (if that was not already done), and conducting a systems and logistics analysis to determine throughput rate and identify equipment and staffing needs to support operations. Throughout this chapter, we identify those actions that the SONGS co-owners can take regardless of the shipper and those activities that would be specific to a private shipper (in scenarios where transportation is not being conducted by the federal government or by a contracted federal agent).

We assume that, along with the identification of a licensed destination site, agreement on funding sources and transportation roles and responsibilities would be reached by the time Phase II planning activities commence. Such agreement would be necessary to move forward with the acquisition of items required for the shipping campaign. Most of the activities in Phase II can be performed only after the destination for a SNF shipping campaign and its operations model (federal or private) are known. This planning phase also requires a general sense of the shipping schedule so that resource outlays can be

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88 Per meetings between NWT and ISP and Holtec on January 9, 2020, Washington, D.C. This time frame is when the CISF owners project being able to receive the first SNF shipments, assuming construction begins just after license issuance. It does not represent a timeframe within which the facilities would be able to receive SONGS SNF. In all likelihood, the CISFs will transfer SNF from originating sites owned by their affiliates first. When either facility might be in a position to receive SONGS SNF is not predictable with any precision due to the many variables that would be involved with negotiating a commercially reasonable arrangement for private storage services.

89 For reasons discussed at length in the Strategic Plan, the hurdles to achieving a commercially reasonable arrangement could be very high for any of the non-federal scenarios NWT analyzed.

90 It should be noted that the financial responsibilities assumed by various participants in the transportation of SNF from SONGS are likely to be highly negotiable and subject to the terms of any agreement between the SONGS co-owners, the federal government, and the receiving facility. These costs and how they are allocated will also be dictated to a great extent by the storage model that is being implemented by the receiving facility.
timed to minimize maintenance and renewal costs. Priorities for Phase II planning would include analyzing specific transportation needs, identifying likely rail routes, acquiring transportation packagings and rolling stock, and, if the federal government is the shipper, beginning to develop site-specific transportation plans that define roles and responsibilities. Phase II will also mark the initiation of efforts to plan for communications and public outreach. These efforts will continue as long as the shipping campaign is active.

A private shipper will need to determine the cost and schedule for acquiring transportation casks, cask handling equipment, and rolling stock. A private shipper will also need to decide their approach for (1) engaging with states, tribes, state regional organizations, and localities along potential routes; (2) supporting training for first responders along potential routes; and (3) planning public outreach and communication. While there is no requirement that a private shipper begin coordinating with states, tribes, and local officials during this phase, the likely high-profile nature of SNF shipments and previous experience suggest that it would be prudent to develop relationships well in advance and work cooperatively to develop site-specific transportation plans. The purpose of these plans would be to define roles and responsibilities, operational interfaces, and communications activities.

If the shipping campaign is to be sponsored or conducted by DOE (or another federal entity), and if priority is to be given to removing SNF from shutdown plant sites, a Phase II activity for the SONGS co-owners might be to work with the owners of other shutdown plant sites\(^9\) (perhaps via the Decommissioning Plants Coalition) to determine a mutually acceptable removal sequence that can be proposed to the federal government. This suggestion is predicated on the assumption that DOE would prioritize SNF removal from shutdown sites, as permitted by the Standard Contract. The Strategic Plan also considers a disposition pathway where the federal government pays for and manages the transportation of SNF from plant sites to a non-federal storage facility as a means to remedy DOE’s partial breach of contract in not taking SNF as required by the NWPA (see discussion in Section 7.5 of the Strategic Plan). We did not estimate associated transportation costs because these costs would be borne by the federal government and paid for through the Nuclear Waste Fund. This last alternative requires congressional action to amend the NWPA or provide new authority for the federal government to use a non-federal facility for consolidated interim SNF storage.

### 6.2 Activities Related to the Transportation Planning and Management Organization

The TPMO for a private entity shipper, as described in our discussion of Phase I (Section 5.2), will need to be expanded and fully staffed to support activities in Phase II. Once the receiving facility has been identified and the entity with responsibility for shipping has been established, the full size and scope of responsibilities for the TPMO can be determined. The TPMO will be responsible for planning, public outreach, and all long-lead-time activities required to prepare for shipping. The TPMO should have staffing capabilities in multiple areas, including SNF maintenance and management, legal/regulatory affairs, congressional affairs, transportation planning, contracting and procurement, and stakeholder engagement and communications. The SONGS co-owners will also need to establish or maintain an on-site management organization to (1) continue Phase I maintenance and compliance activities (as described in Chapter 5) and (2) interact with the shipper regarding logistics and operations, including determining the commercial reasonableness of services offered.

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\(^9\) Besides SONGS, there were 18 other shutdown plant sites in the United States as of 2020. This number is expected to grow to 25 sites by 2030 and 37 sites by 2040. See Appendix D of the Strategic Plan.
6.3 Systems Analysis, Logistics, and Project Planning Needs

Before equipment can be acquired, staff hired, and infrastructure updated, the shipper will need to conduct a systems analysis to determine system requirements. That analysis would be informed by a range of inputs such as model(s), likely route(s), packages, and destination unloading times. With this information, an ideal throughput rate and turn rate can be calculated. Results from the systems analysis will drive estimates of fleet sizes for both packages and rolling stock; the analysis itself will likely be undertaken collaboratively by all participating entities.

NWT expects that the SONGS co-owners will work with the shipper to update the SONGS site analysis conducted in Phase I. This would include refining preferred arrangements for de-inventorying the site and updating schedules with specific inputs and target dates. The shipper’s systems analysis will more clearly specify the scope of work for on-site preparations to be undertaken by the SONGS co-owners.

6.4 Acquisition Strategy

Once the shipper updates the systems analysis, the next task is to develop a detailed acquisition strategy, including specifying the timing and responsibility for purchases of needed assets (i.e., transport packagings, rolling stock, and ancillary equipment) and infrastructure improvements, if any. Part of the shipper’s analysis will address cost allocation provisions for these procurements across the shipper’s customer base (the task for the SONGS co-owners would be to determine whether these costs are commercially reasonable or not). If commercially reasonable terms can be negotiated, then the SONGS co-owners would develop a site-specific acquisition strategy that aligns the timing of purchases, infrastructure upgrades, and interface requirements with the shipping entity’s higher-level strategy.

6.4.1 Package Licensing

Section 5.2 lists the transportation package designs certified to ship SONGS SNF and, with amendments, SONGS GTCC canisters. SCE will need to assist the package CoC holder in determining the content of applications for any transportation package CoC amendments needed to certify packages for the SONGS material and canisters. SCE would be expected to review application documents as they are being prepared and attend related meetings with cask vendors and the NRC.

A dialogue should be opened with TN about whether it makes more sense financially to update the 10 CFR 71 CoC for the MP187 to current standards versus amend the CoC for the MP197/197HB to include canisters originally destined for the MP187. Reducing the number of transport cask designs that the shipper will have to procure would provide cost savings over the duration of the shipping campaign. Those savings would come from reducing the amount of hardware that would have to be procured, along with the loading, testing and maintenance procedures that would be needed and the number of training iterations that would be required. Appendix C provides a more detailed discussion of package CoC amendments.

6.4.2 Transportation Cask and Rail Car Procurement

The transportation packages used to ship SONGS SNF and GTCC are composed, fundamentally, of the canister and the cask. The canisters are already in service at the ISFSI. Thus, only the transportation casks, cradles, impact limiters, and associated cask loading equipment need to be acquired. Based on the licensing strategy, either two or three transportation cask designs will be used, depending on whether the TN canisters are shipped in one package design or two different package designs. Any licensing costs to the vendors for CoC amendments are assumed to be included in the purchase cost of the first cask.
Purchasing and owning transportation casks will be very costly up front. The estimated lifetime cost for each transportation cask is $10 million.\footnote{The cost of a transportation cask, cradle, and impact limiters alone is estimated to be in the $5–$6 million range. The additional cost used in this paragraph is attributable to lifetime costs, such as for cask maintenance, storage, spare parts, disposition etc. The actual cost will vary based on whether the casks are leased or purchased, and what ancillary costs are included in the commercial agreement. That determination is part of the full transportation systems analysis. Only the initial purchase price of $6 million is used in the table below as a rough order-of-magnitude value for purposes of this estimate.} After the SONGS SNF and GTCC waste is removed from the site, packages that have been purchased will require final disposition (i.e., sale or lease to other users, or disposal). The number of transportation casks needed and the value of a future sale or lease of those casks needs to be considered in any purchase or lease analysis. Transportation cask disposal represents a substantial fraction of the package cost and will need to be factored into negotiations for the purchase or lease of packages.

In a private shipping scenario, transportation casks (including cradles, impact limiters, and ancillary equipment) and cask rail cars could be acquired by the operator/licensee of the receiving facility or their subcontractor. Given the significant uncertainty and optionality involved with these acquisitions, NWT chose not to speculate about which arrangement is most likely. The assignment of costs to the SONGS co-owners for these acquisitions would be an integral part of any negotiation with a commercial shipper.

An initial shipment of a three-package consist will require three transportation casks, three cask rail cars, two buffer cars, and an escort car. The total number of transportation casks and rail cars purchased or leased will be determined by the transportation systems analysis. For planning purposes, three consists, each carrying three packages, represent a reasonable starting point. The timing for ordering transportation casks will be driven by target dates in the shipping schedule, as well as by lead-time estimates provided by cask and rail car vendors. We estimate the lead time for ordering a single cask to be about two years, or about five years for an order of nine casks (across three consists). Lead times to procure specialized rail cars also average three years for small orders; possibly longer for the more complex escort car.

The rail cars purchased for these shipments need to be designed to accommodate the cradle and other tie-down requirements of the transportation casks, regardless whether the rail car is S-2043-compliant or not. Since rail car manufacturers normally set up their production lines to produce hundreds of cars at a time, there is a cost premium to ordering small lots of rail cars that are specially designed for SNF transportation casks. The acquisition strategy will need to consider the cost and manufacturing time for these rail cars, which can take up to three years.

DOE has developed both a 12-axle “Atlas” rail car and begun work on an 8-axle “Fortis” rail car design\footnote{https://www.csgmidwest.org/MRMTP/Meetings/Fall%202020/Bickford_SRG_FallMtgs_2020.pdf}. The 12-axle rail car multi-car consist is expected to begin testing at the AAR’s Transportation Technology Center Inc. in Pueblo, Colorado in March 2021, with testing expected to last about two years. DOE completed a final design for an 8-axle car and submitted this design to the Equipment Engineering Committee of the AAR in late June 2020. The AAR’s Equipment Engineering Committee approved fabrication of the prototype Fortis rail car for testing in late 2020. DOE is currently working on procurement for the fabrication of the first 8-axle prototype cask rail car for testing.

The 8-axle design is anticipated to offer several operational and cost advantages compared to the 12-axle design, including lower weight, shorter length, and a lower deck height, as well as lower
purchase/lease and maintenance costs. The geometry of the car layout in terms of truck spacing, span bolster spacing, etc., should also offer other advantages, including better ability to handle tight curves, which would be valuable at a compact site such as SONGS.

### 6.4.3 Other Rolling Stock Procurement

In addition to the transportation casks and cask rail cars required to transport SNF packages, three other types of rail assets must be considered: buffer car(s), escort car, and locomotive. Buffer cars are required between the cask cars and any occupied cars (escort car and locomotive). Buffer cars may also be required between cask rail cars to distribute the track load, depending on bridge ratings along the route and the number of packages being transported in the consist. The escort car, which carries security personnel, must be positioned such that these personnel can keep all cargo cars under visual observation at all times (including through bends and tunnels). Lead time for buffer car procurement is estimated to be two years. The greater complexity of escort cars and the probable need to use custom fabricators could easily extend lead time for these cars to four years.

The locomotive and locomotive operator are typically provided by the rail company as a service associated with their carriage fees. In order to take advantage of the performance reporting features included in the AAR S-2043 operating standard, locomotives will require special communication links to the real-time data monitoring on each car in the consist. NWT is unaware of any locomotives that currently have this capability. There are no special requirements for the locomotive itself, except that it may have different speed limitations based on AAR operating constraints (AAR Circular OT-55) which define SNF shipments as “key trains” and limit their speed to 50 miles per hour.

### 6.5 Readiness to Prepare SNF and GTCC Waste for Shipment at SONGS

To enable shipments of SNF and GTCC waste off site, the hardware and infrastructure capability to move SNF and GTCC canisters from ISFSI storage modules, transfer them into transportation casks, and then load the transportation casks with impact limiters and cradles onto rail cars will need to be present at SONGS. If the 12-axle Atlas rail car is used, each cask car will be 78 feet long between pulling centers. The AAR S-2043 buffer cars are 66 feet between pulling centers and the escort car is approximately 60 feet between pulling centers (no final design details are available). Thus, a consist of three cask cars, two buffer cars, and one escort car will be 426 feet long without the locomotive.

If a multi-cask rail consist cannot be loaded on site, plans will have to be made for loading one rail car at a time. Loading rail cars on site will likely be the responsibility of the SONGS co-owners regardless of the shipping entity. If loaded cars have to be moved to a consolidation yard off site to assemble the consist, this will be the shipper’s responsibility. Identifying where such a consolidation yard might be placed and how security might be provided during the lengthy process of assembling the full consist is a task that should be completed long before shipments begin. Other facilities at Camp Pendleton could be considered, or the SONGS co-owners could assess the cost/benefit of developing parallel track sidings with consolidation capability within the SONGS site. The capability to prepare transportation packages for shipment and move them out of the protected area to begin the journey to a consolidation or receiving facility must also be planned for. This section summarizes the transportation equipment and physical infrastructure required at SONGS to accomplish these tasks (additional details are provided in Appendix C). Our discussion considers two scenarios for moving loaded transport casks from the ISFSI area to rail cars on the SONGS site.
6.5.1 Update of Canister Inventory, Inspections, and Maintenance of CoCs and Documentation Packages

Because of the undetermined and potentially long timeframes between phases, an important Phase II activity will be to review and update, as necessary, the current compliance status of each SNF and GTCC waste canister and its contents, consistent with the current requirements of the applicable transportation CoC. The results of this review should be used to identify needed changes to the transportation CoCs and to update the documentation packages that will be necessary to ship the SONGS SNF and GTCC waste.

6.5.2 Transfer Equipment Procurement

The equipment needed to move canisters from storage modules at the ISFSI to transportation packages varies significantly between the TN canisters and the Holtec canisters (see Appendix C). While SCE already owns a transfer cask that is compatible with the Holtec canisters (this cask is currently being stored on site), equipment such as the Holtec mating device, the TN transfer trailer and hydraulic ram system, lid seals and bolts, and package preparation equipment (e.g., drying systems) would most likely be provided by the transportation package owner. However, other ancillary equipment, including the vertical cask transporter (VCT), self-propelled modular transporter (SPMT), consumable parts, and lifting and rigging equipment required to move loaded packages on site could be supplied by others.

6.5.3 Crane Procurement

The SONGS co-owners will be responsible for operations and equipment within the SONGS site, including crane operations. Crane capacity of approximately 200–300 tons will be needed to lift loaded transportation packages. Two mobile hydraulic truck cranes would be preferable for a project such as this; these cranes could be either leased or purchased depending on the terms that the SONGS co-owners can negotiate. A mobile crane provides a higher level of cost recovery when compared to a permanent gantry or girder crane because the resale values of mobile cranes are relatively high. Additionally, mobile truck cranes provide a greater degree of flexibility to move around the site. However, given the relatively high design-basis seismic accelerations for the site, mobile cranes may or may not be feasible. This issue should be carefully evaluated as part of a more detailed technical evaluation of site infrastructure.

6.5.4 Site Infrastructure Upgrades

As detailed in Appendix C, a number of site infrastructure upgrades will be required to move SNF and GTCC canisters from the ISFSI storage modules to transportation casks, and to move the loaded transportation casks to rail cars. Appendix C details the activities that must be performed and different site layout, equipment, and facility options for performing them. The preferred scheme for these activities and facilities will be an outcome of the technical evaluation performed in Phase I. Major items to be addressed include:

- Whether to extend the reinforced roadway or the abandoned onsite rail spur to the ISFSI;
- Where to locate the cask transfer facility or station, downending station,94 and crane pads;

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94 The downending station is used to re-orient the empty and loaded casks between the vertical and horizontal orientations. The term “downending station” is used for simplicity.
• What, if any, of the rail sidings and spurs being installed to support the decommissioning of SONGS Units 2 and 3 should be retained after decommissioning is complete; and

• Whether the SONGS co-owners should consider any changes to the scope of work for SONGS Units 2 and 3 decommissioning that would be cost-effective in terms of supporting future SNF shipments.

6.5.5 Site Procedures and Maintenance Program

While it would be premature to draft detailed operational and administrative procedures or a detailed maintenance program in Phase II, drafting a master document index and a procedural framework into which these later procedures can be inserted would be beneficial. Additionally, an inventory control and prescribed maintenance framework can be developed for those items that SCE anticipates maintaining on site.

6.5.6 Site Training

SCE will need to identify the training programs needed to support shipping operations. These programs may be developed independently by different organizations depending on their negotiated roles and responsibilities in the context of the overall shipping campaign. Training will be needed in several areas, including site operations, site safety (including radiation safety and safety culture), DOT general awareness, security awareness, and function-specific awareness. Appendix C provides more detail concerning training needs.

6.5.7 SCE Quality Assurance Program and Operating Procedures

SCE’s Decommissioning Quality Assurance Program (DQAP) has been approved by the NRC to govern activities conducted under 10 CFR Parts 50, 72, and 71. The DQAP will require another review by SCE in Phase II to determine if any additional changes to the program are required as the details of the shipping campaign become clearer. Such changes, if needed, may require prior NRC review and approval. The DQAP is implemented via site procedures. Because it has been quite some time since SNF was shipped from SONGS, a new suite of implementing procedures will need to be developed. With the use of at least two different package designs, parallel sets of procedures may be required. These procedures will need to be developed in collaboration with the logistics company and the transportation package certificate holders. Depending on the level of detail known about transportation packages and on-site loading plans, it may be possible to draft or outline some QA and operations procedures in Phase II. But most of the detailed development of procedures would occur in Phase III when all relevant package details are known and loading contracts are in place.

6.6 Carrier Selection

The shipper will hire a logistics company to manage shipments. Part of the logistics company’s responsibility is the selection of carriers. The selection of a carrier for SNF shipments must follow NRC and DOT requirements, which include operational, security, and shipment stowage and parking

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95 The SCE Decommissioning Quality Assurance Program, or DQAP, is the NRC-approved, high-level summary document that explains how SCE intends to implement the quality assurance requirements of 10 CFR 50, Appendix B; 10 CFR 72, Subpart G; and 10 CFR 71, Subpart H at the SONGS site during decommissioning and until the licenses are terminated. Site-controlled procedures provide the detailed instructions on how quality-related activities are implemented on a day-to-day basis.

96 NRC 10 CFR 71 QA program approval No. 71-0174, Revision 8, dated August 7, 2015.
requirements. If DOE has negotiated additional measures with carriers for its shipments, beyond regulatory requirements, then a private entity may want to consider adding those measures to the negotiation. Train operators and crews must meet applicable training requirements under 49 CFR 172.704. These requirements cover several areas:

1. General awareness/familiarization training
2. Function-specific training
3. Safety training
4. Security awareness training
5. In-depth security training
6. Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (EPA), and other training.

Before an individual is granted unescorted access to SNF in transit or certain protected information relating to specific shipments, the licensee is required to complete a background investigation of the individual, in accordance with 10 CFR 73.38 (“Personnel Access Authorization Requirements for Irradiated Reactor Fuel in Transit”). The requirements of 10 CFR 73.38 apply to vehicle operators, escorts, and any other individuals accompanying a SNF shipment during transport; they also apply to movement control center personnel, reviewing officials, background screeners, and any other program personnel with authorized access.97

### 6.7 Interactions with States, Tribes, Local Authorities, and Public Safety Personnel

A federal shipper, following the transportation model developed by DOE, will actively engage state and tribal governments and state regional groups during this phase. Topics to address include route selection, advance notifications, security escorts, inspections, satellite tracking technology and information sharing, emergency response planning, and training. A federal entity will also need to resolve multiple issues outside of regulatory requirements, including whether to support the revival of the NRC’s program in the early-2000s to conduct a package performance study (PPS)98 on a transportation cask. (The PPS was intended to enhance public confidence in the inherent safety of these casks.) Additional issues to be resolved include when and how to coordinate communications materials and activities, and how to address policies adopted by state regional organizations with respect to SNF transport.99

A private entity shipper, while not required to do so by regulation, may find it advisable to provide information to states, tribes, state regional groups, and others about the planning process and precautions taken to ensure shipment safety and security. Although some states have expressed their expectation that private shippers will follow an engagement process similar to that developed by DOE, this might be viewed as too expensive for a private shipper and unnecessary to ensure shipment safety and security.

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97 NUREG-0561, 10 CFR 73.37
99 [https://www.westernenergyboard.org/category/library/hlrcw-library/](https://www.westernenergyboard.org/category/library/hlrcw-library/)
The shipper and the SONGS co-owners will want to coordinate their engagement plan, vet the plan with other relevant parties, and then be ready to implement the plan—either in Phase II or Phase III as appropriate.

### 6.7.1 Preliminary Route Planning

The regulatory process for selecting routes, which requires safeguarding information (SGI), a special category of sensitive unclassified information that must be protected, will occur in Phase III. However, once a destination is known and the mode and rail carrier have been selected, routes can generally be predicted. As this information becomes public, stakeholders and elected officials on potential routes may begin to inquire, and media attention and heightened public interest may follow. The shipper can build greater understanding of the safety measures taken for these shipments by providing accurate and credible information to interested parties early in the planning process. If a private shipping entity does not engage state, tribal, and local elected officials early and often, it may be difficult to overcome misunderstandings, fears, and concerns.

This CTP does not consider a specific destination site for SONGS SNF. However, the development of both the Strategic Plan (Vol. II) and this CTP (Vol. III) follows from the terms of a Settlement Agreement that specifically directs the analysis to consider a destination site in the southwestern United States. Figures 6.1 and 6.2 show all major rail lines from the SONGS site that could potentially serve as routes for shipping SONGS SNF to a destination in this region.

### 6.7.2 Emergency Preparedness and Response Training

If the federal government is the shipper, DOE will need to finalize plans for the implementation of NWPA Section 180(c) emergency response assistance. Training for emergency responders generally needs to be repeated every two years so it is unlikely that training will begin during the same time period as the SONGS co-owners’ Phase II activities. The idea would be to avoid training public safety officials who then leave their positions and thereby limit the need to conduct refresher training in the years before shipments commence. However, it should be noted that training along routes for WIPP shipments was initiated about eight years prior to the first shipment (not intentionally, but because WIPP’s opening was delayed). Many consider the early training of first responders to have been a significant factor in building public confidence in the safety of the WIPP shipments.

As discussed in Section 2.2, private shipping entities are likewise subject to a requirement for advance planning and coordination with states and tribes. However, the required planning window is short (two weeks prior to shipment) and there is no requirement that the shipper provide support for training or technical assistance. However, the shipper may want to consider the benefits of gaining public trust by either funding training for jurisdictions along the route or helping state, tribal, and local governments access the training available from federal and private industry sources. For example, the shipper may be able to provide assistance so that these jurisdictions can identify federal funding and training opportunities, as part of cooperative efforts to ensure preparedness along the routes. Further, commercially available options exist for training emergency responders in hazardous materials shipments, including radioactive material. The federal government offers significant resources to help states, tribes, and local governments train for accidents or incidents that involve hazardous materials, including SNF.
Figure 6.1. Major Rail Routes Near SONGS
Figure 6.2. Major Rail Routes from SONGS to the Southwestern United States

LEGEND
- Burlington Northern Santa Fe Railway Company (BNSF)
- Union Pacific Railway Company (UP)
- Commuter Rail
6.8 Costs for Phase II

Phase II includes activities that involve high cost and long lead times, including procurement and construction activities. This includes some ongoing administrative and regulatory assurance activities from Phase I, the construction or installation of on-site infrastructure to support transportation; the selection and ordering of transportation casks and rolling stock; and provisions for other functions as needed to enable SNF transport as soon as the opportunity is available. Table 6.1 summarizes estimated costs during this phase, including capital costs incurred between five and ten years prior to first shipment. These estimates assume a single private entity is responsible for shipments, but they can easily be multiplied to match the scale of a multi-utility or larger-scale transportation effort by a private entity.

