APPENDIX B

EVALUATION OF ALTERNATIVE PORTS OF ENTRY

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This appendix describes the approach taken in this EA to the identification and evaluation of alternative ports of entry for subsequent shipment of the imported Pu-238 fuel to either the SRS or LANL.

B.1 IDENTIFICATION OF ALTERNATIVE PORTS OF ENTRY

In identifying alternative ports of entry, DOE considered all major ports on the Atlantic, Gulf, and Pacific coasts of the United States (U.S.) as described in CIGNA (1989). The alternative ports of entry considered in this EA have been identified in Table 2-1 of the main text. A total of 36 alternative ports of entry are considered, including 15 on the Atlantic Coast, 9 on the Gulf Coast, and 12 on the Pacific Coast. As addressed in this EA these port locations include both civilian and U.S. Naval port facilities in the area of each location identified. The majority of these ports are located in large metropolitan areas. In order to consider the effect of port area population density in the evaluation, several smaller ports with low population densities have been included. Ocean distances from St. Petersburg, Russia to each port of entry, the highway distances from each port of entry to SRS and LANL, and all supporting tables related to the transportation risks associated with these alternative ports of entry are presented in Appendix C.

Although a large number of smaller ports could have been included for evaluation, up to and including all ports in the U.S. having sufficient harbor depths to accommodate an ocean cargo vessel, DOE believes this would have been excessive in the context of NEPA with respect to the need to consider a reasonable number of alternatives. Other factors important in port evaluation relate to experience, facilities, security, and safeguards. Smaller ports are likely to be less suitable from an experience viewpoint in terms of the Russian familiarity with port entry/departure and facilities, and port experience with international cargo vessels delivering shipments of radioactive materials. It is less likely that port cargo handling facilities will be suitable in terms of capability of handling the type of cargo involved and the port capacity for handling cargo in a timely manner. Also, vessel turning and maneuvering areas are more restrictive in smaller ports. These factors in the case of smaller ports translate into reduced operating flexibility for port-related activities under the proposed action and, while not quantifiable, could adversely affect accident risk.

B.2 APPROACH TAKEN IN THE EVALUATION

A number of factors were considered by DOE in evaluating the alternative ports of entry. These included both quantitative and qualitative factors reflecting exclusionary and/or evaluative screening criteria. The exclusionary factors are essentially those described in the previous section related to smaller ports that determine whether a port was included in the list of 36 ports considered in the first screening step. DOE has tentatively assumed that all the 36 ports are potentially acceptable with the port preference based on evaluative criteria. The quantitative evaluative criteria considered by DOE include:

- Ocean distance from St. Petersberg to port of entry
- Highway distances from port of entry to SRS and LANL

- Transportation health risk (including the ocean transport to the port of entry and highway transport from the port of entry to SRS or LANL)

The approach to evaluating transportation risk using the HIGHWAY 3.0 and RADTRAN 4.0 computer codes has been described in Appendix A. The transportation risks considered include those resulting from incident-free transportation (involving external exposure) and accidents (involving radioactive material release and traffic fatalities).

Qualitative evaluative criteria, although less tangible and not subject to quantification, are also important considerations in evaluating the alternatives. These criteria include:

- Experience factors related to Russian familiarity with port facilities, and port experience with international cargo vessels importing radioactive materials
- Port access in terms of direct ocean access versus the use of rivers and inland waterways
- Compatibility with existing port operations
- Safeguards and security
- Emergency response capabilities and assets

Unless available information indicated otherwise, all 36 ports have been assumed to be adequate regarding:

- Port cargo handling facilities in terms of capability of handling the type of cargo involved and the port capacity for handling cargo in a timely manner.
- Vessel turning and maneuvering areas

The latter criteria would not be expected to be an issue with the major U.S. ports considered.

B.3 EVALUATION OF ALTERNATIVES

The results of the HIGHWAY 3.0 / RADTRAN 4.0 analysis of the transportation risks associated with each alternative port of entry for the incident-free and accident scenarios considered are summarized in Appendix C for the Atlantic, Gulf, and Pacific ports, respectively. In order to understand the general features of these results it is instructive to focus first on the average results for ports along each of the three coasts (Atlantic, Gulf, and Pacific) as presented in Table B-1. Some general features of these results that can be observed include:

- The average transportation risks for each coast in terms of expectation of fatalities, including consideration of incident-free and accident conditions, range from 2.8×10^{-3} to 8.4×10^{-3} fatalities. The average risks are within about a factor of 3.0 for transport from any given coast to SRS, and within a factor of about 1.6 for transportation to LANL.

Table B-1

Average Characteristics of Alternative
Ports of Entry by Coastal Group

Characteristic	Atlantic Ports	Gulf Ports	Pacific Ports
Distances, km:			
St. Petersburg to Port	8,820	11,100	17,400
Port to SRS	821	1,300	4,340
Port to LANL	3,290	2,160	2,060
St. Petersburg to SRS[a]	9,640	12,400	21,700
St. Petersburg to LANL[a]	12,100	13,300	19,500
Transportation Risks, fatalities			
St. Petersburg to SRS	2.75×10^{-3}	3.07×10^{-3}	8.35×10^{-3}
St. Petersburg to LANL	7.11×10^{-3}	4.85×10^{-3}	4.49×10^{-3}

[a]Sums are rounded.

- The average transport distances from St. Petersburg for each coast are within a factor of 2.3 for transport to SRS, and within a factor of 1.6 for transport to LANL.

When the details of the risk results are examined, it is found that the risks are dominated by those due to traffic fatalities and incident-free worker radiation exposure, rather than by accidents involving the release of Pu-238 fuel. The contribution of port accidents to the total risk of any given alternative was found to be small, approximately 10 percent. Thus, port population density does not become a discriminating factor in the quantification of risk.

The significance of the transportation risks presented in Table B-1 can be evaluated by considering the population at risk. The population affected by these risks is on the order of 10^5 persons or greater, depending on the specific port of entry. Thus, the average individual risk to a member of the public would be less than 10^{-7} for the proposed action. (Note: this is a bounding upper limit estimate since the transportation risks reported include those to both workers and the general population). According to the National