Importantly, the costs shown in Table 6.1 represent rough estimates based on the activities described in this chapter and on NWT’s expert judgment and professional experience. They do not include costs for long-term maintenance and regulatory compliance programs for needed equipment. Without knowing which entity (or entities) will ultimately bear financial responsibility for future SNF shipments, it is extremely difficult to estimate costs to the SONGS co-owners in this phase of preparations.

As in Section 5.6, our cost estimates for Phase II are provided for informational purposes and to help inform the SONGS co-owners’ strategic decision-making going forward. The allocation of costs for different activities to different entities—and the commercial reasonableness and title and liability considerations that apply—will depend on specifics of the disposition pathway being pursued and on the arrangements that exist between the entities involved.

Table 6.1. Rough-Order-of-Magnitude Phase II Cost Estimates

<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Cost to the SONGS Co-owners</th>
<th>ROM Cost to Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-up the Transportation Planning and Management Organization</td>
<td>$65,000</td>
<td>$175,000</td>
<td>Dependent on shipper.</td>
</tr>
<tr>
<td>Augment capabilities of TPMO based on determination of receiving site and shipper of record. Acquire the services of a logistics company to consult on the systems analysis, carrier selection, etc. Begin development of a site-specific transportation plan.</td>
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</tr>
<tr>
<td>Systems Analysis, Logistics, and Project Planning</td>
<td>$80,000</td>
<td>$500,000</td>
<td>Dependent on shipper and whether logistics for more than one site of origin need to be factored into the systems analysis. The role of the SONGS co-owners will be largely limited to providing information and coordinating with the destination facility and shipping entity.</td>
</tr>
<tr>
<td>Conduct a transportation program systems analysis to determine system requirements. That analysis would be informed by a range of inputs such as mode(s), route(s), packages, and destination unloading times. With this information, throughput, turnaround rates can be calculated. Results from the systems analysis will drive estimates of fleet sizes for both transportation packages and rolling stock. Development of a schedule and milestones for Phases II and III starts with the transportation systems analysis.</td>
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<tr>
<td>Scope of Work Item</td>
<td>ROM Cost to the SONGS Co-owners</td>
<td>ROM Cost to Shipper</td>
<td>Cost-Relevant Considerations</td>
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</tr>
<tr>
<td><strong>Upgrade On-Site and Near-Site Infrastructure</strong></td>
<td>$50,000,000</td>
<td>$0</td>
<td>Requires contracting for engineering and construction assets and coordinating with shipping organization.</td>
</tr>
<tr>
<td>Review and update the technical evaluation from Phase I, as necessary. Perform final design and conduct near-site and on-site infrastructure upgrades, including rail spur or reinforced roadway extension, crane pads, and CTF, and other construction necessary to prepare the SONGS site for transportation activities.</td>
<td></td>
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</tr>
<tr>
<td><strong>Develop Cask Acquisition Strategy</strong></td>
<td>$130,000</td>
<td>$200,000</td>
<td>An overarching acquisition strategy will be the responsibility of the primary funding entity. However, the SONGS co-owners will have to develop their own acquisition strategy, in addition to the overall project strategy—this may be a subdivision of the overall strategy.</td>
</tr>
<tr>
<td>Develop a detailed acquisition strategy and timeline based on the systems analysis.</td>
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<tr>
<td><strong>Verify Quality Assurance Programs</strong></td>
<td>$50,000</td>
<td>$50,000</td>
<td>The main driver of cost is the scope of the QA program and procedure changes, which will be determined by the negotiated terms of the package procurement.</td>
</tr>
<tr>
<td>The SCE Decommissioning Quality Assurance Program (DQAP) will need to be reviewed, and revised as required, and implementation procedures will need to be developed to execute hardware procurement, receipt, maintenance, preparation, and shipping. The cask vendors’ and shipper’s QA programs will need to be compared to the SONGS DQAP to ensure any gaps are identified and addressed.</td>
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<tr>
<td><strong>Package Licensing</strong></td>
<td>$100,000</td>
<td>$0</td>
<td>Depends on whether two or three package designs will be used. Vendors’ licensing costs will be included in the transportation cask cost.</td>
</tr>
<tr>
<td>Identify transportation package licensing actions required and work with package owners to amend the CoCs. SCE will review documents and attend meetings in support of the CoC amendments.</td>
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</tr>
<tr>
<td><strong>Transportation Cask Procurement</strong></td>
<td>$0</td>
<td>$18 million for a 3-package consist</td>
<td>Fleet size and cask lease model will be the primary cost drivers. $3–$10k per day is the package lease ROM – purchase vs. lease analysis will need to be performed once throughput rate and project time are known. Consideration of cask re-sal (e.g., to DOE or another utility) after the SONGS site is cleared should be a consideration in the purchase vs. lease analysis.</td>
</tr>
<tr>
<td>Place order for purchase of transportation cask(s). Price for purchase of three transportation casks, including a cradle and two impact limiters for each cask, ancillary equipment, maintenance, spare parts, and other overhead costs.</td>
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</table>
Table 6.1 (continued)

<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Cost to the SONGS Co-owners</th>
<th>ROM Cost to Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procurement of Cask Rail Car</strong></td>
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</tr>
<tr>
<td>Place order for purchase of one AAR S-2043 rail car for each cask (three per consist at $1.5 million each).</td>
<td>Variable*</td>
<td>$4,500,000 for 3 cars to create a 3-package consist.</td>
<td>Fleet size is the primary cost driver, as determined by the transportation systems analysis.</td>
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<tr>
<td><strong>Procurement of Buffer Cars</strong></td>
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<tr>
<td>Place order for purchase of buffer cars (two per consist at $350,000 each)</td>
<td>Variable*</td>
<td>$700,000 for 2 cars to create a 3-package consist</td>
<td>Fleet size is the primary cost driver, as determined by the transportation systems analysis. Additional buffer cars could be needed for each consist depending on load distribution requirements for tracks and bridges.</td>
</tr>
<tr>
<td><strong>Procurement of Escort Cars</strong></td>
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<td></td>
</tr>
<tr>
<td>Place order for purchase of escort car (one per consist)</td>
<td>Variable*</td>
<td>$4,500,000</td>
<td>ROM cost to produce a new dedicated escort car outfitted with modern electronic security monitoring equipment, armor, and living accommodations for escorts</td>
</tr>
<tr>
<td><strong>Preliminary Route Planning</strong></td>
<td></td>
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</tr>
<tr>
<td>Work with states, tribes, and DOT to perform preliminary mode and route analysis. Begin initial engagement with state and tribal officials along the route.</td>
<td>$50,000</td>
<td>$150,000</td>
<td>Cost depends on the number of states and tribes traversed and how many years in advance engagement begins. This does not include formal regulatory route selection which requires safeguarded information.</td>
</tr>
<tr>
<td><strong>Acquisition of Vertical Cask Transporter</strong></td>
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</tr>
<tr>
<td>Place order for purchase or lease of vertical cask transporter for moving Holtec transfer casks and canisters from storage to the CTF.</td>
<td>$2,000,000</td>
<td>$0</td>
<td>Transfer cask is already on site and in storage. VCT may be purchased or leased but needs to be compatible.</td>
</tr>
<tr>
<td><strong>Procurement of Mobile Cranes</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Place order for purchase or lease of two mobile cranes, 200–300 ton capacity</td>
<td>$3,100,000</td>
<td>$0</td>
<td>The feasibility and number of mobile cranes required will depend on the results of the technical evaluation of site infrastructure. This cost estimate assumes mobile cranes will be feasible even with the relatively high seismic accelerations at SONGS. If fixed cranes are necessary, this estimated cost will increase.</td>
</tr>
<tr>
<td><strong>Procurement of Self-Propelled Modular Transporter (SPMT)</strong></td>
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<tr>
<td>Place order for purchase or lease of one SPMT</td>
<td>$3,000,000</td>
<td>$0</td>
<td>Whether an SPMT is required will depend on the results of the technical evaluation of site infrastructure.</td>
</tr>
<tr>
<td><strong>Site Operating and Maintenance Procedures</strong></td>
<td>$160,000</td>
<td>$1,500,000</td>
<td></td>
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</table>

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<table>
<thead>
<tr>
<th>Scope of Work Item</th>
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<th>ROM Cost to Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop equipment inventory; operating, maintenance, and inspection program procedures; and maintenance and materials management program.</td>
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</tr>
<tr>
<td><strong>Safety and Operational Training</strong></td>
<td></td>
<td></td>
<td>Responsibility for and level of communications, public outreach, and training for first responders will largely depend on who is the shipper.</td>
</tr>
<tr>
<td>Develop safety and operational training programs for site operations personnel. Training will be needed in several areas, including site operations, site safety (including radiation safety and safety culture), DOT general awareness, security awareness, and function-specific awareness.</td>
<td>$250,000</td>
<td>$1,500,000</td>
<td></td>
</tr>
<tr>
<td><strong>Detailed Planning with States and Tribes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-planning for route preparedness – external communications, stakeholder engagement, EMS training, communications and coordination along proposed transportation routes. This cost could include implementation of training plans.</td>
<td>$0</td>
<td>$1,375,000</td>
<td></td>
</tr>
<tr>
<td>Phase II Totals</td>
<td>Total: $58,985,000</td>
<td>Total: $33,150,000 for a 3-car rail consist.</td>
<td></td>
</tr>
</tbody>
</table>

* If a private entity is the shipper, costs to the SONGS co-owners, as reflected in transportation fees, will vary depending on the allocation of cask and rail car procurement costs across the shipper’s entire customer base (which would presumably include multiple utility owners of SNF). In that case the size of the customer base could make a large difference in terms of cost, with costs being highest in the extreme case where equipment is being purchased to transport SONGS SNF only. Of course, if the federal government is the shipper, these costs (to the SONGS co-owners) would be the lowest.
7. Phase III: Actions Within a Five-Year Timeframe for Transporting Songs SNF

Phase III is defined by activities that will need to be undertaken by the SONGS co-owners and the shipper within a five-year timeframe before shipments begin and end once the first shipment has been initiated (at that point, although many activities discussed in this chapter will continue, they will be part of operations and will no longer be considered planning). Phase III includes activities that entail shorter lead times and more detailed preparation, including implementing plans developed during Phase II, such as plans for acquiring equipment, contracting transportation services, developing site operations procedures, and providing security.

7.1 Equipment Receipt and Inventory

The receipt of equipment at SONGS must be logistically coordinated to ensure that arrivals are staggered and do not overwhelm on-site capabilities to perform needed inspections and inventory control measures. Items received during this time will be varied and will likely include canister transfer equipment, cask cranes, transportation casks on rolling stock, and a number of smaller items needed on site, such as leak testing equipment, radiological survey instruments, hand tools, lifting and rigging equipment, and transportation package spare parts. Accepting and managing these items would be SCE’s responsibility regardless of ownership of the items themselves because SCE controls site deliveries and access to the SONGS site. However, ownership would need to be tracked as a part of the inventory control program.

7.2 Site Operating Procedures and Loading Plans

SCE, in coordination with the shipper and the owner/operator of the receiving facility, will need to develop final procedures and plans for the shipment in several areas, including:

- Loading and site operations procedures;
- QA procedures for package inspection, maintenance, and assembly;
- Site safety procedures; and
- Radiation protection procedures.

Additional procedures, such as offloading, carrier recovery, package maintenance, and rolling stock maintenance will be developed by the implementer/owner of those items.

7.3 Coordination, Logistics, and Carrier

The logistics necessary for transporting SNF require a specialized skill set specific to this activity. This skill set can be developed internally by the shipper. However, it may be more cost-effective to subcontract these services to an experienced logistics firm.

Whichever entity handles logistics will hire the carrier, finalize the logistics required for shipments, and coordinate planning and operational activities among the site of origin, the carrier, the destination site, and jurisdictions along the route. The entity responsible for logistics coordination will document the interfaces in a campaign-specific transportation plan (see Appendix E to view a table of contents for a standard campaign-specific transportation plan). Specific examples of activities that will need to be coordinated include arranging for a dry run, FRA Safety Compliance Oversight Plan (SCOP) inspections and any required state and NRC inspections, NRC route approval, development of a transportation security
plan including escorts and security responsibility handoffs, and a plan for harmonizing train movements with site cask operations.

7.4 Route Approval\textsuperscript{101}

The shipper will submit an application to the NRC for approval of selected transportation route(s) once the carrier is under contract (because route development requires input from the carrier and transited states). The approval request should be submitted at least six months prior to the first shipment to allow sufficient time for NRC review. Route development costs and NRC review fees would most likely be paid by the organization with overall responsibility for transportation, but these processes will require the SONGS co-owners’ input. NRC approvals expire after seven years for rail routes. If approvals expire, they have to be renewed with an updated route analysis and regulatory review.

For shipments under the purview of DOE, routes will be identified by the carrier in accordance with 49 CFR 172.820. Once potential routes have been identified, DOE will seek stakeholder input, when appropriate, prior to route selection. However, NRC approval is not required (as it would be for a private shipper). DOE will review and approve/reject route(s) identified by the carrier in a manner comparable to what is required for commercial shipments.

Once all stakeholder inputs and requirements are collected, decisions about a primary route and an alternate route should be finalized and assembled into a route package for submission to the NRC (in accordance with the provisions of NUREG 0561\textsuperscript{102}):

\textit{In 10 CFR 73.37(b)(1)(vi), the NRC requires the licensee to obtain NRC approval for the planned road and rail routes over which SNF is to be shipped and for any U.S. ports where a vessel carrying an SNF shipment is scheduled to dock. Whenever possible, the licensee should request approval of two routes (i.e., a primary and an alternative) when transporting SNF by road or rail.}

7.5 On-site and Offsite Training

For onsite staff, the SONGS co-owners will need to implement the training programs developed in Phase II.

The shipper will be responsible for the offsite training needed for carriers, escorting agencies, emergency response organizations, receiving site personnel, movement control center staff, and all other individuals with a safety or security role in managing or operating shipments. Implementing these training programs will be the responsibility of the shipping entity but because these programs are required by regulation it will be incumbent on the entity with ultimate responsibility for the shipping campaign to ensure that training and all other regulatory requirements flow down via contractual obligations.

\textsuperscript{101} https://www.nrc.gov/docs/ML1634/ML16348A028.pdf
\textsuperscript{102} NUREG-0561, Revision 2, Physical Protection of Shipments of Irradiated Reactor Fuel, April 2013.
7.6 Security Planning
The shipper will need to develop a security system based on applicable regulatory requirements and industry standards. All relevant codes and regulations, required physical protection elements, and needed implementation strategies will have to be identified early in the planning process. Appendix G provides a template for a shipment security plan.

7.7 Readiness Reviews
A detailed readiness review undertaken prior to initiating any shipping operations is part of good operating practice. The review will be orchestrated by the shipper and will include a master checklist of all readiness items necessary to ensure the safety, security, and regulatory compliance of the shipping campaign. This checklist would logically be broken down by areas of responsibility. SCE would work with the highest-tier organization involved in the campaign to ensure that the list is comprehensive, and that SCE has met all obligations and commitments prior to commencing shipments.

SCE may choose to implement individual, area-specific on-site reviews to verify readiness for defined stages of the campaign as needed. These reviews will allow the project to transition smoothly from the formulation and planning phase to the operations phase. A desktop exercise with all participants is a good way to begin to verify that all participants are ready. This exercise, followed by a full dry run as described in Section 7.11, comprises the overall readiness process for a successful shipping campaign. A first shipment that is largely uneventful, safe, and secure will pave the way for a successful campaign.

A table listing each of the areas evaluated during a readiness review is included in Appendix F.

7.8 Engagement with States and Tribes
During Phase III, the shipper will need to fully activate communications and outreach plans developed earlier. For the SONGS co-owners, this will likely include communicating with California state officials and local and tribal officials along the route through California. The SONGS co-owners and state, local, and tribal officials will also want to coordinate their communications to the general public. The site-specific transportation plan will also be finalized during this time in coordination with state and tribal governments along planned routes.

7.9 Training of Emergency Responders Along Routes
For shipments conducted by the federal government, training of public safety personnel along planned routes will begin in earnest in this phase. Private-entity shippers may choose to work with jurisdictions along the route and may be able to help leverage the federal training programs mentioned in Section 2.2.2.

7.10 Public Communication and Engagement
The shipper will fully implement the communications strategy developed and partially implemented in an earlier planning phase. If the shipper follows a cooperative model, communications will be conducted as a multi-party effort, with state, tribal, and local public safety officials working in tandem with the

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103 A separate security plan is required for each shipment, however a master template can be developed and modified to speed this process. The security plan is the ultimate responsibility of the licensee, subject to NRC regulations.
shipper to develop messages and actively engage the public (including hearing from the public about concerns and answering questions). Related efforts must be conducted with communities along the full route, from origin to destination. The scope of the SONGS co-owners’ communications and outreach will depend on the roles and responsibilities negotiated with the shipper in Phase II. Regardless of those negotiations, the SONGS co-owners will want to consider undertaking their own communications efforts along routes within California. Given the likelihood that SNF shipments from SONGS will attract a high level of public interest, these efforts are likely to be most effective if they follow a cooperative model that emphasizes coordination with state, tribal, and local officials to address public questions and concerns. Since the SONGS co-owners will be viewed as having some responsibility, regardless of which entity executes the shipments, they may also want to consider if there is value in providing communications and outreach support along the route all the way to the destination. Of course, any activities of this nature would need to be closely coordinated with the shipper and with state, tribal, and local jurisdictions.

Planning for public engagement and communication should take advantage of lessons learned from previous shipping campaigns. As part of records management efforts undertaken in Phase I, the SONGS co-owners could collect briefings and papers that capture best practices.

7.11  Comprehensive Dry Run

The shipper may choose to complete a comprehensive dry run before shipping an actual SNF or GTCC canister as part of its overall readiness review. The dry run could include the process of moving a canister to a transportation cask, preparing that package for shipping, moving the package to the rail car, and transporting the package to the destination site. This exercise could involve the personnel and equipment to be used for actual shipments but employ a dummy canister and any other mock-up equipment appropriate for a training exercise. Lessons learned from the dry run could then be incorporated into the procedures and processes to be used for actual shipments. A dry run exercise may also include participation by state, tribal, and local officials as well as representatives of federal regulatory agencies.

7.12  Preparations to Ship and Shipping

Shipment-specific preparations, including finalizing operations and loading plans, commonly begin at least three to six months prior to the first shipment, and then two to three weeks ahead for each subsequent shipment.\textsuperscript{104} Initial shipment-specific preparations may include receiving and staging the dry transfer equipment, establishing contracts for necessary services such as crane operations, securing the carrier(s) and escorts, writing the transportation security plan, and finalizing site operation and cask loading procedures. The three-to-six-month window prior to shipments may be used to perform final readiness checks, make infrastructure adjustments, acquire any remaining short-lead-time equipment such as rigging equipment and personal protective equipment, initiate contact with private security and/or law enforcement escorts, and stage casks and rail cars for loading.

7.12.1  Cask Loading

Approximately three weeks prior to shipment, cask positioning and initial loading operations will begin on site. The shipper must also contact law enforcement agencies along the route and/or private security escorts to ensure their readiness and to obtain specific names and contact information for escort

\textsuperscript{104} This is based on STS experience conducting multi-year SNF shipping campaigns.
personnel. Ten days prior to shipment, barring any loading issues, the shipper must send formal notifications to affected state and tribal governments, as required by NRC regulations. The carrier must also obtain all necessary permits from transit states during this time. For rail shipments, the makeup of the security personnel in escort cars needs to be thought out. Some rail shipments that cross multiple states use a federal agent as the lead security officer on the train. Federal agents have authority in all states and can deputize other security personnel as needed. The authority of private security is limited in all states. Highway shipments typically pick up a state police escort as they cross state lines, but that isn’t possible with rail shipments.

Two days prior to shipment, the NRC emergency operations center must be contacted to ensure that it has received proper notifications and is prepared for the shipment. Transportation casks, with canisters inserted, will also be undergoing final loading and consist assembly during this time.

One day prior to shipment, package(s) should be loaded onto the conveyance and final preparations should be made for transport. The shipper will apply all marking and labeling required by DOT regulations, conduct a final readiness check with escorts along the route, prepare the NRC and DOT paperwork that will accompany the shipment, and assist with final regulatory inspections. The conveyance operator will also be performing systems and communications tests and furnishing regulatory inspectors with any required documentation or training certificates. The transportation or movement control center (MCC) for the shipment (see Subsection 4.5.9) will also test all equipment and check conveyance tracking ability.

7.12.2 Pre-shipment Regulatory Inspections

The NRC will perform on-site inspections to verify that canisters have been moved from storage modules to transportation casks in a manner consistent with applicable regulatory requirements. The NRC will also inspect package loading and preparation processes to ensure they comply with all requirements in the applicable package CoC.

For SNF shipments by rail, the FRA’s Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel\(^{105}\) requires point-of-origin inspections of rail transport equipment, route inspection prior to the first shipment and at least semi-annually for subsequent shipments, and a hazardous materials compliance inspection to be performed prior to every shipment of SNF. These inspections may be performed by FRA personnel or FRA-certified state personnel with qualifications in the appropriate inspection discipline. In addition, the NRC would perform inspections to ensure compliance with package CoCs, security regulations, and the SONGS co-owners’ QA program.

7.12.3 Material in Transit

When a shipment departs, a series of notifications must be made by the shipper or the shipper’s agent. These notifications alert the NRC Emergency Operations Center, the MCC, the receiver, and downstream escorts that the shipment has begun to move.

While the shipment is in transit, escorts will have primary security custody of the material, which must remain under constant surveillance and must never be left unattended. Escort changeovers (if required) will be pre-arranged and the MCC will be notified whenever they occur. The shipment will proceed along

the designated route stopping only for required rail sidings, food and subsistence breaks, conveyance operator changeovers, and escort changeovers, as required. In the event of an unplanned stop, a secure location along the route must be utilized in accordance with NRC regulations or DOE orders.

The shipment must proceed in this manner until it arrives at the destination.

7.12.4 Arrival at Destination

Upon arrival at the destination, a series of notifications must be made to the NRC, the MCC, and the shipper that the shipment has arrived safely and is now in the possession of the receiver. The receiver is responsible for ensuring that the shipment has arrived as expected, with all material accounted for and with all locks and seals in place.

Transportation package(s) will then be unloaded at the receiving site in accordance with that facility’s package receipt and processing program and returned to SONGS for the next shipment.

7.12.5 Equipment Inspection and Maintenance

After the transportation package contents are unloaded, each cask will require an inspection by the CoC holder or a designee to ensure that the casks are still in good working order and compliant with the safety and operability requirements of the CoC. The details of these inspections will be included in the CoC holder’s QA procedures.

7.13 Phase III Cost

Phase III activities largely represent a move from planning to implementation and operations, including all preparatory activities that need to occur within five years of the first shipment. In addition to ongoing container maintenance and regulatory assurance functions, Phase III includes many of the logistics activities that would likely be performed by a transportation management subcontractor. The cost estimates shown in Table 7.1 assume a single private entity is the shipper.

The costs shown in Table 7.1 represent ROM estimates based on the activities described in this chapter and on NWT’s expert judgment and professional experience. As for Phases I and II, these estimates are provided for informational purposes and to help inform the SONGS co-owners’ strategic decision-making going forward. The allocation of costs for different activities to different entities will depend on specifics of the disposition pathway being pursued and on the terms of arrangements between the entities involved.
<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Costs for the SONGS Co-owners</th>
<th>ROM Costs for Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update Shipment Specific Plans and Procedures</td>
<td>$295,000</td>
<td>$1,000,000</td>
<td>Includes NRC review fees</td>
</tr>
<tr>
<td>NRC Route Approval</td>
<td>Variable*</td>
<td>$165,000</td>
<td>NRC rail routes expire seven years after being issued. So, this should be timed to maximize available route usage without needing to renew the route approval</td>
</tr>
<tr>
<td>Implement communications plan for stakeholders along the route</td>
<td>$155,000</td>
<td>$600,000</td>
<td>The SONGS co-owners will likely want to lead the engagement with local California communities along the route.</td>
</tr>
<tr>
<td>Implement training program for site operations personnel</td>
<td>$775,000</td>
<td>$0</td>
<td>Depends on (1) how many jurisdictions are transited and (2) whether a private shipper funds training or helps states and tribes leverage existing training programs.</td>
</tr>
<tr>
<td>Implement training program for public safety officials along the route</td>
<td>Variable*</td>
<td>$1,400,000</td>
<td></td>
</tr>
<tr>
<td>Conduct Readiness Review</td>
<td>$165,000</td>
<td>$180,000</td>
<td></td>
</tr>
<tr>
<td>Develop Route Security Plan</td>
<td>$0</td>
<td>$50,000</td>
<td></td>
</tr>
<tr>
<td>Finalize Site Operating Procedures and Loading Plans</td>
<td>$390,000</td>
<td>$100,000</td>
<td>If implemented, this could involve readying a package for shipment using a dummy canister with non-radioactive contents, including moving the canister from the ISFSI to the transportation cask and undertaking mock package preparations, security, notifications, communications checks, etc., and moving rail cars near the site.</td>
</tr>
<tr>
<td>Conduct Comprehensive Dry Run</td>
<td>$30,000</td>
<td>$2,000,000</td>
<td></td>
</tr>
</tbody>
</table>
Table 7.1. (continued)

<table>
<thead>
<tr>
<th>Scope of Work Item</th>
<th>ROM Costs for the SONGS Co-owners</th>
<th>ROM Costs for Shipper</th>
<th>Cost-Relevant Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canister Transfer and Package Prep Costs</td>
<td>$450,000</td>
<td>$0</td>
<td>Assumes movement of three canisters from storage to transportation casks and preparation of the packages for shipment per the applicable CoC.</td>
</tr>
<tr>
<td>Pre-Shipment regulatory inspections</td>
<td>$160,000</td>
<td>$0</td>
<td>NRC inspection fees. SCOP inspection fees are unknown at this time.</td>
</tr>
<tr>
<td>Carrier transportation costs</td>
<td>Variable*</td>
<td>$500,000</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Variable*</td>
<td>$100,000</td>
<td></td>
</tr>
<tr>
<td>MCC Operations during shipment</td>
<td>Variable*</td>
<td>$50,000</td>
<td></td>
</tr>
<tr>
<td><strong>Phase III Totals</strong></td>
<td><strong>Total: $2,420,000</strong></td>
<td><strong>Total: $6,145,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

* If a private entity is the shipper, costs to the SONGS co-owners, as reflected in transportation fees, will vary depending on the allocation of cask and rail car procurement costs across the shipper’s entire customer base (which would presumably include multiple utility owners of SNF). In that case the size of the customer base could make a large difference in terms of cost with costs being highest in the extreme case where equipment is being purchased to transport SONGS SNF only. Of course, if the federal government is the shipper, these costs (to the SONGS co-owners) would be the lowest.
8. **Key Steps Toward Transportation Readiness**

This chapter reviews key steps in an overall plan for ensuring readiness to ship SONGS SNF and GTCC waste as soon as a commercially reasonable, offsite disposition pathway is available. Several of these steps are independent of the identification of a specific receiving facility. A few should be implemented quickly because they are time sensitive and tied to the decommissioning work plan for SONGS Units 2 and 3. Others involve steps that the SONGS co-owners can take but that also require action by the entity with ultimate responsibility for shipping SONGS SNF to an offsite location. Some of these actions would be undertaken independently: for example, the SONGS co-owners would conduct a systems analysis for the transportation-related activities that occur at the SONGS site, while the shipper would analyze on-site and near-site interfaces, operations that occur off site, and any system needs at the receiving facility. Other actions, such as communicating with state regulators and the public, might require joint effort and active coordination between the SONGS co-owners and the shipper.

Figure 8.1 at the end of this chapter offers a notional schedule of the activities in each phase and indicates which entity has responsibility for the action.

8.1 **Overarching Priorities for the SONGS Co-Owners Across All Phases**

- Seek to form and catalyze coalitions at the local, state, and national level to build pressure on Congress and the administration to reinvigorate a national program for both interim storage and a permanent repository.
- Support the passage of legislation that would allow the federal government to contract with private storage facilities or enter into other forms of public–private arrangements with the aim of taking title to the SNF and meeting its obligations under the Standard Contract. Ultimately, action by the federal government to perform on its longstanding responsibility for nuclear waste management and disposition offers the most reliable and perhaps only commercially reasonable path forward to resolving the issue of stranded SNF at SONGS and numerous other plant sites around the country.
- Consider encouraging federal support for needed capabilities among state, tribal, and local entities in connection with private SNF shipments, including support for preparedness and emergency response training.

8.2 **Priorities for Phase I of Transportation Planning (near term)**

**SONGS Co-Owners:**

- Develop a plan for an on-site management organization to ensure the continued availability of personnel with the knowledge and capabilities needed to carry out Phase I and Phase II readiness activities and to manage regulatory compliance until determinations are made about the offsite disposition of SONGS SNF.
- Develop a comprehensive capability/equipment needs analysis for a future shipping campaign assuming 100 percent of on-site capabilities are lost after current decommissioning activities are complete.
Figure 8.1. Notional Schedule of Activities in Each Planning Phase

<table>
<thead>
<tr>
<th>PHASE I</th>
<th>PHASE II</th>
<th>PHASE III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeline Unknown</td>
<td>~ 5-10 Years Before Shipments Commence</td>
<td>&lt;5 Years Before Shipments Commence</td>
</tr>
<tr>
<td>Design Management Organization</td>
<td>Set up Management Org/TPMO</td>
<td></td>
</tr>
<tr>
<td>Communication with Local Communities and Tribes</td>
<td>Regulatory and Legal Support</td>
<td></td>
</tr>
<tr>
<td>Infrastructure and Logistics Analyses</td>
<td>Systems Analysis, Logistics, and Planning</td>
<td></td>
</tr>
<tr>
<td>Transportation Mode and Route Analysis</td>
<td>Onsite Preparations—equipment acquisitions, onsite and near site infrastructure, training, and procedures</td>
<td>Site Operating Procedures and Loading Plans</td>
</tr>
<tr>
<td>Interaction with State, Tribal, and Local Governments Along Route</td>
<td></td>
<td>On- and Off-Site Training</td>
</tr>
<tr>
<td>Carrier Selection</td>
<td></td>
<td>Emergency Responder Training Along Routes</td>
</tr>
<tr>
<td>Rolling Stock Acquisition</td>
<td></td>
<td>Logistics Coordination with Carrier</td>
</tr>
<tr>
<td>SONGS Coordination with Receiving Entity</td>
<td></td>
<td>Route Approval</td>
</tr>
<tr>
<td>SONGS Co-Owners Responsibility</td>
<td></td>
<td>Security Planning</td>
</tr>
<tr>
<td>SONGS Co-Owners + Shipper Responsibility</td>
<td></td>
<td>Equipment Receipt and Inventory</td>
</tr>
<tr>
<td>Shipper Responsibility*</td>
<td></td>
<td>Readiness Reviews</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public Communication and Outreach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comprehensive Dry Run</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepare Packages, Load, and Ship</td>
</tr>
</tbody>
</table>

*Because of the regulatory difference in responsibilities between DOE and a private entity as shipper, the tasks assigned in this notional schedule are not definitive. Who has responsibility, and when each activity would begin, would change depending on who ships the SNF.
• Conduct a detailed technical evaluation to determine the best approach and associated infrastructure needs for transferring SNF canisters to the transportation casks and moving the transportation packages to rail cars on site. This evaluation should be performed in the near future to allow time for SCE to modify the work scope for its decommissioning infrastructure design and to make needed changes, if any, in “as-left” conditions at the site after current decommissioning activities are complete. SCE should evaluate whether an amended or new coastal development permit will be required for each loading scenario analyzed. For the on-site rail portion of the technical evaluation, SCE should specifically consider:
  o Whether all or part of the sidings and spurs that will be constructed for the decommissioning of Units 2 and 3 should be left in place to be utilized for future SNF transportation.
  o Cost tradeoffs between (1) extending the existing, abandoned on-site rail spur so as to allow for SNF rail cars to be placed adjacent to the ISFSI for direct loading versus (2) extending the reinforced roadway from the ISFSI to the planned decommissioning sidings and spurs instead. This evaluation should account for the need for a self-propelled modular transporter (SPMT) if a roadway extension is used, for the number of cranes required to load and move transportation packages from the ISFSI area to rail cars, and for the ability of a loaded consist to negotiate the uphill grade away from the ISFSI area in the space available.
  o How options for loading rail cars and assembling the consists will affect the required security perimeter for these activities.

• Conduct a detailed technical evaluation for the SONGS Holtec canisters to select the appropriate configuration for a cask transfer facility (CTF) or equivalent facility. This evaluation should consider related engineering and construction costs and the potential need for a new or amended coastal development permit. In addition, because the HI-STAR 190 transportation package is also shipped in the horizontal orientation, SCE will need to investigate when, where, and how casks will be upended and downended during the transportation cask receipt and shipment preparation process.

• Implement an ongoing “retention of knowledge” program within SCE and develop a library of “primer documents” that would aid the transfer of knowledge and institutional memory to the TPMO.

• Enhance relationships with communities and tribes along the rail routes out of SONGS. These communities may be aware that SNF transport routes could pass through their jurisdictions and may have questions or concerns regarding future shipments. Enhancing such relationships would be a valuable way to exchange information and build positive working relationships that can be marshalled in Phases II and III.

8.3 Priorities for Phase II of Transportation Planning (begins once a destination for SONGS SNF is known)

SONGS Co-Owners:

• Implement site infrastructure recommendations from the Phase I technical evaluation.

• Determine what inspections and acceptance criteria are appropriate to verify that aged canisters are (1) in compliance with 10 CFR 71 CoCs and drawings, and (2) suitable to return to storage service as the confinement system at a CISF.
Identify individuals or subcontractors who already possess the necessary certifications to act as crane operators or helium leak testers, rather than training SCE staff to perform these tasks. These positions involve specialized skills and require significant training—hence it will generally be more cost- and time-effective to hire the required expertise rather than develop it in-house.

**The Shipper (if not the federal government):**

- Retain a logistics management contractor to advise on systems engineering needs and coordinate transportation logistics between SONGS and the destination site(s), negotiate with rail carriers, and manage the regulatory compliance aspects of the shipping campaign.

- Engage early and frequently with states and tribes along potential transportation routes. The goal of these interactions is to build positive working relationships and to ensure that (1) issues are resolved well in advance of shipments, (2) operational interfaces are resolved prior to shipments, and (3) communications efforts with local jurisdictions, elected officials, and the general public are well-coordinated. Some coordination with the SONGS co-owners concerning public outreach and communication will likely be appropriate as part of these activities.

**SONGS Co-owners and Shipper:**

- Clarify the division of responsibilities for elements of the transportation system under the disposition path to be pursued. If DOE or another federal agency is the shipper, then the SONGS co-owners will want to ensure that responsibilities and requirements for preparing and loading transportation packages are clearly defined. In a scenario where the federal government is not the shipper, the SONGS co-owners would have to explore options and determine whether commercially reasonable business arrangements can be negotiated with a private shipper, both with respect to transportation costs and liability considerations (a commercially reasonable arrangement would, of course, also have to be in place with the owner/operator of the receiving facility in this scenario).

- Conduct a systems analysis (or refine any analysis conducted in Phase I) and undertake related logistics and planning activities to ensure integration between the site of origin and the destination.

- Coordinate engagement activities between the shipper and the SONGS co-owners to ensure consistent and up-to-date communication with states, tribes, local governments, and the general public.

**8.4 Recommendations for Phase III of Transportation Planning**

**SONGS Co-Owners:**

- Review the SONGS DQAP again to identify and address any needed changes as more is known about on-site activities pertaining to shipping.

- Develop detailed quality assurance, inspection, repair, and operating procedures for moving canisters from storage service to transportation casks and for loading transportation packages on rail cars. Consider performing “dry run” exercises for these operations.

- Ensure that training courses for on-site personnel are taught by subject matter experts who have the specific qualifications required to ensure that trainees can safely and competently carry out their roles. Training courses and seminars are widely available for most of the specific job functions related to SNF transportation. As a result, every training module need not be created from scratch—on the contrary, it should be readily feasible to identify courses that already exist by conducting an
open-source search. The employer is responsible for selecting training courses that, if not accredited by a recognized institution,\textsuperscript{106} meet employees’ training needs for their assigned tasks.

*The Shipper (if not the federal government):*

- Hire a logistics management contractor (if this was not already done in Phase II) to coordinate transportation logistics between SONGS and the destination site(s), negotiate with the rail carrier, and manage the regulatory compliance aspects of the shipping campaign.
- Fully implement the communications plan developed in Phases I or II. Coordination with state and tribal officials along the routes would improve effectiveness.
- Coordinate with public information officers (PIOs) along planned routes to ensure that these officers are prepared to share accurate and timely information about SNF shipments with the media, elected officials, and the public—both in the context of routine transport operations and in the event of an accident.
- Expand and build upon prior coordination with state and tribal personnel responsible for transportation-related activities along planned routes. The goal of these interactions is to ensure that any remaining issues have been resolved and that necessary operational interfaces have been finalized. This will be a period of peak activity for states and tribes in terms of planning and training for SNF shipments, and expectations for stakeholder engagement can be expected to be high.

*SONGS Co-owners and Shipper:*

- Receive equipment at origin and destination sites, as appropriate.
- Begin training personnel involved in loading and unloading SNF at the origin and destination sites, as appropriate.
- Conduct readiness reviews, including consideration of a dry run exercise.
- Continue coordinated communications and stakeholder engagement.
- Receive and inspect all cask and rail hardware, move canisters to transportation casks, prepare packages for transport, load transport packages on rail cars, and begin shipments.

**8.5 Conclusion**

Transportation is a critical strategic consideration in any plan for relocating the SONGS SNF and GTCC waste to an offsite interim storage or disposal facility. Because of the significant costs and the complexity of the issues involved, the potential benefit of retaining certain resources and assets to support a future shipping campaign, and the long lead times associated with many preparatory activities, a clear and early understanding of transportation needs and challenges is important and can help ensure that SONGS SNF will be removed expeditiously once a receiving facility is available.

\textsuperscript{106}For example, many training courses claim to satisfy the U.S. Department of Transportation (DOT) training requirements found in 49 CFR 172.704. These requirements are somewhat vague, but some courses are better than others. NWT contacted DOT to inquire about training accreditation and was told that it is the employer’s responsibility to ensure, and to certify, that any training provided to employees meets training needs for the specific task(s) to be performed by those employees.
The analysis developed for this CTP gives grounds for confidence that the technical and organizational demands of implementing a safe, efficient shipping campaign for SONGS SNF can be met with judicious advance planning and resource commitments. As with the Strategic Plan, however, resolution of the federal role remains a key source of uncertainty and one with profound implications for every aspect of planning for the offsite disposition of SONGS SNF, including with respect to transportation. Moving beyond the current political impasse and restarting an effective national waste management program thus remains the overarching and urgent priority for all parties who are committed to achieving the safe relocation of the SONGS SNF and the full decommissioning of the SONGS site.
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APPENDIX A
North Wind Team Biographies
ABOUT US
North Wind, Inc., founded in Idaho Falls, Idaho in 1979, is a nationwide small business leader in the engineering, environmental, construction, and technical services industries providing creative and practical solutions to complex problems. North Wind provides innovative and comprehensive solutions to complex hazardous and radiological remediation, D&D, and waste management challenges. The experience we bring includes past performance of nuclear facility and system engineering evaluation, facility design, project cost and schedule reviews. It also includes the analysis and evaluation of proposed nuclear facilities and reactors, independent technical reviews and recommendations for the implementation of future nuclear programs, storage cask manufacturing, nuclear regulatory reviews, and actual code development.

North Wind brings together for this work a team of highly experienced and nationally recognized professionals, many of whom affiliated with North Wind specifically to support finding a solution to spent nuclear fuel disposition. Secure Transportation Services (STS Nuclear), is the leading transportation coordinator of Spent Nuclear Fuel in North America with decades of experience both within the United States and abroad.

THE TEAM

Brian Gutterman, PE | Project Manager
Brian Gutterman has over 36 years of experience in the nuclear energy field, the last 20 of which involve 10 CFR 72 and 10 CFR 71 regulatory matters governing SNF storage and transportation. Mr. Gutterman is a nationally recognized expert in dry spent fuel storage cask design, licensing, and operation including deep knowledge with the two suppliers and storage technologies used at SONGS. Mr. Gutterman is recognized as an expert in the field by the NRC’s Division of Spent Fuel Storage and Transportation and has authored industry guidance documents used nationwide by Independent Spent Fuel Storage Installation licensees and Cask Certificate of Compliance holders and provided training on their use. He has also consulted to both Nuclear Energy Institute and DOE in evaluating the cost of designing, constructing, licensing, and operating a spent fuel interim storage facility under the NRC’s 10 CFR 72 regulations.

Elizabeth Helvey, PMP | Senior Advisor
Elizabeth Helvey has over 25 years of experience designing stakeholder engagement strategies related to the transportation of SNF. Ms. Helvey specializes in working with state and tribal governments to prepare emergency responders, elected officials, and the general public along the routes used for shipments of SNF. She has supported the U.S. Department of Energy’s (DOE) efforts with the National Transportation Stakeholder Forum, the Transportation Core Group comprised of state and tribal officials who advise DOE on transportation issues related to SNF, and the Tribal Radioactive Materials Transportation working group. She has also supported DOE’s recent consent-based siting effort and the Office of the Nuclear Waste Negotiator’s work to site an interim storage facility.

Timothy Runyon | Transportation Regulatory and Facility Siting Specialist
Timothy Runyon has over 35 years in the nuclear industry with 25 years managing one of the premier State programs for inspection and enforcement of radioactive material transportation, including highway and rail SNF shipping campaigns from Midwestern utilities to the only operating storage facility at GE Morris; cross country rails shipments of SNF debris from Three Mile Island and the DOE cross-country shipping campaigns for recovered foreign research reactor fuel. He is knowledgeable on State and Federal (NRC/Department of Transportation) transportation regulations and has provided training for inspection/enforcement and emergency response personnel throughout the U.S. and at the International Atomic Energy Agency. In his capacity at the Illinois Department of Nuclear Safety he interacted with local elected officials, State and Federal elected officials, stakeholders along transportation corridors, and DOE advisory boards. Beginning in early 2013, he provided support to the DOE Office of Nuclear Energy, developing a national transportation plan and authoring a report recommending a route selection process that included stakeholder input. More recently, he functioned as a communications and stakeholder outreach consultant for the DOE Carlsbad Field Office following the 2014 fire and radiological events at the Waste Isolation Pilot Plant near Carlsbad, New Mexico. He currently manages the Carlsbad Field Office Technical Assistance Contract, operated by North Wind Portage.
Kelly Horn | State Regulatory Specialist
Kelly Horn is a highly skilled senior manager with extensive project management and leadership experience in projects and programs, including site decommissioning, radioactive materials packaging and transportation, environmental assessment, radioactive waste management, and radiological emergency response. He possesses more than 24 years of experience managing multiple projects and programs, with core responsibilities including oversight of radiological decommissioning projects for licensed and unlicensed sites in Illinois. He was appointed by the last two governors to represent Illinois on the Council of State Governments Midwest Radioactive Materials Transportation Committee. He served as committee chairman for two terms and currently functions as the governor’s point of contact for advanced notification of spent nuclear fuel and high-level waste shipments. He is one of nine national instructors for the Commercial Vehicle Safety Alliance Level VI Inspection program and the Health Physics Advisor to the Level VI Committee. He is a subject matter expert in the field of radioactive material transportation and has been called on to provide technical assistance and testimony to regulatory agencies and congress at both the State and Federal levels.

Roy Boyd | STS Nuclear President
Roy Boyd is a U.S. Navy trained Nuclear Engineer and Small Business Owner. He has 34 years of experience in Nuclear Reactor Operations, Package Licensing, Project Management and Systems Design. His background includes 12 years in the U.S. Navy as a Nuclear Plant Supervisor & Instructor, and Mechanical Division Supervisor & Instructor, eight years at NAC International as a Senior Project Manager & Deputy Manager of Operations, and two years at Booz Allen Hamilton as a Senior Consultant to the DOE OCRWM program, responsible for policy development pertaining to Yucca Mountain. Since 2005, as Co-owner of STS, he has focused on SNF-related services to the nuclear industry, including package licensing, reactor services, regulatory compliance, procedure development, transport routing and security.

Mat King | STS Nuclear Vice President
Mathew King is a Research Reactor operations, project management, and HazMat shipping specialist. In 2018, he became a minority owner of STS. He has 10 years of HazMat operational, technical, and training experience working for the Washington State University (WSU) Nuclear Radiation Center as a student, Reactor Operator, and Senior Reactor Operator. The SRO license issued by the Nuclear Regulatory Commission was the culmination of 36 months of continuous training consisting of 5000+ hours of reactor operations, nuclear instrumentation manipulations, and system maintenance; 60 hours of classroom instruction on reactor theory, chemistry, and neutron kinetics; and 100+ hours of independent study. Since 2010, when his Senior Operator license was issued, Mat has worked as a coordinator and technician on a number of diverse projects for universities and national laboratories as well as a primary contact for vendors and subcontractors. He has been a certified DOT HazMat shipper since 2007 and has extensive experience designing and performing HazMat shipping packages, processes, and procedures. In addition to his technical skills, Mat has fostered a personal philosophy of lifetime learning and constant improvement that will not allow failure. He is excellent at cultivating and maintaining professional relationships and is an excellent team member that is always attempting to exceed expectations to achieve the team’s goals.

Marika Tatsutani | Writer and Editor
Marika Tatsutani has more than 30 years of experience in energy policy and more than 20 years of experience as a technical writer and editor on energy and environmental issues. She was the lead author of the Blue Ribbon Commission on America’s Nuclear Future report and the U.S. Department of Energy’s Final Report on Designing a Consent-Based Siting Process: Summary of Public Input. Ms. Tatsutani has worked on major reports with a range of organizations, including the MIT Energy Initiative, the Bipartisan Policy Center, the Nuclear Energy Institute, and the Harvard Project on International Climate Agreements, among numerous others.
APPENDIX B
Regulatory and Legal Framework
for Commercial Spent Nuclear Fuel Transportation
1. Overview

The federal agencies that regulate spent nuclear fuel (SNF) transportation are primarily the Nuclear Regulatory Commission (NRC) and the Department of Transportation (DOT). The Department of Energy (DOE) regulates transportation of its own SNF, and commercial SNF, to the extent specified in the Nuclear Waste Policy Act (NWPA). Because NRC and DOT jointly regulate certain aspects of the transportation of radioactive materials, the two agencies signed a memorandum of understanding (MOU) in 1979 that outlines their respective roles regarding the safe transport of radioactive materials. DOE asserts its ability to ship SNF under Atomic Energy Act (AEA) authority, independent of DOT or the NRC. DOE shipments comply with internal DOE orders that meet or exceed DOT and NRC requirements when conducting transport operations. (DOE also ships SNF for research and development purposes; such shipments are not bound by NWPA requirements.)

Which federal regulations will apply to SNF shipments from the San Onofre Nuclear Generating Station (SONGS) will depend on whether the shipper is the federal government (e.g., DOE) or a private entity. Private commercial SNF shipments are regulated directly by NRC and DOT. Under current federal law, shipments made by DOE would be regulated by DOE, subject to its own orders concerning the transportation of radioactive material and the requirements of the NWPA. This Conceptual Transportation Plan (CTP) discusses the distinctions between requirements under a commercial shipping scenario and shipments made by the federal government as part of a transportation program implemented by DOE under NWPA authority.

State and tribal governments also have regulatory roles, and shippers and carriers are required to coordinate with these state and tribal authorities prior to and during transport operations. This appendix provides a summary of the NRC and DOT regulations that apply to SNF shipments. It also reviews the roles of subsidiary agencies, DOE, states, and tribes.

2. NRC Regulations

The NRC has regulatory authority for the packaging and transportation (10 CFR 71) of radioactive material by licensees who are authorized by the NRC to receive, possess, use, or transfer licensed radioactive material. These regulations apply if the licensee delivers the material to a carrier for transport or transports the material outside the site specified in the NRC license. The NRC also has regulatory authority over the security of certain types of radioactive materials (10 CFR 73). Specific areas of NRC regulation that apply to the transportation of radioactive materials include:

- Establishing the regulatory requirements for Type B package design;
- Certifying the manufacture, use, and maintenance of Type B packages;
- Inspecting these transportation packages;
- Certifying packaging, specifically for fissile material and Type B package designs, which include SNF and high-level radioactive waste (HLW) packages (the NRC package certification covers the packaging, which, for canister-based systems, includes the cask, canister design, impact limiters, cradle,\textsuperscript{107} and certain ancillary equipment such as tie-downs), and specific approved contents.\textsuperscript{108}

\textsuperscript{107} The different package designers may use varying terminology for the cradle, such as “transport skid.” Cradle is used in this CTP for simplicity.

\textsuperscript{108} See Section 2.1.1 for definitions of “package” and “packaging.”
• Approving quality assurance programs for package design, manufacture, and use;
• Developing physical protection requirements for SNF in transit;
• Reviewing all routes for security considerations;\textsuperscript{109}
• Establishing requirements for advance notification to governors and tribal officials, or their
designees, for SNF shipments within or across state or tribal boundaries;
• Conducting inspections in accordance with NRC requirements;\textsuperscript{110} and
• Providing technical support to DOT in accordance with inter-agency agreements.

2.1 10 CFR 71

2.1.1 Overarching Requirements

NRC regulations in 10 CFR 71 govern the transport of radioactive materials and the design requirements for shipping packages. In 10 CFR 71.4, the NRC defines “package” and “packaging” as follows:

• \textit{Package} means the packaging, together with its radioactive contents, as presented for transport.
• \textit{Packaging} means the assembly of components necessary to ensure compliance with the packaging requirements of 10 CFR 71. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated part of the packaging.

By granting a 10 CFR 71 certificate of compliance (CoC), the NRC approves the radioactive material package because the contents allowed to be shipped are specifically listed in the CoC. Thus, the SONGS SNF and greater than Class C (GTCC) canister designs and the contents of each must be included in the certified package design (as described in the CoC) in order to be shipped. The package, as defined in the CoC, also includes the designs for ancillary components and equipment used for shipping, such as impact limiters, cradle, and tie-down systems. The packages that are currently contemplated to be used to ship SONGS SNF and GTCC waste are discussed in Sections 2.6 and 4.5 of this CTP.

10 CFR 71 also contains the requirements for executing a shipment of radioactive material. Some requirements are specified directly in Part 71 and others are specified by reference to other regulations, such as 10 CFR 73\textsuperscript{111} for security requirements, DOT regulations in 49 CFR 172.820 for rail routing

\textsuperscript{109} 10 CFR 71.97 requires the licensee responsible for a shipment to provide advance notification to the governor of a state (or designee) of the shipment of licensed material within or across the boundary of the state before initiating transport of the material outside the confines of the licensed facility. Another section of the same regulation also requires advance notification of the tribal official (or designee) of participating tribes of the shipment of licensed material within or across the boundary of the tribal reservation. For tribes to be considered “participating,” they must choose to “opt in” to NRC regulations. This includes attending training on the identification and control of Safeguards Information related to transportation and other pertinent nuclear security requirements. Opting in allows tribes to participate in route planning with the NRC, states, and the licensee shipper. To date, five tribes have opted into the NRC’s regulations.

\textsuperscript{110} NRC inspections of DOE shipments are limited in scope because DOE is not an NRC licensee when they make shipments under the NWPA.

\textsuperscript{111} Title 10, “Energy,” Part 73, “Physical Protection of Plans and Materials.”
requirements, and 49 CFR 173\textsuperscript{112} for shipments of hazardous materials, of which radioactive materials are a subset. 10 CFR 70 also provides regulations for carriers of SNF shipments.\textsuperscript{113} Each of these sets of regulations is discussed in more detail below.

2.1.2 General License under 10 CFR 71

Anyone with an NRC license to possess nuclear material is granted permission, by 10 CFR 71, to ship that material under a Part 71 general license. The general license granted by §71.17(a) states:

\begin{quote}
A general license is issued to any licensee of the Commission to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance (CoC), or other approval has been issued by the NRC.
\end{quote}

For SONGS, this means the SONGS co-owners may transport, or deliver to a carrier for transport, the SONGS SNF and GTCC that the co-owners possess under the Part 50 licenses for the site. No application is required; however, a package certified by the NRC to ship the material must be used, and the licensee must inform the NRC of its intention by becoming a “registered user” of the package.\textsuperscript{114} Subsequent language in 10 CFR 71.17 sets out the conditions for using this general license. These require, among other things, that Southern California Edison (SCE) has a quality assurance program that meets the applicable requirements of Subpart H of 10 CFR 71. The SONGS quality assurance program is assumed to meet the requirements of Subpart H by virtue of the fact that SCE regularly shipped radioactive waste to disposal facilities while SONGS was operational.

In summary, for a shipment conducted under the NWPA, DOE is statutorily authorized to remove the SONGS SNF and GTCC waste without an NRC license. DOE is required by the NWPA to use an NRC-certified package and follow the NRC’s requirements with respect to pre-notifying states and tribes before shipment. A private shipment model requires that the NRC licensee with authority to possess SONGS SNF use its Part 71 general license for shipping. Currently, the SONGS co-owners are the licensee; however, it could be any private entity that might acquire SONGS’s NRC Part 50 and Part 72 licenses.

We note also that GTCC shipments do not involve fissile or special nuclear materials—hence, the packaging requirements that apply are those for general radiological materials (as found in DOT regulations, Title 49 of the United States Code). GTCC shipments are not subject to the NRC security requirements for SNF; however, they may be subject to the security requirements found in 10 CFR 37\textsuperscript{115} for a Category 1 or Category 2 radiological source, depending on the quantities and isotopes present in the shipments. These security requirements are similar to SNF shipments in many respects, though they are far less stringent.

2.1.3 Transportation Package Design and Operation

10 CFR 71 provides the requirements for package designs that apply to the various types of fissile and non-fissile packages used to ship radioactive material. “Fissile material” means the radionuclides


\textsuperscript{113} Title 10, “Energy,” Part 70, “Domestic Licensing of Special Nuclear Material.”

\textsuperscript{114} Irrespective of the entity actually executing the shipment (i.e., the contracted logistics company and carriers), a private shipment would be authorized under the SONGS Part 50 licenses, which provide the qualification for the Part 71 general license allowing the shipment.

\textsuperscript{115} https://www.nrc.gov/reading-rm/doc-collections/cfr/part037/part037-0079.html
uranium-233, uranium-235, plutonium-239, and plutonium-241, or any combination of these radionuclides.\textsuperscript{116} SNF packages are considered fissile material packages, whereas GTCC packages are considered non-fissile material packages. However, the same package may be designed and certified by the NRC to ship both fissile and non-fissile material, as is the case for several of the packages approved for shipment of commercial SNF in the United States. The regulations are broken into several subparts that specify the contents of an application for a CoC and the design, testing, and operating controls and procedural requirements for the package:

- Subpart D: Application for Package Approval;
- Subpart E: Package Approval Standards;
- Subpart F: Package, Special Form, and LSA-III Tests; and
- Subpart G: Operating Controls and Procedures.

SNF transportation packages of the type to be used to ship the SONGS SNF and GTCC canisters are “Type B(U)F” packages, where the “B” represents a high concentration of radioactive material, the “U” represents a requirement for unilateral approval of international shipments, and the “F” represents the package’s approval to be used to ship fissile material. The primary goals of the Type B(U)F package design are to prevent a critical configuration of the payload and to maintain containment integrity under normal conditions of transport and hypothetical accident conditions.

10 CFR 71.55 establishes the general requirements for fissile material packages. 10 CFR 71.71 and 71.73 include the package testing requirements for normal conditions of transport and hypothetical accident conditions, respectively. Normal transportation conditions include design criteria for external temperature and pressure, vibration, water spray, drops, compression, and penetration. Hypothetical accident conditions include testing one test cask (outfitted with impact limiters) to all of the following: \textsuperscript{117}

- Nine-meter (30-ft) drop onto an unyielding surface;
- Forty-inch drop onto a 6-inch-diameter steel post;
- Fully engulfing fire at 1,475 degrees Fahrenheit (\textdegree{}F) for 30 minutes; and
- Immersion in 0.9 meters (3 ft) of water.

To preserve the assumptions in the analyses supporting the package design, the transportation CoC and associated safety analysis report (SAR) include detailed operating and pre-shipment leak-testing procedures. These procedures and tests ensure that the package has been prepared for shipment in a manner that is bounded by the analysis assumptions. These assumptions establish the initial conditions of the package at the time of shipment to ensure that all normal conditions of transportation and any accident event that may occur during shipping are bounded by the design. These design requirements also ensure that first responders and other personnel responding to an accident can safely perform their duties to recover the package and transport it to an appropriate location for further corrective actions.

2.2 10 CFR 73

The NRC’s regulations in 10 CFR 73 apply to the protection of licensed facilities and certain regulated materials, including those being shipped pursuant to 10 CFR 71. 10 CFR 73 is mentioned specifically three times in Part 71. Part 73 is invoked generally for all radioactive material shipments in 10 CFR 71.0(b). 10

\textsuperscript{116} 10 CFR 71.4, “Definitions.”
\textsuperscript{117} 10 CFR 71.73(c), “Tests.”
CFR 71.11 refers to 10 CFR 73.21 through 73.23, as applicable for the protection of Safeguards Information (SGI). 10 CFR 71.88 refers to 10 CFR 73.24, which applies to air transport of plutonium. Transportation of SONGS SNF and GTCC canister by air is not considered practical, primarily due to the nominal 125-ton weight of each package and also because no Type B packages are currently certified for air transport of SNF. Therefore, air transport is not considered viable and is not discussed further in this CTP.

Regulations from 10 CFR 73.25 through 73.38 provide security requirements for physical protection of special nuclear material, including SNF, in transit. Specifically, 10 CFR 73.37 provides the requirements for physical protection of irradiated reactor fuel in transit. 10 CFR 73.37 provides performance objectives and detailed general requirements for meeting the performance objectives. 10 CFR 73.38 establishes the personnel access authorization requirements for irradiated reactor fuel in transit.

2.3 10 CFR 70

10 CFR 70 plays a role in SNF shipments for carriers. Specifically, 10 CFR 70.20a(a) grants a general license to possess special nuclear material for private transport, stating, in part [emphasis added]:

(a) A general license is issued to any person to possess formula quantities of strategic special nuclear material of the types and quantities subject to the requirements of §§73.20, 73.25, 73.26 and 73.27 of this chapter, and irradiated reactor fuel containing material of the types and quantities subject to the requirements of §73.37 of this chapter, in the regular course of carriage for another or storage incident. Carriers generally licensed under §70.20b are exempt from the requirements of this section. Carriers of irradiated reactor fuel for the United States Department of Energy are also exempt from the requirements of this section. The general license is subject to the applicable provisions of §§70.7 (a) through (e), 70.32(a) and (b), and §§70.42, 70.52, 70.55, 70.91, 70.81, 70.82 and 10 CFR 74.11.

The above regulation extends the NRC’s security requirements to carriers, as applicable to their temporary possession of the material. 10 CFR 70.20a also specifically exempts carriers of SNF for DOE because DOE would not be using an NRC license to perform the shipment and would provide security for the shipments under its own regulations and orders. 10 CFR 70.20a(b) makes it clear that the general license granted to carriers for transportation does not allow the carrier to conduct any “activity” involving the radioactive material being transported. Examples of “other activities” would include anything not related to moving the package from the originating site to the destination site, as described in the transportation and security plans. Such other activities would require authorization under a different license granted in a separate NRC regulation. 10 CFR 70.20a(c) further limits the duties of the general licensee (i.e., the carrier) to the physical protection of the material against theft or sabotage.

10 CFR 70.20a(e) applies the following requirements to carriers of SNF under the general license:

- Receive certification from the shipper that transportation meets the physical protection requirements in 10 CFR 73.37, and
- Comply with the reporting requirements in 10 CFR 73.71, “Reporting of Safeguards Events.”

3. DOT Regulations

Title 49 of the U.S. Code of Federal Regulations includes all federal regulations pertaining to transportation. Subchapter C addresses the transport of hazardous material, which includes radioactive material. Within DOT, the Pipeline and Hazardous Materials Safety Administration (PHMSA) and its
modal partners — the Federal Railroad Administration (FRA), the Federal Aviation Administration (FAA), and the Federal Motor Carrier Safety Administration (FMCSA) — carry out DOT’s authority for ensuring the safe and secure transportation of hazardous materials, including radioactive materials, in commerce. DOT regulation of hazardous materials, of which radioactive materials are a subset, encompasses several responsibilities, including:

- Preparation of a package for loading, preparation of shipping papers, movement of packages, unloading, etc., in accordance with a 10 CFR 72, Subpart H quality assurance program.
- Requirements for shipping papers, package marking, labeling, and transport vehicle placarding applicable to the transport of these materials.
- Requirements for preparing hazardous materials for shipment by air, highway, rail, or water, or any combination thereof; and identification of inspection and testing requirements for containers used in the transportation of hazardous materials. It is worth noting that there are no provisions in DOT regulations for air shipment of SNF, and no packages have been certified for air shipment of SNF in the United States.
- Requirements for training of personnel involved in a hazmat shipment.
- Additional requirements specific to rail, motor carrier, air, or vessel transport.
- Requirements for pre-shipment and en-route safety inspections by carriers.
- A requirement for railroads to develop an annual assessment of safety and security along their routes. The railroads are required by statute to use specific safety and security criteria, with 27 attributes for selection of rail routes for shipment of highway route controlled quantities of radioactive material (SNF and HLW) and other highly hazardous wastes.  

- The FRA’s Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel (SCOP).  

4. **DOE Regulations and Orders**

Under the AEA, as amended, DOE has authority to regulate all aspects of activities involving radioactive materials that are undertaken by DOE or on DOE’s behalf, including transportation. However, DOE typically uses commercial carriers for its shipments and does not assert its AEA authority. Accordingly, most DOE shipments are undertaken by commercial carriers under the same terms and conditions as comparable commercial shipments for private entities and are subject to DOT and NRC regulations, as appropriate. Under DOE policy, all DOE shipments are conducted in a manner that meets or exceeds the requirements and standards that apply to comparable commercial shipments, unless there is a determination that national security or another critical interest requires different action.

As mentioned above, the NWPA requires that commercial SNF be shipped in transport casks that are certified by the NRC; the NWPA also requires adherence to the NRC’s pre-notification requirements prior to shipping, and to provide funding and technical assistance for training of public safety officials.

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118 49 CFR 172.820.
119 The SCOP addressed mechanical equipment condition, infrastructure integrity, and highway-rail grade crossing safety. It was developed through a coordinated effort among the FRA, DOE, the Association of American Railroads (AAR), railroad labor organizations, and state and tribal representatives.
120 DOE also transports SNF and HLW that is not covered by the NWPA (for example, non-commercial SNF and HLW being moved between DOE facilities). For those shipments, DOE may use DOE-certified packages as regulated by DOE Orders 460.1C and 460.2.
along shipment routes (Section 180(c)). DOE internally governs its radioactive material shipments through DOE Orders 460.1C, *Packaging and Transportation Safety* and 460.2A, *Departmental Materials Transportation and Packaging Management*.

DOE addressed transportation safety and security issues for shipments to a repository or interim storage facility in the last iteration of its *National Transportation Plan*, which was released in January 2009.\(^\text{121}\) The plan reiterates DOE’s commitment to follow NWPA requirements for the use of NRC-certified transportation casks, provide advance notification to states and tribes in accordance with NRC regulations, and provide funding and technical assistance for training of emergency responders and public safety officials along SNF transportation corridors. DOE addressed compliance with DOT regulations by indicating that it would follow its own internal order: DOE M 460.2-1A, *U.S. Department of Energy Radioactive Material Transportation Practices Manual*. Under this manual and associated DOE Order 460.2, DOE shipments would meet or exceed any requirements in equivalent DOT regulations for the transport of radioactive materials.

5. **State, Tribal, and Local Governments**

State, tribal, and local governments are responsible for protecting the health and safety of citizens and the environment within their respective jurisdictions. As such, they have some level of authority over shipments of radioactive materials within and through their jurisdictions, including through a regulatory role, an emergency management and response role, and, although not regulatorily required, a public communication and confidence-building role. States often adopt federal (DOT) regulations by statute and often function as part of the DOT’s inspections and enforcement apparatus. States cannot prohibit the transport of SNF and HLW through their jurisdictions. However, they can enact laws or ordinances, provided that these are not in conflict with federal laws, that address areas not otherwise covered by federal regulations. States have authority to determine general truck driver qualifications, ensure safe operation of motor vehicles, and conduct inspection and enforcement activities for highway and rail shipments consistent with federal regulations.\(^\text{122}\) Qualifications for hazmat drivers are determined by DOT. Tribal governments have similar enforcement authorities, if they choose to exercise them. Local government authority is generally limited to emergency response. Specific areas of state inspection and enforcement include:

- Registration and permit programs that may require the payment of registration or permit fees.
- Inspection and enforcement activities for highway shipments that exit, enter, or traverse states; states must have qualified inspectors and an active FRA State Rail Participation Program in order to inspect rail shipments.
- Notification requirements, including responsibility for disseminating information on routing, emergency preparedness, and emergency response planning activities.
- Financial liability in the event of an accident.
- Emergency preparedness training, planning activities, and response to an incident or accident involving all hazardous materials.

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• Assessment of fees for shipments that traverse state jurisdictions, as long as the fees are reasonable and can be justified for use in emergency planning and preparedness activities related to SNF transport. Fees cannot be charged to replicate funding for activities that are also covered by federal requirements under the NWPA.

Through various state and federal programs (e.g., the Emergency Planning and Community Right-to-Know Act), states, local communities, and tribes have amassed significant experience with preparedness and planning efforts for hazardous material transportation incidents within their jurisdictions. State and local governments are responsible for creating the emergency response systems necessary to handle hazards in their communities. This applies to shipments of SNF where the expectation is that state and local governments, once they know shipments are planned through their jurisdictions, will be trained and prepared to respond to an accident or incident involving SNF.

6. California State Oversight and Regulation

This subsection summarizes the jurisdictions of, and the interactions between, key California state agencies with respect to SNF and GTCC shipments. A detailed plan for transporting SONGS SNF will need to address these interactions, and perhaps others as, the time for implementation grows closer, and where laws or regulations may change.

6.1 California Coastal Commission

Under the California Coastal Act of 1976, the California Coastal Commission (CCC) has, with minor exceptions, regulatory oversight of land and water development activities in the California Coastal Zone. The California Coastal Zone extends from the Oregon and Mexico borders and seaward to the state’s outer limit of jurisdiction, including all offshore islands, and extending inland generally 1,000 yards off the mean high tide line. Within that zone, the CCC’s mission is to balance development with the protection of California’s coastal environment. The CCC implements its responsibilities under the California Coastal Act by considering applications from developers and by issuing coastal development permits (CDPs).

Activities related to SONGS decommissioning are covered by three active CDPs. The first CDP authorized construction and operation of the TN Advanced NUHOMS®, or TN, independent spent fuel storage installation (ISFSI) in the early 2000s. The second authorized construction and operation of the Holtec HI-STORM UMAX, or Holtec, ISFSI in 2015. The third CDP authorized deconstruction of the former SONGS Units 2 and 3 reactor structures in 2019. Each CDP includes conditions. The most significant of these conditions, with respect to removing SNF and GTCC from the site, are included in the Holtec ISFSI CDP. Permit CDP 09-15-0228, Section III, “Special Conditions,” Condition 2.d requires the SONGS co-owners to provide assurance that the canisters will be suitable for transportation when that time arrives. This means any aging-related degradation of the canisters will be managed (i.e., monitored, inspected, detected, and remediated) in a way that leaves the canisters in a condition that meets all applicable regulatory requirements for them to be transported.

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123 Section 30103, California Coastal Act of 1976.

B-9
To provide additional assurance of canister suitability for transportation, in satisfaction of Condition 19 of the CDP for plant deconstruction (CDP 09-19-0194) SCE developed an inspection and maintenance program (IMP) for the Holtec ISFSI. This program is to be implemented by SCE at the Holtec ISFSI before the NRC-required aging management program is required when the first Holtec canister reaches 20 years in storage service. The SCE IMP was approved by the CCC in July 2020 and includes requirements to inspect the canisters and repair flaws that could affect safe storage or transportation well before such flaws become safety concerns.

Another topic that could involve the CCC is any site development that is required to support the process of moving SNF and GTCC canisters from storage modules to rail cars for transportation. If modifications are required on the SONGS site (e.g., one or more crane foundations, the cask transfer facility, and/or recovery of part of the on-site rail spur), the CCC may need to approve a new or amended CDP before that work can proceed. This issue should be considered as part of the site infrastructure technical evaluation described in the body of the CTP and in Appendix C.

### 6.2 California Energy Commission

The California Energy Commission (CEC) is directly involved in the transportation of radioactive materials within the state, acting as the governor’s designee for advance notification for such shipments. The CEC would be the primary point of communications within California in preparing for and executing offsite shipments of SONGS SNF and GTCC waste, including granting permits for the shipments. The CEC is responsible for developing and implementing the state’s emergency plan for responding to an accident that involves a shipment of radioactive materials. The CEC is also responsible for maintaining awareness and coordinating intra-state communication pertaining to the commencement and status of radioactive material shipments while they are located within California borders or within California-controlled waterways.

### 6.3 California Public Utilities Commission

Among other responsibilities, the California Public Utilities Commission (CPUC) oversees rail safety in California and is a participating organization in the FRA rail safety program via its Office of Rail Safety and Enforcement Division. CPUC oversight of rail safety is broken down into three areas: (1) railroad safety, (2) rail transit safety, and (3) rail crossing safety. The Railroad Operations and Safety Branch (ROSB) of the CPUC is responsible for ensuring that California communities and railroad employees are protected from unsafe practices on freight and passenger railroads. The ROSB enforces state and federal rail safety rules, regulations, and inspection efforts; it also carries out proactive assessments of potential risks before they create dangerous conditions. ROSB rail safety inspectors investigate rail accidents and safety-related complaints, and recommend safety improvements to the CPUC, railroads, and the federal government, as appropriate.

As a participating member of the FRA’s rail safety program, ROSB, either independently or in collaboration with the FRA, would conduct inspections of SNF rail shipments from SONGS. These inspections would be conducted using a safety compliance oversight plan developed by the FRA for shipments of HLW and SNF.

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124 [https://www.cpuc.ca.gov/rail/](https://www.cpuc.ca.gov/rail/)
125 [https://www.cpuc.ca.gov/rosb/](https://www.cpuc.ca.gov/rosb/)
6.4 California Highway Patrol

The California Highway Patrol’s (CHP’s) Commercial Vehicle Enforcement Section is the state authority that enforces state and federal motor carrier and hazardous materials regulations for commercial vehicles. The CHP administers the DOT Federal Motor Carrier Administration’s Motor Carrier Safety Assistance Program, the purpose of which is to mitigate commercial vehicle and hazardous material accidents through strong regulation and enforcement. Specifically, California Vehicle Code, Division 14.5, “Transportation of Radioactive Materials [33000 - 33002]”\textsuperscript{126} provides the CHP with routing authority and requires carriers of radioactive material, including SNF, to notify the CHP prior to shipping. For shipments of highway route controlled quantities of radioactive materials, the CHP is required to conduct a point-of-origin Level VI inspection, as required by 49 CFR 385(4)(b)(1). These inspections would only apply in the case of a motor-carrier highway shipment within California. The CHP would not inspect rail shipments.

7. Carriers

7.1 Overview

Private carriers executing shipments of SNF, such as railroad companies and trucking companies, do not have a direct regulatory role in SNF shipments beyond the general license provisions included in 10 CFR 70.20a (discussed in Section F.2.3). Carriers do, however, work within their professional associations to set industry standards and practices for hazardous waste transportation. The Association of American Railroads (AAR) sets forth recommended practices in its Circular OT-55\textsuperscript{127} “Recommended Railroad Operating Practices for Transportation of Hazardous Materials.”

As part of a settlement agreement with the railroads, DOE has committed to requiring rail carriers to use the AAR S-2043 rail car design for SNF shipments. On the other hand, railroads contracted to private entities for SNF transportation are not obligated to use the S-2043 rail car design by law, regulation, or commitment. However, there may be operational differences between conventional and S-2043 rail cars that affect the efficiency, and therefore the cost, of overall SNF transportation operations. The decision on which rail car type to use would be part of a larger transportation plan that evaluates cost differences between the S-2043 rail car and a standard rail car. These differences include the cost of rail car assets and operational efficiencies, including trip cycle time and rail car maintenance frequency and duration.

7.2 Recent Rail Car Testing

Extensive testing of a S-2043 rail car prototype (Figure B.1) has been ongoing as part of the AAR certification process for the DOE Atlas rail car. This testing process and conditional approval of the Atlas rail car design are expected to be complete by mid-2022.\textsuperscript{128}

\textsuperscript{126} https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=VEH&division=14.5.&title=&part=&chapter=&article.
A separate multi-modal spent fuel transportation test program was conducted by a consortium of 12 participating organizations in 2017. This test program involved a standard rail car with modern suspension, a 32-assembly bare fuel transportation cask, and surrogate fuel assemblies, all instrumented to collect relevant physical data, such as strain and accelerations. The test cask was moved via heavy-haul truck, intercoastal ship (Figure B.2), transoceanic ship, and rail across seven countries and 12 U.S. states, traversing over 9,400 miles in total.

After the transoceanic shipment from Spain, the cask was shipped by rail from the port of Baltimore to the Transportation Technology Center, Inc. (TTCI) testing facility in Pueblo, Colorado, on a KASGRO 12-axle rail car, which was not of the AAR S-2043 design. At TTCI, a full series of rail tests were performed, including twist and roll, pitch and bounce, dynamic curving, turnouts, cross-overs, single bump, crossing diamond, and coupling impact tests.

The Sandia report on this test program concludes that “all recorded strains and accelerations on the surrogate fuel assemblies were exceedingly low during the rail-cask tests for all the transport and handling modes. The results provide a compelling technical basis for the safe transport of spent fuel under normal conditions of transport.”

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129 A bare fuel transportation cask does not incorporate a canister as part of the SNF packaging. Thus, this test is for a packaging that is of a different design than the SONGS SNF and GTCC packages. However, many of the test results are applicable to either type of packaging.


131 Ibid.

132 Ibid.

8. **Law and Contracts**

This subsection briefly summarizes transportation-relevant parts of the NWPA and the Standard Contract between DOE and the owners of commercial SNF.

8.1 **Nuclear Waste Policy Act**

The NWPA directs DOE to remove SNF and HLW\(^{134}\) from all originating sites in the United States. This includes commercial SNF at power plants such as SONGS, as well as Navy spent fuel and DOE-managed SNF and HLW from research activities and weapons production facilities. This SNF, HLW, and GTCC waste is required by the NWPA (and related court decisions) to be disposed of in a repository at Yucca Mountain, Nevada. Title I, Subtitle H, of the NWPA addresses transportation. Section 181 of Subtitle H addresses airborne transportation of plutonium through U.S. airspace between foreign countries and is not relevant to this CTP. Section 180 of Subtitle H contains three subsections that set out requirements for shipments governed by the NWPA:

- **Section 180(a)**—SNF and HLW packages used for transportation by DOE shall be certified by the NRC.

- **Section 180(b)**—DOE shall follow NRC regulations pertaining to advance notification of state and local governments prior to transportation.

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Section 180(c)—DOE shall provide technical assistance and funds to states for training public safety officials of appropriate units of local government and Indian tribes through whose jurisdiction the Secretary plans to transport SNF or HLW.

Subtitle A of the NWPA, Section 136(a), directs the Secretary of Energy to enter into contracts with the civilian owners of commercial reactor SNF and to take title to that SNF at the owner’s site, transport it to a federal facility, and store it pending further processing, storage, or disposal. Section 136 also authorizes the Secretary to establish a fee structure for SNF owners to create the Nuclear Waste Fund (NWF). A partial excerpt from Section 136 of the NWPA is provided below:

(1) During the period following the date of the enactment of this Act [enacted Jan. 7, 1983], but not later than January 1, 1990, the Secretary is authorized to enter into contracts with persons who generate or own spent nuclear fuel resulting from civilian nuclear activities for the storage of such spent nuclear fuel in any storage capacity provided under this subtitle: Provided, however, That the Secretary shall not enter into contracts for spent nuclear fuel in amounts in excess of the available storage capacity specified in section 135(a) [42 U.S.C. 10155(a)]. Those contracts shall provide that the Federal Government will (1) take title at the civilian nuclear power reactor site, to such amounts of spent nuclear fuel from the civilian nuclear power reactor as the Commission determines cannot be stored onsite, (2) transport the spent nuclear fuel to a federally owned and operated interim away-from-reactor storage facility, and (3) store such fuel in the facility pending further processing, storage, or disposal. Each such contract shall (A) provide for payment to the Secretary of fees determined in accordance with the provisions of this section; and (B) specify the amount of storage capacity to be provided for the person involved.

DOE has published several draft plans for implementing these requirements in the Federal Register. The Department’s last draft of its Section 180(c) policy was published in 2008. It proposed that the amount of funding each state or tribe would be eligible for would consist of a base portion for planning purposes and a variable amount calculated by a formula that considered the number of shipments through a jurisdiction, the miles per shipment in that jurisdiction, and other factors. The same draft rule envisioned that a grant of up to $200,000 would be made to each eligible jurisdiction for a needs assessment. This would include a $100,000/year base grant, plus a grant for the variable amount. Tribal governments would receive a base grant and could apply for funds after conducting a needs assessment. Private shippers of SNF are not explicitly required to provide similar funding for training, but some states and tribes have expressed their expectation that the same assistance would be provided in a private shipping scenario. As pointed out in the Federal Register Notice, funding for DOE Section 180(c) grants is subject to congressional appropriations.

The NWPA has no bearing on a private shipment model that does not involve direct government participation or funding.

8.2 The Standard Contract

To comply with section 136(1) of the NWPA, DOE promulgated a rule at 10 CFR 961, Subpart B, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste.” The Standard Contract was executed between DOE and all civilian owners of SNF from commercial nuclear

power reactors. It contractually binds DOE to take title and remove SNF from commercial reactor sites in return for payments into the NWF. Because the Standard Contract required DOE to take title to the SNF at originating sites and remove it, the Contract necessarily required DOE to possess the SNF and transport it away from reactor sites.

The Standard Contract establishes numerous detailed responsibilities of the U.S. government (represented by DOE) and the utility (“the Purchaser”). The Purchaser’s responsibilities pertaining to transportation are found in Article IV.A.2 of the Standard Contract [emphasis added]:

(a) The Purchaser shall arrange for, and provide, all preparation, packaging, required inspections, and loading activities necessary for the transportation of SNF and/or HLW to the DOE facility. The Purchaser shall notify DOE of such activities sixty (60) days prior to the commencement of such activities. The preparatory activities by the Purchaser shall be made in accordance with all applicable laws and regulations relating to the Purchaser’s responsibilities hereunder. DOE may designate a representative to observe the preparatory activities conducted by the Purchaser at the Purchaser’s site, and the Purchaser shall afford access to such representative.

(b) Except as otherwise agreed to by DOE, the Purchaser shall advise DOE, in writing as specified in appendix F, annexed hereto and made a part hereof, as to the description of the material in each shipping lot sixty (60) days prior to scheduled DOE transportation of that shipping lot.

(c) The Purchaser shall be responsible for incidental maintenance, protection and preservation of any and all shipping casks furnished to the Purchaser by DOE for the performance of this contract. The Purchaser shall be liable for any loss of or damage to such DOE-furnished property, and for expenses incidental to such loss or damage while such casks are in the possession and control of the Purchaser except as otherwise provided for hereunder. Routine cask maintenance, such as scheduled overhauls, shall not be the responsibility of the Purchaser.

DOE’s responsibilities pertaining to taking title and transportation are found in Article IV.B of the Standard Contract [emphasis added]:

1. DOE shall accept title to all SNF and/or HLW, of domestic origin, generated by the civilian nuclear power reactor(s) specified in appendix A, provide subsequent transportation for such material to the DOE facility, and dispose of such material in accordance with the terms of this contract.

2. DOE shall arrange for, and provide, a cask(s) and all necessary transportation of the SNF and/or HLW from the Purchaser’s site to the DOE facility. Such cask(s) shall be furnished sufficiently in advance to accommodate scheduled deliveries. Such cask(s) shall be suitable for use at the Purchaser’s site, meet applicable regulatory requirements, and be accompanied by pertinent information including, but not limited to, the following:

(a) Written procedures for cask handling and loading, including specifications on Purchaser-furnished cannisters for containment of failed fuel;
(b) Training for Purchaser’s personnel in cask handling and loading, as may be necessary;

(c) Technical information, special tools, equipment, lifting trunnions, spare parts and consumables needed to use and perform incidental maintenance on the cask(s); and

(d) Sufficient documentation on the equipment supplied by DOE.

3. DOE may fulfill any of its obligations, or take any action, under this contract either directly or through contractors.

4. DOE shall annually provide to the Purchaser pertinent information on the waste disposal program including information on cost projections, project plans and progress reports.

5. (a) Beginning on April 1, 1991, DOE shall issue an annual acceptance priority ranking for receipt of SNF and/or HLW at the DOE repository. This priority ranking shall be based on the age of SNF and/or HLW as calculated from the date of discharge of such material from the civilian nuclear power reactor. The oldest fuel or waste will have the highest priority for acceptance, except as provided in paragraphs B and D of Article V and paragraph B.3 of Article VI hereof.

(b) Beginning not later than July 1, 1987, DOE shall issue an annual capacity report for planning purposes. This report shall set forth the projected annual receiving capacity for the DOE facility(ies) and the annual acceptance ranking relating to DOE contracts for the disposal of SNF and/or HLW including, to the extent available, capacity information for ten (10) years following the projected commencement of operation of the initial DOE facility.

The timing for DOE to provide these services is captured in Section II of the Standard Contract, which states [emphasis added]:

_This contract applies to the delivery by Purchaser to DOE of SNF and/or HLW of domestic origin from civilian nuclear power reactors, acceptance of title by DOE to such SNF and/or HLW, subsequent transportation, and disposal of such SNF and/or HLW and, with respect to such material, establishes the fees to be paid by the Purchaser for the services to be rendered hereunder by DOE. The SNF and/or HLW shall be specified in a delivery commitment schedule as provided in Article V below. The services to be provided by DOE under this contract shall begin, after commencement of facility operations, not later than January 31, 1998 and shall continue until such time as all SNF and/or HLW from the civilian nuclear power reactors specified in appendix A, annexed hereto and made a part hereof, has been disposed of._

There are many other requirements in the Standard Contract, including, for example, requirements that the Purchaser provide periodic reports of SNF discharges and requirements with respect to how DOE defines “standard,” “non-standard,” and “failed” SNF. However, a key point about the Standard Contract is that it was created in the early 1980s (DOE was required to execute Standard Contracts with all civilian owners of SNF by January 1, 1990). At that time, the industry’s dry storage program for SNF was in its infancy. The development of canister-based SNF storage systems was in the research and development phase when the Nuclear Waste Policy Amendments Act of 1987 directed the Secretary of Energy to
conduct a study of the use of dry cask storage technology for storing spent fuel at the sites of civilian nuclear reactors until a geologic repository is available. These tests began in 1987 with multiple dry cask storage designs at several reactor sites. DOE’s own efforts to design a multi-purpose canister (MPC) suitable for the storage, transportation, and disposal of SNF began in 1990 and were abandoned in 1997.\textsuperscript{136,137} Canister design efforts at DOE resumed in 2008 with the development of a performance specification for a standardized transportation, aging and disposal (TAD) canister. DOE issued two contracts for TAD design that were submitted to the NRC for review. However, this work stopped when DOE’s Office of Civilian Radioactive Waste Management was disbanded in 2010. At that point, storage system suppliers continued their efforts to develop canister-based SNF storage systems that offered an alternative to the bolted-lid, bare fuel casks that were then in common use in the industry. Canister-based technologies for SNF storage were first introduced as part of a demonstration program at the H.B. Robinson site in the mid-1980s. Widespread use of canister-based storage systems began at the Oconee Nuclear Station in 1990; today, canister systems are the industry standard. In the early years, canister-based technology was certified only for storage service. Today more than 80 percent of dry storage casks in service use canister designs that are also qualified for transportation inside a rugged, bolted-lid transportation cask.\textsuperscript{138}

The emergence of canister-based storage systems at nuclear plant sites in the 1990s created uncertainty with respect to how language in the Standard Contract applies to future movements of SNF away from these sites. The Standard Contract contemplates moving SNF from fuel pools directly into a DOE-supplied bare fuel transportation cask. Today, there are over 3,300 SNF dry storage systems in service, most of which use dual-purpose canisters that the owners intend to ship directly from their ISFSIs. This uncertainty in the Standard Contract language pertains to the respective responsibilities of the Purchaser and DOE regarding retrieving the canisters from the ISFSI, loading them into transportation casks, and preparing casks (now “packages”) for shipment. Resolution of this uncertainty is of particular importance for shutdown sites like SONGS, where all SNF is in canister storage at the ISFSI. DOE and the SONGS co-owners (as well as other, similarly situated utilities) will need to address this uncertainty as part of planning for any federal government shipments of SNF.

9. Title Transfer

For SNF shipments conducted under the NWPA, it is clear that title to the SNF would transfer from the SONGS co-owners to DOE at the SONGS site when DOE removes the fuel from the site. This is explicitly called for in Section 123 of the NWPA and reinforced in the Standard Contract.

In the case of private shipments, NWPA and Standard Contract provisions for title transfer do not apply. Based on the current draft licenses for the Holtec HI-STORE and ISP WCS consolidated interim storage facilities (CISFs), if the SONGS co-owners (or a subsequent private owner of the SONGS licenses and SNF) were to reach a commercial agreement to store SONGS SNF at one or both of these proposed facilities, the owner of the SNF would need to retain title to the SNF while it is in storage at the CISF. Arrangements for shipping SNF to the CISF, in this scenario, could take several forms, but all options would have to

\textsuperscript{136} “Multipurpose Transportation, Aging and Disposal Canisters for Used Nuclear Fuel – Getting from Here to There and Beyond,” R. McCullum, 2008.

\textsuperscript{137} DOE subsequently developed the Transportation, Aging, and Disposal (TAD) concept to include in the Yucca Mountain license application, but that concept was abandoned when DOE ceased pursuing the Yucca Mountain license and disbanded the Office of Civilian Radioactive Waste Management.

\textsuperscript{138} Source: Gutherman Technical Services, LLC. Other casks in storage service include both transportable and non-transportable bare fuel casks and canisters not designed for transportation.
involve an NRC license. A private shipment made today would be governed by the SONGS Part 50 licenses and would be conducted using appropriate contracted resources (i.e., a logistics company and carriers). Alternatively, the CISF owner (in this case, Holtec or ISP) could acquire the necessary NRC license (e.g., a Part 70 license) to allow it to be the shipper. As the licensee shipper, Holtec or ISP could take possession of the SNF in its packaged configuration at the SONGS site and transport it to the CISFs. However, title to the SNF would remain with the originating site SNF owner in accordance with the conditions of the CISF licenses, as already discussed. Lastly, if the SONGS co-owners were to sell the SONGS assets, the Part 50 (and 72) licenses and title to the SNF would be transferred to the new owners awaiting final disposition. Under all of these private shipping scenarios, all (or a significant portion) of the costs for transportation operations and to acquire transportation hardware (e.g., casks and rail cars) would be borne by the SONGS owners. Those costs could accrue directly or indirectly, through storage fees that also recoup transportation costs.

10. Financial Protection and Indemnification

The Price-Anderson Act (PAA) provides the legal framework for financial protection and indemnification pertaining to nuclear incidents. The Standard Contract between the SONGS co-owners and DOE clearly requires DOE to indemnify its private subcontractors against liability for any damage claims associated with transporting SNF to a repository. Such coverage would also be available to DOE for transporting SNF to a federal CISF; presumably it would be extended by Congress as part of any legislation authorizing DOE to transport SNF to a non-federal CISF.

A fully private transportation model is not quite as clear in this regard. The NRC implements the requirements of the PAA in 10 CFR 140. All NRC licensees of operating nuclear power plants are required to obtain primary tier liability insurance with minimum coverage limits that provides access to additional secondary tier financial protection and indemnification. Operating nuclear plants must provide $450 million in financial protection per reactor under the primary tier in order to have access to over $13 billion of coverage under the secondary tier via deferred premium payments from all operating plant licensees. If the secondary tier financial protection is depleted, Congress is obligated to address additional compensation to those suffering damages. Transportation accidents are neither explicitly included nor excluded in the text of the PAA; however, the use of the phrase “nuclear incidents” in the language of the PAA is broad enough to include transportation accidents. Furthermore, given the limits of liability discussed above, the PAA clearly provides sufficient financial protection for operating power plants to privately ship SNF and GTCC waste to a private CISF.

In 2018, the SONGS co-owners, like other owners of shutdown nuclear plant sites, were granted an exemption by the NRC to reduce their primary offsite limit of financial liability for SONGS from $450 million to $100 million. This reduction was based on the significantly lower risk of accident events at a shutdown nuclear site compared to an operating site, but it did not include specific consideration of transportation incidents. Along with this reduction in liability exposure, the SONGS co-owners were also permitted to withdraw from participation in the secondary tier of financial protection. To date, the SONGS

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141 This protection would end when the material is received and accepted by the CISF owner. Financial protection during storage at the private CISF would be addressed in the commercial arrangement for storage services between the title holder of the material and the CISF owner.
co-owners have not elected to take advantage of the reduction in primary tier insurance and remain covered up to $450 million.

Based on the AHL Consulting analysis performed for this project\textsuperscript{142} the NRC is obligated to provide a supplemental $460 million in coverage for decommissioning sites. For SONGS, this provision would provide a total financial protection limit of $560 million if the SONGS co-owners decide to reduce their primary coverage limit to $100 million as authorized by the exemption. Thus, NWT concludes that up to $560 million of financial protection is available for a private transportation campaign (using private logistics company and carriers). Whether that level of financial protection and indemnification is acceptable to private carriers (e.g., railroads) and the NRC would be a subject to be addressed as part of the negotiation of commercial arrangements for offsite transportation and storage.

\textsuperscript{142} See Appendix C of the Strategic Plan, Volume II.
APPENDIX C
Site Considerations and Readiness
1. **Training of On-Site Personnel at Origin and Destination Sites**

Training of operational personnel must be approached systematically. Each job function must be analyzed for training needs and training requirements should be included in the job description for each function. Additionally, positions that require special qualifications must be identified.

Training records must be maintained by each employer who is responsible to the overall project management organization for ensuring that supplied personnel meet the training and certification requirements specified in the job description. These training records must be verified by the overall project management organization to ensure uniformity and regulatory compliance.

A training program should utilize the PADDIE-M Methodology, which is the standard for government and military training.\(^{143}\) PADDIE-M includes seven phases: plan, analyze, design, develop, implement, evaluate, and maintain. Each phase is explained in more detail below:

1. **Planning.** Planning will examine each job function and identify the training requirements prescribed by regulation or industry standards to determine the scope and elements of the training program. Additionally, the planning phase will involve acquiring the necessary publications to support the required training.

2. **Analysis.** The analysis phase takes the requirements and publications obtained during the planning phase and uses them to create a set of tasks needed to create the comprehensive training program.

3. **Design.** In the design phase, the list of required training tasks is broken into appropriate modules. Specific and measurable learning objectives are established for each module, which can then be sequenced and storyboarded. A learning management system must be designed that will provide a location for tracking training records, as well as for delivering course content. Finally, a system of evaluation should be designed during this phase as well.

4. **Development.** The development phase is where the content of each module is developed, as well as course format, training materials, and supporting documents.

5. **Implementation.** Training is delivered during the implementation phase.

6. **Evaluation.** Trainees provide course feedback to improve future iterations of the training. This feedback is delivered to training developers via the system created during the design phase.

7. **Maintenance.** Training records for each job function must be maintained in the learning management system, and a training periodicity for each job function should be established. Each individual is then placed into the training surveillance regime and notified when trainings are required.

1.1 **Additional Considerations for SCE**

Training courses and seminars are already available for the majority of job functions related to the transportation of SNF. As a result, it is not necessary to create every training module from scratch; instead, an open-source search for preexisting training courses should be conducted. The training

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courses, if they are not accredited by any institution, should be evaluated by subject matter experts for satisfactory scope, content, and cost.

Certain certifications require a very large amount of expensive training, such as private security escorts, crane operators, and helium leak testers. SCE may find it advantageous to identify individuals or subcontractors who already possess the necessary certifications for these positions rather than attempting to create these resources in-house.

It is the responsibility of DOE or the licensee offering the SNF for transport (e.g., the SONGS co-owners or a successor licensee) to verify the training certifications and records of all employees, as well as employees of subcontractors, as appropriate.

1.2 Training and Qualification of Security Personnel

The above methodology may also be used to train private security escort personnel. However, due to the extensive nature of security training, it is advisable to seek a subcontractor that provides these services and is already licensed to operate within the transit states along the route. The SONGS co-owners would then be required to receive written verification that training requirements have been met; in addition, the co-owners may need to conduct an audit of the subcontractor’s training program. It should also be noted that active duty law enforcement officers are exempt from these training requirements. However, due to the difficulties associated with using state or local law enforcement personnel on a rail route that crosses multiple state jurisdictions, private security may be required. For federal shipments of SONGS SNF, DOE is currently responsible for providing appropriately trained and qualified security escorts. Previous DOE shipments by rail have used a combination of federal agents from DOE’s Office of Secure Transportation and private security personnel. For these shipments, the federal government is responsible for all costs and certifications of compliance.

The following excerpt from 10 CFR 73 Appendix D outlines training requirements:

“Pursuant to the provision of § 73.37 of 10 CFR part 73, each licensee who transports or delivers to a carrier for transport irradiated reactor fuel is required to assure that individuals used as shipment escorts have completed a training program. The subjects that are to be included in this training program are as follows:

Security En-route
Route planning and selection
Vehicle operation
Procedures at stops
Detours and use of alternate routes

Communications
Equipment operation
Status reporting
Contacts with law enforcement units

144 As an example, many training courses are available that claim to satisfy the somewhat vague DOT training requirements found in 49 CFR 172.704. Some of these courses are better than others. According to DOT, it is the employer’s responsibility to ensure, and to certify, that the provided DOT training meets the needs of the employee with regard to training accreditation.
Communications discipline
Procedures for reporting incidents

Radiological Considerations
Description of the radioactive cargo
Function and characteristics of the shipping casks
Radiation hazards
Federal, State and local ordinances relative to the shipment of radioactive materials
Responsible agencies

Response to Contingencies
Accidents
Severe weather conditions
Vehicle breakdown
Communications problems
Radioactive “spills”
Use of special equipment (flares, emergency lighting, etc.)

Response to Threats
Reporting
Calling for assistance
Use of immobilization features
Hostage situations
Avoiding suspicious situations

The licensee is also required to assure that armed individuals serving as shipment escorts, other than members of local law enforcement agencies, have completed a weapons training and qualifications program equivalent to that required of guards, as described in III and IV of appendix B of this part, to assure that each such individual is fully qualified to use weapons assigned him.\(^\text{145}\)

2. Package Criticality

Any carrier for SNF shipments must be able meet requirements for package stowage, transport, and interim storage incidental to transport with respect to criticality safety.\(^\text{146,147}\) Each fissile material package is assigned a criticality safety index (CSI) based on its design and allowed contents. 10 CFR 71.59(b) states, in part, “The value of the CSI may be zero provided that an unlimited number of packages are subcritical...” The CSI values for the MP187, MP197/197HB, and HI-STAR 190 packages slated for use to ship SONGS SNF are all 0.0, as stated in their respective CoCs. 10 CFR 71.59(c) states that for fissile material packages with assigned CSIs less than or equal to 50, “that package may be shipped by a carrier in a nonexclusive use conveyance, provided the sum of the CSIs is limited to less


\(^\text{146}\) 10 CFR 71.59, “Standards for Arrays of Fissile Material Packages.”

\(^\text{147}\) 49 CFR 176.704, “Requirements Relating to Transport Indices and Criticality Safety Indices.”
than or equal to 50.” Thus, a non-exclusive conveyance may be used to ship the SONGS SNF packages because the sum of the CSIs will always be zero.

Likewise, DOT regulations at 49 CFR 176.704(d) state: “The sum of the criticality safety indices (CSIs) for all packages and overpacks of fissile Class 7 (radioactive) materials on board a vessel may not exceed the limits specified in Table IIIIB of this section.” Because all three transportation package designs used at SONGS have assigned CSIs of zero, this regulation is also met irrespective of the shipping configuration on the conveyance.

3. Quality Assurance Program

The quality assurance (QA) requirements applicable to SNF transportation can be found in 10 CFR 71, Subpart H. These requirements apply to any applicant for an NRC CoC, or to a licensee who is responsible for designing, owning, maintaining, handling, using, loading, or assembling for transport, a Type B package. 10 CFR 71.101(f) allows for the substitution of an existing QA program that satisfies all the requirements of Subpart H and is approved by the NRC under Appendix B of Part 50, or Subpart G of Part 72. The NRC must be informed in writing of the intent to use this existing program, as specified in 71.101(f). If the existing Part 50 QA program does not satisfy the Part 71, Subpart H requirements, then it must be amended to do so, or a separate QA program must be developed which does satisfy them.

QA requirements are implemented by a two-tiered system of documents. The licensee is required to develop and submit a quality assurance program (QAP) for approval by the NRC. This QAP is implemented according to a set of quality procedures (QPs). The QPs do not have to be approved by the NRC but may be inspected by the NRC at any time.

The purpose of the 10 CFR 71 QAP is to ensure that Type B package(s) are maintained and operated in accordance with the design the NRC approved when it granted the CoC. Sections 101 to 137 of Part 71, Subpart H correspond to the chapters that are required in the QAP document. The architect of a QAP may rely exclusively on the NRC’s Regulatory Guide 7.10, Establishing Quality Assurance Programs for Packaging Used in Transport of Radioactive Material (Rev. 2), in creating a document that describes the QAP in detail.

The SONGS Decommissioning Quality Assurance Program (DQAP) applies to important-to-safety activities performed under 10 CFR Parts 50, 72, and 71. The NRC has issued 10 CFR 71 QA program approval 71-0174 to SCE approving the SONGS DQAP as meeting 10 CFR 71, Subpart H, for Part 71 activities performed under their control. The DQAP is a high-level document that describes how SCE meets the 18 QA criteria applicable to operations on site. The number of applicable criteria may vary as the emphasis shifts from performing Part 50 activities toward only performing Part 72 activities and, eventually, Part 71 activities. Before shipping the SONGS SNF and GTCC canisters, SCE will need to review the SONGS DQAP to determine if any changes are required to support those activities. If changes to the DQAP are required, the nature of the changes will determine whether NRC approval is needed prior to implementation.

QA and other department procedures are used to implement the activities covered by the DQAP. These documents are not approved by the NRC; however, they must align with the commitments in the DQAP. Implementing procedures provide detailed step-by-step instructions for performing any function that is

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148 The 18 quality assurance criteria are essentially the same among 10 CFR 50, Appendix B; 10 CFR 72, Subpart G; and 10 CFR 71, Subpart H.
subject to QA oversight. This includes line operations as well as oversight functions performed by the QA organization itself. A set of QA and other implementing procedures must be developed and approved prior to any SNF or GTCC shipment taking place. The DQAP review is included as a Phase II activity in this CTP (see Chapter 6) to set the foundation early for future development of QA and implementation procedures and to acquire NRC approval of DQAP changes, if necessary. QA and other procedure development functions are included as a Phase III activity (see Chapter 7) because detailed information about package design and preparation for shipment is needed to develop those procedures.

3.1 Vendor Requirements

Any vendor that is performing an important-to-safety service, or providing a product described in Subpart H is subject to QA oversight. This requirement includes, but is not limited to the following entities and activities:

- The package designer (CoC holder),
- The package manufacturer/fabricator,
- The package owner (who may be different than the package designer),
- The spare or replacement part manufacturer,
- Package closure,
- Package assembly for transport, and/or
- Package leak testing.

If a package owner requires a product that performs a safety function (e.g., seals, closure bolts, etc.), the manufacture of that part is subject to QA oversight via the procurement process of the entity with the NRC-approved QA program. Thus, the shipper’s or the CoC holder’s QAP can provide the necessary oversight. The following sequence of events illustrates how this process might unfold:

- The package owner identifies which spare parts are subject to QA oversight.
- The package owner creates or obtains engineering drawings for the required parts (the drawings are also subject to QA review under the QAP).
- The package owner identifies a manufacturer capable of producing the parts exactly as specified in the drawings.
- The manufacturer implements a QA process to ensure the parts are manufactured according to drawings and specifications.
- The package owner audits the manufacturer’s QA process to ensure that the parts are manufactured to specification.
- The package owner then issues a contract, which stipulates that the parts are subject to the previously audited QA process.
- The package owner receives parts from the vendor and inspects these parts per the “receipt inspection procedure,” which is required to be developed as part of a QAP.
- Parts are accepted into the package owner’s “quality inventory” and tracked via a numbering system described in the QAP.
• Parts may then be used in packages, with documentation of their part numbers.
• Parts that are placed in use are removed from the quality inventory.

4. Site Operations and Infrastructure

4.1 Canister Preparation and Documentation Requirements

Before it can be moved off site, each SONGS SNF and GTCC waste canister and its contents must comply with applicable requirements in a 10 CFR 71 CoC. In addition, up-to-date CoCs need to be in place before package owners can fabricate transportation casks and impact limiters. As of this writing, the 10 CFR 71 CoCs for the canisters being used to store SONGS SNF and GTCC waste are as follows:

• SONGS-1 SNF Canisters (24PT1): TN MP187 Package (CoC 9255).
• SONGS-1 GTCC Waste Canister: None.
• SONGS-2/3 SNF Canisters (24PT4): TN MP197/197HB Package (CoC 9302).
• SONGS-2/3 SNF Canisters (MPC-37): Holtec HI-STAR 190 (CoC 9373).
• SONGS-2/3 GTCC Waste Canisters: None.

Prior to shipping, SCE needs to review and document the current compliance status of each SNF and GTCC canister and its contents against the current revision of the applicable transportation CoC (which includes specific revisions to the package drawings). This review needs to include:

• Physical state of each canister (e.g., resolution of fabrication issues, changes made for storage use under 10 CFR 72.48, and resolution of any age-related degradation issues).
• Contents of each canister (fuel/burnup and non-fuel items) and canister preparation (drying, backfilling).

The results of this review will yield a request from SCE to the respective CoC holder to amend the CoC to address any identified compliance gaps or otherwise suggest how to bring the affected canisters into compliance for shipping. At a minimum, CoC amendments are required to add GTCC waste canisters to one or more of the CoCs when the contents of the SONGS-2/3 GTCC canisters are known. That information will not be available until decommissioning activities for SONGS Units 2 and 3 reach the reactor dismantlement stage.

The MP187 package was certified by the NRC under an earlier version of the Part 71 regulations. To use the MP187 package, CoC 9255 will need to be amended by TN to reflect current regulations. This would also be an opportunity for TN to amend CoC 9255 to reduce the minimum cooling time required to ship 14 of the 17 SONGS Unit 1 SNF canisters, which are currently the last ones eligible to be shipped among all canisters at the ISFSI. Alternatively, TN could amend the MP197/197HB package CoC to add the

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149 Research on techniques to repair canisters in situ is ongoing across the industry (i.e., via the Electric Power Research Institute’s Extended Storage Collaboration Program (ESCP) repair and mitigation subcommittee). SCE has successfully demonstrated a prototype process for a cold-spray (weld overlay) technique as an alternative to weld repair. Commercialization of this prototype process is expected to be deployed long before SNF is shipped from SONGS.

150 SCE Presentation to SONGS Community Engagement Panel, “Spent Fuel Transportation,” August 9, 2018, shows the last of the SONGS Unit 1 canisters will be qualified for shipment in 2030.
SONGS-1 canisters as allowable contents and not use the MP187 package to ship the SONGS-1 canisters. The MP187 transportation cask is designed for the SONGS Unit 1 canisters, which are approximately 10 inches shorter than the SONGS Units 2 and 3 canisters. Thus, it would be impractical to amend the MP187 package to accept the longer SONGS Units 2 and 3 canisters. However, the MP197/197HB package design could be modified to accept the shorter SONGS Unit 1 canisters. The SONGS co-owners should determine whether it is more cost-effective to have TN upgrade the MP187 package or certify the SONGS-1 SNF and GTCC canisters for transportation in the MP197/197HB package. Either way, a CoC amendment is required.

Holtec could also evaluate the option of amending the HI-STAR 190 CoC to reduce cooling time for the one canister that currently cannot be shipped until 2028\footnote{Ibid.}

It is possible, theoretically, for a single “universal” transportation package design to be certified that includes both the TN and Holtec canisters and contents. This would simplify transportation cask acquisition because only one design would be needed. However, this approach presents significant challenges given the intellectual property considerations pertaining to each of the canister designs. It is unlikely that any one entity would be able to gain access to the detailed canister design information needed to certify a universal transportation package design.

\subsection*{4.1.1 Documentation Packages}

Before SNF and GTCC canisters can be moved off site, a documentation package needs to be assembled that includes the information required for shipping under 10 CFR 71, as well as any documents required by the receiving facility, which may vary for different receiving facilities. A repository licensed under 10 CFR 61/63, for example, may require different documentation than a CISF licensed under 10 CFR 72. SCE should develop a template for a canister documentation package and then assemble a pilot documentation package for one canister. This process will allow SCE to identify any gaps in documentation that may need to be addressed and to make modifications to the template, as needed, to facilitate the preparation of future documentation packages.

\subsection*{4.1.2 Canister Inspections}

All of the SNF and GTCC waste canisters at SONGS will have been in storage service for years before shipment and will therefore be subject to potential aging-related phenomena. The first SONGS-1 SNF canisters were placed into service at the ISFSI in 2003. Under NRC regulations, storage systems in service beyond 20 years are subject to aging management program (AMP) requirements, as specified in the associated renewed 10 CFR 72 CoC. AMP requirements call for conducting inspections on a subset of canisters to ensure continuation of storage safety functions for all canisters through the period of extended ISFSI operation. However, the AMPs are solely focused on storage requirements, not transportation requirements. (We note that SCE has already developed an inspection and maintenance program to monitor the integrity of the Holtec SNF canisters well in advance of being required to do so by the CoC for the HI-STORM UMAX System.) AMP inspections at the TN ISFSI begin in the next couple of years, as determined by the renewed Advanced NUHOMS \textsuperscript{®} CoC.

The TN and Holtec 10 CFR 71 package CoCs and SARs include pre-shipment inspections that SCE will need to implement. More broadly, SCE will need to not only determine what inspections and acceptance criteria are appropriate to verify that aged canisters are in compliance with 10 CFR 71 CoC and drawings,
but also that the canisters will be suitable to return to storage service as the confinement system at the receiving facility. Because the shipping of aged storage canisters from SONGS could be first-of-a-kind, SCE needs to work closely with the transportation CoC holders, the CISF licensees, and the nuclear industry at large to develop an appropriate pre-shipment inspection protocol that meets NRC requirements and expectations, as well as any license requirements at the receiving facility. We see this as a phased approach, which would begin at the program level by determining what types of inspections are required for transporting aged canisters (with an eye to restoring canisters to storage service on the receiving end; see also discussion of aging management programs in Section 3.3 of the Strategic Plan). Thereafter, more specific inspection procedures will need to be developed that address the particular canister designs at SONGS and related transportation CoCs. For efficiency, it may be possible to integrate these pre-transportation inspection programs with, or draw from, the aging management canister inspections being performed for continued storage operations at the ISFSI.

4.2 Rail Infrastructure at SONGS

SONGS has an on-site rail spur that crosses the northern boundary of the site and connects with the main rail line (the main rail line runs parallel to Interstate Highway 5 in the vicinity of the SONGS site). The main line is owned by San Diego Northern Railway Corporation and BNSF Railway. BNSF has controlling rights to the spur leading into the SONGS site up to the point where Beach Club Road crosses over the spur. SONGS has rights to the spur from Beach Club Road into the site. This portion of the existing rail spur (from Beach Club Road southward into the site proper) is being upgraded and will be joined to a new set of sidings that will be installed to support SONGS decommissioning. Several new sidings will be located on the site of the current SONGS administration building, and two will extend farther into the site. Figure C.1 depicts the existing and planned decommissioning site rail spurs. The SONGS Units 2 and 3 deconstruction project plan currently includes removal of the “decommissioning spurs” at the end of the project. Section 4.2.1 describes in more detail the operations for moving SNF canisters from storage to transportation and options for on-site infrastructure to accomplish that objective.

4.2.1 Canister Transfer from Storage Modules to Transportation Casks

The procedure for moving storage canisters from ISFSI storage modules to transportation casks is significantly different between the TN canisters, which are stored horizontally, and the Holtec canisters, which are stored vertically. SCE will need to make separate logistical arrangements for these two types of transfers, including a plan to identify and acquire the specific lifting and handling structures and equipment needed in each case. Some of this equipment is only available from the storage technology suppliers, while some of the other lifting and rigging equipment is standard and available from other vendors.
TN CANISTERS

The TN canisters can be moved directly from storage modules into transportation casks. The Transnuclear MP187 and MP197/197HB transportation casks are designed to mate with the Advanced NUHOMS® storage modules. This allows the canisters to be pulled horizontally, via hydraulic ram, directly from the Advanced NUHOMS® module into the transportation cask without using a transfer cask. The Advanced NUHOMS® module door is removed and the TN transportation cask (situated on a transfer trailer) is moved into position at the circular module opening. A hydraulically driven grapple mechanism is used to retrieve the canister. An opening in the bottom of the transportation cask provides access for the grapple mechanism to be extended through the empty cask to engage the grapple ring attached to the bottom of the TN canister (see Figures C.2 and C.3). Once engaged, the TN canister is pulled out of the Advanced NUHOMS® module into the transportation cask using the hydraulic drive system.

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152 Orano TN Advanced NUHOMS® storage FSAR and the TN MP187 and MP197/197HB transportation Safety Analysis Reports.
This figure and Figure C.3 show a NUHOMS® transfer cask and grapple system. The configuration for a transportation cask is the same. View shows the bottom of the canister and the grapple ring inside a NUHOMS module.
Once the TN canister is seated inside the transportation cask, the transfer trailer is backed a short distance away from the module, allowing the transportation cask lid to be temporarily installed. The cask is then moved to a suitable location to be prepared for shipment (i.e., final lid fastening, drying, sealing, and leak-testing). Once cask preparation is complete, the cask is moved to the railcar where impact limiters and a personnel barrier are installed. At this point, the package is ready to ship. A customized TN transfer trailer and hydraulic ram must be used to facilitate canister withdrawal from the Advanced NUHOMS® module. Cask cranes and appropriate lifting and rigging equipment will be needed to lift and handle smaller components (e.g., the transportation cask lid), and to move the transportation cask between the transfer trailer and the railcar. Details of the loading sequence will vary somewhat based on the railcar and cradle designs being used. In some cases, the transport cask is placed on a cradle, which is then loaded onto the railcar. In other cases, the cradle is attached to the railcar before the transport cask is loaded. The preferred approach for the SONGS site will have to be determined as part of the detailed on-site transport logistics study.

There is no difference in operations between the SNF canisters and the GTCC canisters. After loading operations have been successfully performed, the transportation package is ready for shipment, pending approval and transfer of appropriate paperwork from the licensee to the carrier.

**HOLTEC CANISTERS**

Moving the Holtec MPC-37 canisters from ISFSI storage to the transportation cask involves more equipment and maneuvering because the canisters are stored vertically and transported horizontally. The Holtec MPC-37 design requires the canister to be lifted and lowered from the top, using temporary MPC lifting attachments. Further, the HI-STAR 190 transportation cask bottom closure is not removable. Thus, the Holtec canister needs to be lifted out of the HI-STORM UMAX module into a transfer cask and subsequently lowered from the transfer cask into the transportation cask from the top, in what is known as the “stack-up” configuration. A mating device is situated between the UMAX module and the transfer cask. The mating device facilitates removal and re-installation of the transfer cask bottom lid.

Figure C.4 shows a graphical cutaway depiction of the configuration of a Holtec canister being lifted out of the UMAX module into the transfer cask through the mating device. The canister slings are attached to a vertical cask transporter (VCT) (not shown in Figure C.5), which raises the canister into the transfer cask with its lifting boom.
Figure C.4. MPC-37 Removal from the UMAX Vertical Ventilated Module into the Transfer Cask\textsuperscript{154}

\textsuperscript{154} Source: Holtec International presentation to SONGS Community Engagement Panel, October 14, 2014. Vertical Cask Transporter not shown for clarity.
Once the MPC-37 canister is inside the transfer cask, it is suspended until the transfer cask bottom lid is re-installed via the mating device. After the transfer cask bottom lid is re-installed, the canister is lowered to rest on the bottom lid and the canister lift slings may be detached from the canister. The transfer cask (with the canister inside) is then lifted off of the mating device and readied to transfer the canister to the HI-STAR 190 transportation cask.

As previously mentioned, the transfer cask containing the Holtec canister needs to be stacked atop the up-ended transportation cask with an interstitial mating device in between (Figure C.6). This allows removal of the transfer cask bottom lid after lift slings are reattached to the MPC and tensioned. The MPC can then be lowered into the transportation cask. After the canister is moved into the transportation cask, the mating device and transfer cask are removed and the transportation cask lid is installed. The transportation cask can then be downended and moved to the preparation area.

To transfer the MPC-37 into the transportation cask from the transfer cask requires a specially designed structure, known as a Cask Transfer Facility (CTF). If the stack-up operation is performed at grade-level, the CTF would reach approximately 40 feet high. It would require additional surrounding space and structural support to allow downloading equipment to be attached to the canister at the top. It also needs to provide for personnel access via mobile crane to facilitate downloading operations and must be seismically stable during the entire process. This type of CTF would present significant engineering challenges at SONGS because of the site’s high seismic loadings and space limitations. Figures C.7 and C.8 show two examples of above-ground CTF arrangements used with Holtec canister-based storage systems.

Alternatively, in-ground CTFs have been successfully used at several ISFSIs around the country to transfer Holtec canisters from transfer casks to aboveground storage overpacks. At SONGS, this concept would involve placing the empty transportation cask in a below-grade opening, with the top one or two feet of the cask protruding above the ground. The mating device and transfer cask would then be mounted atop the transportation cask using a VCT and the canister transfer would be performed, as described above. NWT investigated the potential use of one of the empty UMAX modules as a CTF. However, the UMAX cavity diameter is approximately 6 inches smaller than the diameter of the HI-STAR 190 transportation cask, even with the divider shell removed. Thus, the HI-STAR 190 transportation cask does not fit into a UMAX module for use as a CTF. Modification of a UMAX module to increase its diameter is not considered practical.

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156 Source: https://www.nrc.gov/docs/ML1432/ML14323A935.pdf
Figure C.7. Example 1 of Above-Ground Cask Transfer Facility\textsuperscript{157}

Figure C.8. Example 2 of Above-Ground Cask Transfer Facility\textsuperscript{158}

\textsuperscript{157} Ibid.

\textsuperscript{158} Photograph courtesy of Portland General Electric. Used with permission.
An in-ground CTF would require excavation of an approximately 9-foot-diameter opening to a depth of approximately 15 to 18 feet, placement of a foundation, and erection of the peripheral structure around the opening. At the surface, the CTF would also require a reinforced concrete pad around the opening to provide the access and structural support needed for the loaded VCT to perform canister downloading. Once the canister is downloaded into the transportation cask at the CTF, the mating device and transfer cask can be removed. The VCT is then used to install the transportation cask lid, lift the cask out of the CTF, and move the cask to the preparation area to be readied for shipment. Figures C.9 and C.10 show a graphical depiction of a generic in-ground CTF and the in-ground CTF used at the Diablo Canyon ISFSI, respectively.

A detailed technical evaluation should be performed for the SONGS Holtec canisters to select the appropriate CTF configuration, taking into account engineering and construction costs. In addition, because the HI-STAR 190 transportation package is shipped in a horizontal orientation, the evaluation needs to investigate when, where, and how the cask should be upended to receive canisters, prepared for transportation, and ultimately downended from the vertical position to the horizontal position for installation of the impact limiters and shipment offsite on a rail car. Upending and downending operations could be performed on a specially designed transport cradle (as envisioned for Yucca Mountain) or on a separate, purpose-built frame. These operational considerations are discussed below.

**Figure C.9. In-Ground Cask Transfer Facility**

![In-Ground Cask Transfer Facility](image)

Source: NRC Agency Documents Access Management System (Accession No. ML17310A222). A SONGS in-ground CTF would allow for the transportation cask to extend upward out of the CTF opening about two feet. Crane shown in lieu of VCT.
4.2.2 Transfer of Transportation Casks to Rail Cars on the SONGS Site

NWT considered two separate scenarios with regard to the movement of canisters, empty transportation casks, and assembled transportation packages and equipment around the SONGS site during transport package loading. As previously mentioned, the two different SNF canister designs at SONGS require different equipment and facilities. Once SNF canisters are placed in transport casks and prepared for shipment, the casks will have to be loaded on rail cars for transport. Two possible loading concepts and site infrastructure arrangements are outlined here. A detailed technical evaluation is needed to determine which is the better option at SONGS.

After the Holtec transportation cask containing the MPC-37 canister is removed from the CTF and prepared for shipment, it must be downended into the horizontal orientation and placed on a cradle for loading on the railcar. The TN canisters inside their transportation casks are handled entirely in the horizontal orientation. Of note, the location for the cask handling crane(s) must be carefully considered due to the significant weights involved (the crane itself plus the lifted load). The crane will weigh approximately 150,000 pounds, including its counterweights; transportation packages, including impact limiters, will add as much as another 421,000 pounds, approximately. The entire weight of this combined load will be borne by the foundation on which the crane sits. That foundation must be designed to support static, live, and dynamic loads during lifting operations.

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160 Mating device is hidden. Photo courtesy of Pacific Gas and Electric. Used with permission.
The first scenario involves restoring and extending the existing SONGS rail spur near the site’s current administration building down to the ISFSI and installing a crane pad adjacent to the rail spur. Cask rail cars could then be moved down to the ISFSI, directly loaded with transport casks, and subsequently moved again—either to a staging spur or to be linked directly to a rail consist.

The second scenario extends the existing structurally-reinforced roadway from the existing rail spur, approximately where the site administrative building currently stands to a point south of the ISFSI. A wheeled, self-propelled modular transporter (SPMT) would ferry loaded transport casks from the ISFSI, along the roadway eastward, and then northward, up the hill, to the rail spur. At that location, a second crane would transfer transport casks from the SPMT to rail cars.

As discussed in Section 4.2.1, the TN canisters are more straightforward to load into transport casks than the Holtec canisters. The TN transportation cask is loaded at the ISFSI on a transfer trailer that is pulled by a tractor. The transfer trailer can then be simply moved to a point adjacent to the cask crane located south of the ISFSI to prepare the cask for transport. After preparation is complete, the TN transportation package can be lifted from the transfer trailer directly onto the shipping cradle on the rail car or the SPMT.

By contrast, the Holtec transportation cask needs to be lifted out of the CTF and moved with the VCT to a preparation location, and then to a downending station. At the downending station, a crane (or perhaps the VCT) is used to transition the package from the vertical to the horizontal orientation on a cradle. Once horizontal and securely fastened, the Holtec package must be lifted and moved from the downending station onto the rail car or the SPMT.

Figures C.11 and C.12 show layouts for both the SPMT and direct-to-rail loading scenarios, including potential locations for the CTF, cask crane(s), and downending station. The relative locations of the crane pad(s), CTF, downending station, and rail car/SPMT must be considered carefully to ensure that the crane will have sufficient reach to handle the necessary loads and distances to conduct these operations. There will also be a trade-off in cost and complexity between the two scenarios.

Recovering and extending the rail spur down to the ISFSI with the necessary structural reinforcement is likely to be more costly than installing a roadway capable of supporting the SPMT and transport cask. However, the SPMT option requires two crane pads and cranes, as well as the SPMT itself. The SPMT option also involves an additional rigging step, which increases operational complexity and risk. Lastly, it is unclear, without a more detailed investigation, whether a consist with one or more loaded cask rail cars could negotiate the incline to the upper level to exit the site in the available space. All of this needs to be investigated in a more detailed evaluation of technical, operational, and cost considerations.

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162 The portion of the on-site rail spur inside the former plant area has not been removed, but has been covered with asphalt.
Figure C.11. Scenario 1: Recover and Extend the Onsite Rail Spur to the ISFSI

Figure C.12. Scenario 2: Extend the Onsite Reinforced Concrete Roadway to the ISFSI
4.2.3 Actions for the SONGS Co-Owners to Consider

Chapter 8 highlights several steps and priority actions that the SONGS co-owners may want to consider to ensure transportation readiness. Those steps are strategic in nature. The four actions below are more tactical in nature and specifically relate to decisions and preparations at the SONGS site that will facilitate shipments once a destination site becomes available.

- Determine whether it is more cost-effective to have TN upgrade the MP187 package CoC to meet current regulations, versus certify the SONGS-1 SNF and GTCC waste canisters as approved contents in the MP197/197HB CoC. Either way, a CoC amendment is required. If the MP197/197HB packaging will be used for all TN DSCs, spacers and sleeves will likely be required so that the canister fits properly in the MP197/197HB cask.

- Review the SONGS decommissioning quality assurance plan (DQAP) to determine if program changes are necessary for SNF shipments and make changes accordingly.

- Develop a template for canister documentation packages based on NRC regulations and on the expectations of the receiving facility, and then assemble a pilot documentation package for one canister. This process will allow SCE to identify any gaps in documentation that may need to be addressed for all canisters and to modify the template as needed to facilitate the preparation of future documentation packages.

- Review and document the compliance status of each SNF and GTCC waste canister and its contents against the current revision of the applicable transportation CoC (including specific revisions to package drawings). Establish ongoing maintenance of these documents as CoC amendments are issued for each of the cask designs required.
APPENDIX D
Highway and Barge as Modes of Transportation for Relocating SONGS SNF
1. **Highway**

To travel by highway, SONGS SNF would have to be loaded on super-heavy-haul trucks—that is, a category of trucks that exceed the dimensions and weights of most states’ “routine permit limits.” Such trucks are limited to travel on specialized routes, as determined by individual states. Selected routes would be subject to a detailed route analysis by the transportation regulator for each state transited by the SNF shipments. Typically, the route analysis would include a physical survey, as well as engineering analyses, to ensure that the weight and dimensions of planned shipments can be safely supported by the route. State regulators also examine overpasses; weight limits on bridges, culverts, and roadways; and the need for road closures and other safety precautions (such as removing power lines). Only after this type of analysis is complete will states issue a permit. The permit, in turn, typically specifies the route on a turn-by-turn basis, and includes other stipulations with respect to maximum speeds, allowed times for movement, and any additional restrictions.

This over-dimensional route survey and permitting process would have to occur in addition to, and in parallel with, the NRC’s route survey and approval process. The NRC requires that the routes used for truck shipments of SNF must be as short and direct as possible, bypass city centers, and remain on interstate highways whenever possible. The shipper is required to provide a physical route survey. In addition, the NRC’s route survey examines mobile phone coverage, safe parking areas, food and subsistence stops, jurisdictional boundaries for law enforcement, and a number of other issues as recommended by NRC NUREG-0561.

These overlapping routing requirements present a potential difficulty in that the shipper is now subject to two separate sets of regulations, which can produce conflicting route choices. For example, the state DOT may require a circuitous route to avoid a bridge, but this non-direct route must then be justified to the NRC. Thus, shippers have to interface with states and the NRC to find routes that are acceptable to both.

Super-heavy-haul trucks require specialized trailers, tow bars, and multiple tractors, which increases complexity, leads to higher costs per shipment, and requires longer acquisition lead times. The size of the SNF cask, its transport cradle, and the transport vehicle, can exceed 90 feet in length, 12 feet in width, and 16 feet in height; the combined weight of these elements, not including the weight of the SNF or GTCC waste itself, could reach approximately 420,000 pounds. Road closures are often required to allow for the safe passage of shipments of this size and weight.

Shipping SNF by heavy-haul vehicle also entails a highly visible and extended operation. Transit speeds will be slow in comparison to normal traffic flow and could be disruptive to other traffic. Interaction with state, tribal, and local entities will be required to obtain the necessary permissions to transit via public and private roadways. Individual jurisdictions can impede or limit the use of roadways by imposing restrictions with respect to the weight, dimensions, or hazard class of materials being transported. These possibilities are further complicated by issues related to interstate commerce and the movement of goods and materials.

Finally, shipping by super-heavy-haul trucks would increase the number of shipments required to de-inventory the SONGS site. Each super-heavy-haul truck can only transport one package, whereas one rail shipment can transport more than one package. The increased number of shipments to de-inventory SONGS by truck would also increase the overall risk of highway accidents. The relative risk of truck versus rail shipping campaigns was analyzed thoroughly in the Yucca Mountain Repository Environmental Impact Statement: Risks for rail transport were found to be lower than for truck
transport. Studies by the DOT have also shown that freight shipments by rail are safer than comparable shipments by truck. 163

Heavy-haul truck could be used to reach a rail head or barge slip, if needed, and may be required for the final portion of shipment to a receiving facility depending on that site’s transportation infrastructure. Also, as discussed in Appendix C, it may be advantageous to use a truck-like conveyance on the SONGS site to facilitate moving transportation packages from the ISFSI to rail cars. However, with the rail spur arrangement at SONGS, heavy-haul truck transport is generally considered a secondary, and unlikely option for the end-to-end SNF shipping process (a possible exception might be if the receiving site is nearby and does not have rail access). This may require a transfer from rail to heavy haul truck, although both private entities seeking licenses for consolidated interim storage facilities (CISFs) as of the writing of this report (i.e., Holtec and ISP) either have or plan to have rail access into their sites.

2. **Barge**

There are no navigable inland waterways between the SONGS site and the southwestern United States, where a potential receiving facility for the SONGS SNF would most likely be located. Therefore, the only possible water-borne transport option would be to ship SNF via coastal barge to a more favorable rail or highway route, or to an ocean vessel that can transit the Panama Canal. Further, because there is no barge slip at the SONGS site (the nearest barge slip is at the Del Mar boat basin 15 miles to the south164), this approach would require a multimodal transportation plan: The SNF package(s) would have to be transported by rail or super-heavy-haul truck from SONGS to a port or barge slip where the package(s) would be loaded onto a vessel. The same barge offloading transfers would then have to occur at the receiving port to ultimately bring the SNF to the receiving facility. Because barge travel necessitates a multimodal transportation model and therefore entails increased complexity, as well as increased cost, it would be a highly unfavorable option.

Barge travel does have high throughput capacity because as many as 20 casks could be loaded in a single barge shipment. But because this number of casks exceeds the maximum that could be transported by rail or road to and from the barge slip or port, the land-based modes of transportation would still be a limiting factor. Barges would also remain partially loaded in port over the course of the loading process as casks are added one at a time. This introduces additional complexities in terms of security and logistics relative to using rail as the sole mode of transport away from the SONGS facility.

ANSI Standard N14.24-1985 identifies the organizations, equipment, operations, and documentation involved in barge shipments of radioactive materials between U.S. ports by inland waterways and in coastal and ocean service.

Figures D.1 and D.2 help to illustrate why barge transport, though theoretically possible, is not considered a viable option for relocating the SONGS SNF. Any movement to a hypothetical storage facility or repository located in the southwestern United States from ports in the eastern and midwestern United States would require ocean transport and transit through the Panama Canal. The Panama Canal authority was opposed when shipping the SONGS Unit 1 reactor vessel through the canal

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was being considered; it is highly likely the authority would be similarly opposed to shipments of SNF through the canal.

**Figure D.1. U.S. Inland Waterways**

![U.S. Inland Waterways](image1)

*Note: Graphic courtesy of U.S. Army Corps of Engineers study, USACE Institute for Water Resources.*

**Figure D.2. U.S. Coastal Navigable Waterways**

![U.S. Coastal Navigable Waterways](image2)

*Note: Graphic courtesy of U.S. Bureau of Statistics (GIS Overlay).*

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3. Transload/Multi-Modal

Shipments that involve multiple modes, and therefore the transfer of SNF from one mode to another (e.g., from barge to rail or from rail to heavy-haul truck), generally increase logistical complexity—therefore shippers tend to avoid them when practicable. The use of barge transport to reach a land-locked destination, for example, will necessarily require one or more transfers between modes, which would be conducted at what is referred to as a transload site. Since there is rail access to the SONGS site, it is unlikely that multi-modal shipments would be used to remove SNF from the site.
APPENDIX E
Template for a Typical, Shipment-Specific Transportation Plan
This appendix outlines the contents of a typical shipment-specific transportation plan that would be used to communicate operational details to regulatory agencies and other organizations with direct involvement in the movement of SNF. Although the contents of this plan would not contain information that would be considered “Safeguards Information” (SGI), transmittal of the plan would likely be limited to those with a “need to know.” Distribution of some components of the plan, such as the Security Plan, may be further limited to law enforcement or escort personnel.

**Table of Contents for a Typical Spent Nuclear Fuel Transportation Plan**

1.0 INTRODUCTION

2.0 BACKGROUND

3.0 PURPOSE/NEED FOR SHIPMENT

4.0 LOGISTICS OVERVIEW
   4.1 Organizational Responsibilities
   4.2 Typical Shipment Schedule/Duration
   4.3 Advance Notification Information/Shipmen t Tracking
   4.4 Emergency Management Considerations
   4.5 Inspections and Additional Activities for Safe Routine Transportation

5.0 PUBLIC COMMUNICATIONS PLANS AND PROCEDURES
   5.1 Plans for Communication with Media

6.0 CONTINGENCY PLANS FOR DELAYS OR CHANGES IN SCHEDULE

7.0 REFERENCES

APPENDICES

A. Shipment Routes

B. Security Plan

C. Public Communications Plan

D. Points of Contact for Participating Organizations

E. State/Tribal Shipment Requirements

F. Summary of Notification Information

G. Emergency Management Plan
APPENDIX F
Readiness Review
A detailed readiness review is necessary prior to initiating any shipping operations. This review will be orchestrated by the shipper. It will include a master checklist of all readiness items necessary to ensure the safety, security, and regulatory compliance of the shipping campaign. The review checklist would logically be broken down by areas of responsibility. SCE would work with the highest-tier organization involved in the campaign to ensure that the list is comprehensive and that SCE has met all obligations and commitments prior to commencing shipments.

SCE may choose to implement individual, area-specific reviews to verify readiness for defined stages of the campaign, as needed. These reviews will allow the project to transition smoothly from the formulation and planning phase to the operations phase. Table F.1 lists items that would be evaluated in a readiness review.

Table F.1. Readiness Review Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Success Criteria</th>
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</thead>
<tbody>
<tr>
<td><strong>Infrastructure – SONGS</strong></td>
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<td><strong>Staffing</strong></td>
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<td>Management / Administration</td>
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<td>Public information – outreach</td>
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<td>Training and certification</td>
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<td>Safety culture</td>
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<td>Operations</td>
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<td>Health physics</td>
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<td>Quality assurance</td>
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<td>Transportation / logistics</td>
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<td>Security</td>
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<td>Maintenance</td>
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<td>Testing and control</td>
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<td><strong>Site Infrastructure</strong></td>
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<td>Rail on-ground assets</td>
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<td>Track / sidings</td>
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<td>Switches car movement</td>
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<td>Gates, access areas, inspection facilities</td>
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<td>Lifting and handling, material movement</td>
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<td>Crane</td>
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<td>Transfer systems</td>
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<td>Rigging gear, specialized devices</td>
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<td>Specialized movers/power</td>
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<td>Buildings and support equipment</td>
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<td>Power, utilities, site services</td>
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<td>Item</td>
<td>Success Criteria</td>
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<tr>
<td>Security assets</td>
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<td>Surveillance, camera systems</td>
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<td>Barriers, fencing, access control</td>
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<td>Tracking assets / hardware</td>
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<td><strong>Transportation Hardware Assets</strong></td>
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<td>Transportation packages</td>
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<td>Support equipment</td>
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<td>Leak test equipment</td>
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<td>Maintenance and remediation equipment</td>
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<td>Rolling stock</td>
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<td>Cars – SNF, buffer, escort</td>
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<td>Consist</td>
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<td><strong>Software Readiness – SONGS</strong></td>
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<td>Permits – Licenses</td>
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<td>Coastal permit – site</td>
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<td>Required transportation permits</td>
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<td><strong>NRC Requirements</strong></td>
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<td>Site licenses</td>
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<td>Subpart H, Quality Assurance Plan</td>
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<td>Packaging – CoC</td>
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<td>Packaging maintenance</td>
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<td><strong>Contracts / Agreements</strong></td>
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<td>Security</td>
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<td>Receipt facility</td>
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<td>Operational procedures</td>
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<td>Packaging</td>
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<td>Test and inspection</td>
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<td>Radiological – RADCON, Health Physics</td>
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<td>Shipping</td>
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<td>Tracking and monitoring</td>
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<td>Administrative procedures</td>
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<td>Material transfer (MCC – 741)</td>
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<td>Operational checklists, controls</td>
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<td>Notifications</td>
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<td>Emergency management</td>
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<td>Storage, receipt, and dispatch</td>
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<td>Verification of site licenses</td>
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<td>Threat / transport assessment</td>
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<td>Readiness to receive</td>
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APPENDIX G
Shipments Security Considerations
1. **Template for a Security Plan**

1.1 **Administrative Requirements**

1.1.1 **Scope and Applicability**

The shipment or campaign to which this security plan applies is described, and a statement must also be made with regard to what this plan does **NOT** cover.

1.1.2 **Roles and Responsibilities**

All participants with a security responsibility are named down to the position/title level and their responsibilities with respect to the transportation security system are described in detail.

1.1.3 **Policies and Operational Procedures**

This section addresses administrative requirements for transportation security. Specifically, it describes the security methodology (i.e., detect, delay, and response), any evaluations or performance testing or exercises relating to the security plan, the review and update regime, and reporting requirements in the event of a security incident. Additionally, this section describes the security system’s response to higher-level indirect threat conditions (i.e., how the security system will respond if a major catastrophic event disrupts transportation while a shipment is in motion).

1.1.4 **Training Requirements**

The training requirements of all personnel with a security function are described, including the regulations which mandate these training requirements.

1.1.5 **Information Management**

This section addresses records retention and the information protection strategy for preventing unauthorized access to “Safeguards Information” (SGI).

1.1.6 **Trustworthiness of Personnel**

Background check requirements for all personnel who will be granted access to SGI or unescorted access to the material must be described in this section, including the applicable sections of 10 CFR 73 that mandate these requirements.

1.2 **Shipment Security**

1.2.1 **Description of the Nuclear Material to be Transported**

The nuclear material in each shipment must be described in detail, including:

- Grams of fissile material.
- Security category that the amount of material invokes (per 10 CFR 73, definitions section).
- Total amount of radioactivity contained in the shipment in terabecquerels.
- NRC and DOT regulations that govern the shipment based on the security category and radioactivity.
1.2.2 Description of the Transport Physical Protection System

The physical protection system is comprised of those physical devices, administrative measures, and security operational procedures that assist with detecting a security incident, delaying the adversary from completing their task, or responding to a security incident. This includes the following items:

- A detailed description of the packages and conveyances, and how they aid in the security of the shipments.
- Planned and alternative routes and modes of transport, including the safe havens and local law enforcement jurisdictions through which the shipment will pass.
- Physical protection measures, such as security alarms, tracking systems, locks, seals, the NRC approved vehicle immobilization device, etc.
- Communications and positional tracking protocols for normal operation, including check-in intervals and communications methods.
- The movement control center, its capabilities, and staffing.

1.2.3 Maintenance and Testing of Systems and Equipment

A routine maintenance program must be established for each system and piece of equipment with a security function. This section describes the maintenance routines.

1.2.4 Pre-shipment Checks

Prior to shipment departure, each security system must be tested and the results of these tests must be documented to show conformance. Additionally, a Commercial Vehicle Safety Alliance (CVSA) Level VI inspection will be performed to ensure that each highway package and conveyance is properly prepared for transport and in sound mechanical condition.

1.3 Response Planning

The security plan must include a clear statement that the licensee who is responsible for preparing the plan cannot dictate the actions of emergency and security responders. The security plan applies only to the actions of those security personnel who are subject to the licensee’s authority and shows how those personnel will support any type of response.

1.3.1 Security Arrangements

This section describes arrangements and communications with all local law enforcement responders along the route, the NRC, and any DOE assets involved in the shipment or in supporting a security response.

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166 This includes any private security escorts; however, these individuals have highly prescriptive training requirements found in 10 CFR 73 and it is recommended that the licensee defer to their expertise and simply perform an audit on their internal response procedures to ensure their adequacy and incorporate them here by reference.
1.3.2 Contingency Plans

These are the specific actions to be taken by licensee personnel in support of a security response. Items such as providing radiological expertise, communications coordination, tracking information, and other informational assets should be included. Additionally, this section can incorporate the response plans of the escorts by reference.

1.4 Incident Communications, Command, and Control

This section describes the flow of information and the licensee’s command and control system for information flow. The lead security response agency will likely establish a joint operations center (JOC), which would act as the primary incident command (IC) center. Thoroughly exercising this capability and recording this exercise as part of Section 1.3 above is recommended.

1.5 Informational Supplements

This section should include items that may aid in supporting a security response, such as:

- Points of contact and phone numbers for all licensee personnel and all law enforcement along the route.
- A copy of the NRC route approval.
- A copy of state and tribal notifications.
- Emergency response guide (ERG).
- The shipment’s bill of lading.

2. Safeguards Information Under NRC Regulations

Information that is protected as “Safeguards Information” (SGI) under NRC regulations is limited to the schedule, contents, and security arrangements for shipments of SNF. Other shipment information is available for sharing with state and tribal governments, other external stakeholders, and the public. Examples of available information include information that explains why the shipments are occurring; who is responsible for the shipments; the very conservative precautions taken to ensure safety—including with respect to the robustness of the casks (design, construction and testing), security measures, escorts, real-time tracking (TRANSCOM), route selection process, emergency response readiness and assets from the state and federal governments that can assist—and a general timeframe for shipments. This information could be provided in the form of fact sheets or short videos. Routing of shipments is not protected as SGI; however, a broad distribution of routing information may be best limited to organizations on a need-to-know basis.

2.1 Summary of Information Protection Regulations

This section provides an overview and summary of general requirements for the protection of information relating to SNF shipments. Certain types of information associated with commercial SNF transport are classified as SGI, and the specific regulations that apply must be referenced to ensure that they are met during implementation.
2.1.1 Types of Protected Information

Certain pieces of information pertaining to the transportation of SNF are prohibited from being released by NRC regulations (10 CFR 71.21 through 71.23). This information is classified as SGI. SGI is protected before, during, and for 10 days following the completion of a shipment, OR for 10 days following the completion of a shipping campaign.\footnote{To clarify with an example, this means that the security plan used during the first SONGS shipment remains protected as SGI until 10 days after the completion of the final shipment because much of the information would remain unchanged.} Transportation-specific information that must be protected from public release includes:

- The security plan for shipments
- Schedules and itineraries for shipments
- Details on vehicle immobilization devices, intrusion alarms, and communications systems
- Arrangements with, and capabilities of, police responders
- Locations of safe havens on the route
- Limitations of the communications system used during transport
- Security response procedures
- Information relating to tactics and capabilities required to defend against theft or sabotage
- Engineering or safety analyses that could be reasonably utilized as an information source to enable sabotage or theft.

2.1.2 Information Access

Organizations that possess, generate, and distribute SGI must maintain an SGI handling policy, an access-controlled GSA-approved locking safe, a shredder capable of the specified destruction requirements, and a log of all SGI generated and its storage location. Additionally, the organization must designate an individual as the “adjudicating official” who decides on behalf of the organization who is granted or denied access to SGI.

Access to SGI requires a “need to know,” meaning that an individual requires access to this information to perform his or her duties related to the shipment. In addition to establishing need-to-know, individuals are required to be subjected to fingerprinting and an FBI criminal history check. The adjudicating official must also undergo these requirements before assuming his or her duties. The adjudicating official is then responsible for reviewing the criminal history checks of other individuals within the organization, and for making a determination—after receiving a favorable criminal history check and verifying need-to-know—that the person can be considered “trustworthy and reliable.”

Certain individuals are exempt from the fingerprinting requirement. They include:

- NRC or executive branch federal employees who have undergone previous fingerprinting
- Members of Congress
- Employees of a member of Congress who have undergone prior fingerprinting
• The comptroller general or an employee of the Government Accountability Office who has undergone prior fingerprinting
• The governor of a state or his or her designee.
• A foreign government representative under specific circumstances and under specific NRC approval
• Federal, state, and local law enforcement personnel
• State radiation control program directors and state homeland security advisors
• Agreement state employees conducting inspections on behalf of the NRC
• IAEA representatives engaged in international safeguards verifications who have been approved by the NRC
• Any agent, contractor, or consultant of the aforementioned who has undergone an equivalent criminal history and background checks
• Tribal official or the tribal official’s designee.

2.1.3 Information Transmission, Use, and Storage

SGI must be conspicuously marked as such at the top and bottom of each page. It must remain under the direct control of an individual authorized for access or locked in an unmarked safe at all times. All individuals with access to this safe must be authorized for access to SGI.

In order to transmit SGI outside an organization, the sender must verify that the intended recipient is authorized by his or her organization to receive SGI or is exempt per one of the bullets included above in Section 2.1.2. This verification must be documented, so it is common to receive a letter from the receiving entity listing the names of individuals authorized for SGI access. Individuals are subject to NRC enforcement actions if they transmit SGI to an unauthorized individual.

The document must be in hard copy, enclosed in an envelope clearly marked as SGI on the front and back, and then enclosed in a second unmarked opaque envelope, addressed to the specific recipient of the SGI. It may be sent via a common carrier or the U.S. Postal Service. SGI may be transmitted electronically only via NRC-approved secure devices on a case-by-case basis.

Any computer used to process and generate SGI must be isolated from the internet and only individuals approved for SGI can have access to the computer. Electronic SGI information must be stored on a removable hard drive that is stored in a locked safe.

3. Route Security Planning

3.1 Security Considerations and Concepts

The security measures developed for the first shipment from SONGS will also serve as the template for additional follow-on shipments as part of the greater shipping campaign. However, as circumstances change regarding threat levels, routes, and other contributing factors, changes or modifications to the transportation security plan (TSP) may be warranted. The security measures identified and accepted as security system protocols for the shipment and campaign will utilize a graded approach based on the risks associated with transporting SNF within the United States.
3.2 Security Coordination

Coordination must occur among the NRC, the licensee (i.e., shipper), and law enforcement agencies that would be directly involved in escorting the shipments or in serving a secondary security role.

3.3 Security Approach

The security approach required by NRC regulations and DOE orders focuses on the principles of detection, delay, and response. Security measures aim to ensure that malevolent acts are detected by close and continuous surveillance by shipment escorts, and that the time required for an adversary to breach the SNF container is longer than the response time of law enforcement so as to ensure interruption of the adversary’s act and eventual neutralization of the adversary’s ability to complete their task.

The regulatory requirements found in 10 CFR 73.37 and 49 CFR 172.802 provide guidance as to the physical security measures, security planning, and risk assessments that make up the transportation security system for material movements. The principles of detection, delay, and response are addressed in the aforementioned NRC and DOT requirements and, when applied to SNF shipments, provide assurances that the security system would have high system effectiveness, which lowers the risk associated with shipments.

3.3.1 Physical Protection Measures

The physical security measures found in NRC regulations provide the basis for any transportation security program. This program or security system, when applied during shipping operations, provides assurances that the risk to material in transit is low. The following general requirements are found in NRC 10 CFR 73.37 and would be addressed and implemented in detail in the shipment-specific security plan developed during Phase III. However, they must be considered when planning operations, logistics, and training programs because security is a crosscutting function, and will impact all other elements of a transportation system.

3.3.2 General Security Requirements

- Identification of “safe havens” along approved routes
- Required 10-day notifications to the NRC and information sharing and coordination with shippers, consignee, carriers, state and tribal governments
- Protection of SGI
- Protection of schedules and itineraries for specific shipments
- Identification of vehicle immobilization features, intrusion alarm devices, and communications equipment
- Advance planning and coordination with law enforcement response forces
- Limitations of communications (i.e., dead spots) during transport
- Contingency procedures for response to security events
- Maintenance of a staffed and equipped movement control center with the following capabilities:
- Authority to coordinate physical protection activities responding to safeguards incidents on a 24-hour basis, seven days a week
- Ability to maintain a written log of each SNF shipment and include information pertaining to significant events
- Random communication checks with shipment escort not to exceed 2-hour intervals
- Implementation of preplanned procedures in response to deviations from the authorized route
- Notification of actual, attempted, or suspicious activities related to theft, loss, diversion, or radiological sabotage of a shipment
- Identification of contact information for appropriate local law enforcement agencies along the route.

- Security procedures that address:
  - Roles and responsibilities
  - Movement control center personnel
  - Conveyance operators
  - Armed escorts
  - Other personnel or entities with shipment security responsibilities

- Communication protocols and strategies for the use of authentication and duress codes
- Two-way communications between the transport, escort vehicle, movement control center, local law enforcement, and one another.
- Armed escorts that are either law enforcement or private security personnel who have met the training requirements found in 10 CFR 73
- Constant visual surveillance of the shipment by the escorts
- Development, maintenance, and implementation of contingency response procedures to address threats, theft, and radiological sabotage and, upon detection of a malevolent or off-normal event, to undertake the following actions:
  - Assess the situation;
  - Implement response procedures;
  - Take necessary steps to delay or impede threats, theft, or radiological sabotage; and
  - Notify local law enforcement of the threat and request assistance without delay and within 15 minutes of detection.

### 3.3.3 Personnel Security

Individuals, agencies, and organizations involved with a shipment must have the ability to conduct background investigations or have a clearance process to receive sensitive information regarding the SNF shipping campaign. All personnel with access to sensitive shipment information must have a verifiable need to know that information. Law enforcement officers are exempt from this requirement.
APPENDIX H
Generic Shipment-Specific Emergency Response Plan Table of Contents
Generic Shipment-Specific Emergency Response Plan Annotated Table of Contents

1. Introduction

• The responsible party
• The participating entities
• Reason for the shipments

2. Notifications and Communications

• Designated transportation communications center role and staffing
• En route satellite tracking system used and who has access

3. Emergency Preparedness

• Responsibilities of the state, tribal, and local authorities
• Responsibilities of the shipper
• Responsibilities of the carrier
• Training resources and technical expertise available to shipper, carrier, and state, tribal, and local authorities

4. Emergency Response

• Responsibilities of the carrier include making notifications, undertaking first aid actions, initiating incident scene control, providing assistance to first responders, and undertaking other emergency actions, as described in the (mode) carrier transportation plan.

• First responders, as defined by each corridor state/tribe, will respond to the incident scene and initiate response actions in accordance with local plans and procedures and the Emergency Response Guidebook (latest edition). Guide 165 applies to the materials involved in SNF shipments and provides information on potential hazards, public safety concerns, and emergency response actions. Emergency response information accompanying the shipping papers, normally available to responders in the vehicle or accessible via satellite tracking (when TRANSCOM is the tracking system used), should also be consulted. The most recent ERG or other appropriate guidelines should be used for the initial response to other hazards that could be involved at the incident scene. In all cases, the incident commander (IC) for response to SNF shipments will be a local, state, or tribal authority. If state, tribal, or local responders have additional procedures that provide more specific guidance, then responders will follow those procedures.

• State-level hazardous materials (hazmat) or radiological response teams: Many states maintain specialized hazmat and/or radiological response teams that may be activated to provide technical assistance and mitigation during emergencies. State teams are activated by the IC or other appropriate state or local authority.

• Federal support for emergency response is available through the National Response Framework. State, tribal and local emergency responders are trained in the context of this framework and are
familiar with the expanded support that is available at their discretion. Emergency response is managed at the most local level possible.

- **Shipper activities and responsibilities:** The shipper has lead responsibility for the safe and efficient transport of SNF from the site of origin to the destination. To support these shipments, the shipper must ensure the following actions are taken:
  - Shipments are monitored on a 24-hour basis by the MCC.
  - Notifications are completed in accordance with established MCC procedures.
  - Emergency response actions are implemented in accordance with established procedures if the emergency duty officer in the MCC declares an operational emergency for an accident involving these shipments.
  - For incidents/accidents, the DOE regional coordinating office is notified of the affected region and assistance requested and notifies and coordinates with local, state, and tribal authorities.
  - Through the MCC, shipment-specific technical information is provided to affected local, state, and tribal authorities.
  - Radiological assistance is requested, including deployment of DOE’s Radiological Assistance Program (RAP) team(s), upon request by DOE or by the appropriate state or tribal authority. The appropriate state or tribal authority is notified prior to deployment of a region’s RAP team.
  - If an incident/accident occurs that requires a lengthy mitigation/recovery period, the shipper will coordinate with the appropriate state and federal agencies to identify additional technical resources (programmatic, public information, and/or security personnel) to deploy to the incident scene. These federal representatives will provide additional technical assistance and support to the responsible on-scene authority.
  - If an accident occurs that requires the establishment of a temporary federal multiagency coordination center (i.e., joint field office), the shipper will coordinate with DOE headquarters and the regional coordinating office in the affected region to designate a senior official to represent DOE in the unified coordination group. The senior DOE official is responsible for coordinating the DOE radiological emergency response assets deployed to support the event.

- **Regional RAP team(s)** – DOE’s RAP is administered through nine regions. RAP teams provide radiological monitoring and assessment services and advice/consultation to assist in resolving incidents/accidents involving radiological materials. DOE RAP teams can be requested by state or tribal authorities if additional technical assistance is needed to respond to an incident. If DOE is called upon to provide this assistance, the actions of its RAP team(s) will be in accordance with DOE Order 153.1 and the regional RAP response plans. RAP team(s) will take the following actions:
  - Upon request by DOE or the appropriate state or tribal authority, deploy to the incident scene. The RAP team leader will report to the IC and/or the state or tribal on-scene authority to provide radiological advice and/or assistance to resolve the incident/accident.
  - Provide radiological monitoring services and compare/confirm findings with other radiological teams at the scene.
- Provide an assessment and evaluation of the radiological data and provide advice and consultation to mitigate the radiological consequences of the incident/accident.
- Provide a copy of all data collected to the IC and/or the state or tribal authority on-scene.
- Provide information regarding the DOE response (if DOE is the shipper) and support public information activities at the incident scene or joint information center (if established).
- Request additional DOE emergency response assets, if required.
- Provide access to additional DOE or DOE-contractor technical experts for advice on the characteristics of the materials, mitigation activities, transport packages, etc.

5. Recovery

The carrier has primary responsibility for package and transporter recovery operations in case of an accident. Recovery will not begin until the emergency phase of any incident/accident is terminated, following a decision that no radiological or other hazard is present. Recovery operations will be coordinated with the IC and/or the state or tribal authority on-scene. The shipper will assist the carrier in recovery operations, where appropriate.
### Example SNF Emergency Response Contact List

<table>
<thead>
<tr>
<th>Agency</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipper’s Movement Control Center</td>
<td></td>
</tr>
<tr>
<td>DOE Region 2 Regional Coordinating Offices</td>
<td></td>
</tr>
<tr>
<td>DOE Headquarters Watch Office (if DOE is shipper)</td>
<td></td>
</tr>
<tr>
<td>Nuclear Regulatory Commission (NRC) Headquarters Emergency Operations Center</td>
<td></td>
</tr>
<tr>
<td>TRANSCOM Control Center (or other satellite tracking system as used by the carrier)</td>
<td></td>
</tr>
<tr>
<td>Carrier Operations Center</td>
<td></td>
</tr>
<tr>
<td>State or Tribal Patrol Dispatch (for each state and tribe along the route)</td>
<td></td>
</tr>
<tr>
<td>State or Tribal Emergency Management Agency (for each state and tribe along the route)</td>
<td></td>
</tr>
</tbody>
</table>
Emergency Management and Training Guidance Plan for Spent Nuclear Fuel Transportation

1. Introduction

Emergency management is the organization and management of resources and responsibilities for dealing with all aspects of an emergency. The four basic elements of an effective emergency management program are:

1. Mitigation
2. Preparedness
3. Response
4. Recovery

As Figure I.1 depicts, emergency management is a continuous and dynamic cycle in which all four elements are dependent on each other.

![Figure I.1. Emergency Management Program (four phases)](image)

2. Purpose

An emergency management plan is a document that identifies the processes for dealing with emergencies to minimize impacts and facilitate recovery. As such, this appendix provides a high-level description of the emergency management framework for an SNF shipment or shipping campaign. Specifically, the appendix identifies: (1) roles and responsibilities for those involved in the process, (2) hazardous materials and radiological training available through federal agencies, and (3) potential funding sources for first responders.
This emergency management plan describes overarching strategies within an emergency management program for an SNF transportation incident. For purposes of this plan, an incident means a release, or potential release, of a material that may adversely affect human life, health, or the environment. Strategies within this plan include, but are not limited to:

- Communications
- Resources and assets
- Safety
- Responsibilities
- Response management.

3. Situation and Assumptions

3.1. Situation

- The responsibility for emergency management and response to an SNF transportation event is divided among the shipper, carrier, and governmental response entities at all levels (state, tribal, local and federal).
- Once the SNF transportation conveyance enters commerce, the carrier is responsible for specific emergency response actions.
- As is the case with any hazardous material in transit, SNF shipments are subject to delays, weather events, acts of terrorism, and other incidents that would cause the implementation of an emergency management plan.
- Because all emergencies and disasters start at the local level, local fire fighters, law enforcement, emergency medical services, and emergency managers are considered first responders since they will be the first individuals on scene for an accident/incident involving hazardous materials.
- The assurance of a well-prepared first responder community along shipping routes will help build the public’s confidence that SNF shipments moving through their jurisdictions can be conducted safely and securely.

3.2. Assumptions

- Any assessment of nationwide and specific threats in the context of future SNF shipments would be conducted in coordination with state, tribal, local, and federal law enforcement officials.
- Rail will be the mostly likely mode for SNF transportation from SONGS to a storage or disposal facility in the southwestern United States.
- Shippers of SNF are responsible for ensuring that an emergency response structure is in place prior to the commencement of a shipment or shipping campaign.
- The carrier of SNF will have an existing emergency response plan and be responsible for specific emergency response activities in coordination with the local and state incident command structure.
- In the event of a large-scale incident, local and state officials can request federal assets to assist with the response and recovery portion of the incident.
• Stakeholder communications will be a shared responsibility among the shipper, carrier, and incident command.

4. Basis and References

4.1. Basis

This emergency management plan is instituted under the authority of the shipper responsible for transporting SNF offsite from SONGS. The plan will be reviewed every three years (at a minimum), at the discretion of the shipper, to incorporate lessons learned or after an event that results in an after-action analysis that warrants changes.

4.2. References

SCE is expected, in accordance with 29 CFR 1910.120 (OSHA), to have properly trained individuals prepare SNF for transportation. Further, 10 CFR 73 (NRC) requires the licensee (this would be DOE if DOE is the shipper or the SONGS co-owners if the SONGS co-owners retain title to the SNF en route to a private CISF) to have contingency and response procedures in place to address accidents, threats, thefts, and radiological sabotage related to SNF in transit.

5. Mitigation (Prevention)

This phase includes any activities that prevent an emergency, reduce the likelihood of occurrence, or reduce the damaging effects of unavoidable hazards. Mitigation activities should be considered long before an emergency.

The shipper will undertake risk assessment and hazard mitigation activities to lessen the severity and impact of a potential emergency for the transportation of SNF. Mitigation begins by identifying potential hazards that may affect the organization's operations or the ability to conduct services. During the mitigation phase, SCE will identify internal and external hazards and take steps to reduce the level of threat they pose by mitigating those hazards or reducing their potential impact. Areas of vulnerability that cannot be strengthened sufficiently must be addressed in emergency plans.

5.1. Risk Analysis

As part of the mitigation process, the shipper will work with carriers of SNF to ensure a complete and extensive risk mitigation analysis as part of the route identification process. Rail carriers use the Rail Corridor Risk Management System (RCRMS), among other risk assessment tools. The RCRMS is a sophisticated routing tool designed to help select routes that pose the lowest safety and security risk based on the 27 factors listed in Appendix D of 49 CFR 800. The RCRMS analysis will identify key assets and evaluate consequence, vulnerability, and threat information to adequately assess risks facing the system.

Other models can be used to identify potential risks and assess routes. One of these tools is the Stakeholders Tool for Assessment of Radioactive Transport (START). Developed by DOE, START is a web-based geographic information system (GIS) tool that enables users to visualize more than 50 data layers relevant to radioactive materials transportation planning, including modal options, transportation infrastructure conditions, and emergency response assets. The tool also allows for evaluation of possible transportation routes by highway, rail, waterway, or multiple modes, and the incorporation of geo-
tagged imagery from facility site visits.\textsuperscript{168} START serves no regulatory function, only an informational one, and can be used by state and tribal officials to inform their input into the shipper’s route selection process. Currently, DOE has stipulated that START is for official use only, which constrains the use of START to shipments conducted by or for DOE and precludes its use for private shipments. Another GIS tool that DOE developed for modeling transportation routes is the Web-Based Transportation Routing Analysis Geographic Information System (WebTRAGIS). WebTRAGIS is deployed as a browser-based application interface; this routing engine is housed on a server at Oak Ridge National Laboratory (ORNL).\textsuperscript{169}

5.2. Additional Mitigations Steps

Further mitigation practices are available to the shipper, including:

- Validating goals and processes via a thorough review of the procedures used to identify risks and establish a hazards analysis. These procedures should be continually reviewed.
- Updating plans and procedures in response to the validation process or as new or changed hazards are recognized.
- Conducting reviews and program audits to help determine compliance with the plan and identify strengths and vulnerabilities.

5.3. Insurance Coverage

The shipper should meet with insurance carriers to review all insurance policies and assess its coverage for SNF shipments, loss of supplies and equipment, and potential infrastructure issues associated with a SNF shipment. The shipper should have a comprehensive knowledge of the Price-Anderson Act and how it applies to SNF transportation activities. Further, the shipper will ensure that carriers selected to transport the SNF have the appropriate insurance coverage, as required by U.S. DOT regulations.

6. Preparedness

Preparedness activities build organizational capacity to manage the effects of emergencies should an emergency occur. The shipper will need to develop plans and operational capabilities to improve the effectiveness of the organization’s response to emergencies. Specifically, the shipper will:

- Develop and update emergency plans and procedures;
- Work with carriers, regulatory agencies, state and local leaders, and other organizations on SNF transportation planning issues;
- Identify training, resources, and funding opportunities for emergency responders; and
- Conduct or identify emergency preparedness exercises.

6.1. Planning Development and Maintenance

Planning development and maintenance covers three objectives: (1) maintaining readiness of existing emergency management capability; (2) preventing emergency management assets from themselves falling victim to emergencies; and (3) if possible, augmenting the jurisdiction’s emergency management capability. After the emergency management plan is accepted for use, it should be reviewed in its entirety at least annually. The plan will also be reviewed following its activation in response to any emergency, following exercises and other tests (as organizational changes occur), and as policies and procedures require change.

6.2. Training of Staff

All employees involved in SNF shipments should receive training and be provided updates on emergency preparedness, including elements of the emergency management plan. Staff will be trained on the plan at least annually or at the discretion of management.

6.3. Identification of Training, Resource, and Funding for First Responders

The assurance of a well-prepared first responder community along shipping routes will help build the public’s confidence that SNF shipments moving through their jurisdictions can be conducted safely and securely. Although there is no mandate for a private shipper of SNF to ensure that first responders along shipping routes have the appropriate training, this section describes the training requirements for response to a hazardous material transportation incident. Further, a non-exhaustive list of potential training, resources, and funding mechanisms is identified to aid first responders.

As required by federal regulations, the shipper and carrier are responsible for emergency notification and communications in the event of an accident/incident involving SNF. However, the burden of responding to an accident will be the responsibility of first responders in the jurisdiction where the accident occurs. The scope of response actions will be determined by the level of hazardous materials training the local response community has received, in accordance with state and federal law.

OSHA’s 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, and the National Fire Protection Association (NFPA) 472, Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents Emergency Response Personnel Professional Qualifications establish the level of training required to fulfill various response roles, as summarized below:

- **First Responder Awareness Level.** Individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release.

- **First Responder Operations Level.** Individuals who respond to releases or potential releases of hazardous substances as part of the initial response at the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release.

- **Hazardous Materials Technician Level.** Individuals who respond to releases or potential releases for the purpose of stopping the release. These individuals assume a more aggressive role than a first responder at the operations level in that they will approach the point of release to mitigate the release of a hazardous substance.
• **Hazardous Materials Specialist Level.** Individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, their duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities regarding site activities.

Employers are responsible for training members of their workforce who handle hazardous materials, including SNF, to the appropriate level, consistent with their responsibilities. This includes local, state, and tribal emergency management agencies such as fire departments, DOT inspection and enforcement personnel, highway patrol officers, and other public safety officials who may come in contact with or handle hazardous materials as part of their job responsibilities.

**Identification of Relevant Training for SNF Transportation**

DOE Training Courses ([http://teppinfo.com/](http://teppinfo.com/)):

• Modular Emergency Response Radiological Transportation Training
• Compressed Modular Emergency Response Radiological Transportation Training
• Technician Modular Emergency Response Radiological Transportation Training
• Radiation Specialist (DOE shipments only but private training sources are available)
• Hospital Emergency Department Management of Radiation Accidents (DOE shipments only but private training sources are available)

DOE National Nuclear Security Administration (NNSA) ([http://www.ctosnnsa.org/](http://www.ctosnnsa.org/)):

• Radiation Instrument Employment
• Preventive Radiation/Nuclear Detection Team Operations
• Community Reception Center
• Technician Level Response Radiation/Nuclear
• Introduction to Nuclear Device Effects and Response Strategies
• Radiological Operations Support Specialist Training
• Population Monitoring at Community Reception Centers
• Operations Level Response to Radiological/Nuclear WMD for Emergency Medical Services/Healthcare

Centers for Disease Control and Prevention (CDC) ([https://www.cdc.gov/nceh/radiation/emergencies/training.htm#training](https://www.cdc.gov/nceh/radiation/emergencies/training.htm#training)):

• Rad Basics Made Simple
• Medical Counter Measures
• Myths of Radiation: Communicating in Radiation Emergencies
• Public Health Planning for Radiological and Nuclear Terrorism
Federal Emergency Management Agency (FEMA) ([https://training.fema.gov/is/crslist.aspx](https://training.fema.gov/is/crslist.aspx)):

- Radiological Emergency Management
- Radiological Accident Assessment Concepts
- Fundamental Course Rad Responders
- Advanced Radiation Incident Operations

Transportation Technology Center, Inc., Security and Emergency Response Training Center ([https://sertc.org/courses/](https://sertc.org/courses/)):

- Surface Transportation Emergency Preparedness and Security – Freight
- Hazmat/WMD Technician for Surface Transportation
- Highway Emergency Response Specialist

TRANSCAER ([https://www.transcaer.com/training](https://www.transcaer.com/training)):

- Rail Safety and Hazmat Emergency Response Training
- Multiple on-line training videos

**Useful Resources/Links for Radioactive Materials Response**

- TRANSCAER ([https://www.transcaer.com/resources](https://www.transcaer.com/resources))
- National Domestic Preparedness Consortium ([https://www.ndpc.us/](https://www.ndpc.us/))

**Potential Funding Sources for First Responders**

- DOE funding through the Nuclear Waste Policy Act (NWPA) (currently only available if shipments are conducted under the NWPA)

### 6.4. Exercises

Exercises are a core element of the preparedness phase. However, an effective exercise program impacts each phase of the emergency management cycle. Exercises identify vulnerabilities to address in the prevention-mitigation phase, allow entities identified within the plan to practice a response, and identify resource requirements, capability gaps, strengths, areas for improvement, and potential best practices. Exercises should test various plan provisions and should be evaluated. The following three types of exercises are used:
• **Tabletop Exercise.** A verbal walk-through or discussion of response procedures designed to evaluate plans and resolve questions of coordination and roles.

• **Functional Exercise.** A hands-on or physical demonstration of a specific function or operational capability.

• **Full-scale Exercise.** A hands-on test of the overall emergency management structure. A full-scale exercise may test part or all of the emergency response functions outlined in an emergency plan.

Exercises should be evaluated by personnel who are experienced in emergency management. A written record of the evaluation should be completed that summarizes the findings and analyzes player performance against plans and procedures identified during the exercise. Evaluations should be shared with management and revisions to the emergency plan should be made as required.

Both the DOE and NNSA conduct exercises in conjunction with carriers and jurisdictions along routes as part of their regular preparedness activities. Although there is no requirement that a private shipper of SNF conduct joint exercises with the carrier and jurisdictions along the route (outside of required readiness reviews), such exercises play a significant role in teaching emergency responders who may have little prior experience with SNF shipments. They can also serve as a communication tool with regard to assuring the larger public of the safety and security of SNF shipments.

7. **Response**

In emergency management plans, response is traditionally characterized as including the activities that address short-term, direct effects of an incident, including immediate actions to save lives, protect property, and meet basic human needs. These types of tactical actions for an SNF transportation incident will be conducted by the carrier and first responders. Response activities under the emergency management plan should include exchanging information, acting as a technical resource, informing the public, and liaising with stakeholders. These actions will take place in parallel with the response actions of others.

7.1. **Response Notification**

Procedures should be created for notifying individual staff members who will have a role in monitoring, assessing, and executing specific strategies and duties. The dissemination of incident notification and resulting expectations should be systematic and have built-in redundancy.

7.2. **Response Structure**

A standardized hierarchical structure that is scalable and identifies appropriate roles and responsibilities will need to be established. The command structures should replicate the incident command structure (ICS) commonly used in emergency management. The ICS ensures that the most pressing needs are met, and that resources are used without duplication or waste. At a minimum, the shipper’s ICS should include a response manager, technical advisor, public information officer, regulatory affairs manager, transportation staff, IT staff, legal advisor, and logistics manager.

7.3. **Response Communications**

Transparent and accurate communications with regulatory agencies, stakeholders, the media, etc., during and after a transportation incident, will contribute to a successful resolution of the problem and help build stakeholder and public confidence. Therefore, a communications plan should be developed.
This plan should be strategic and adaptable for transportation incidents of varying degrees of severity. Further, it should ensure that messaging is concise.

8. Recovery

Recovery includes the actions that are taken to return to normal or near-normal operating conditions. This phase is primarily concerned with actions that involve ensuring critical needs are being met, repairing and replacing damaged infrastructure, and ensuring operational stability. Recovery needs will depend on the severity of the incident. Therefore, the time to achieve recovery can vary. Much like the response phase, the recovery phase involves work undertaken in parallel by the carrier and local authorities. Recovery processes may include:

- Critical needs assessment
- Evaluation of critical transportation infrastructure
- Regulatory assessment
- Insurance and liability assessments
- Building stakeholder and public trust
- Transition into the mitigation phase.

9. Emergency Management Plan Revision Log

As planning and preparedness considerations are continually reviewed and updated, subject to need, changes must be approved by the SONGS co-owners and documented (example headings for such a log are provided below).

<table>
<thead>
<tr>
<th>Section Revised</th>
<th>Revision Date</th>
<th>Revision Detail</th>
<th>Performed By:</th>
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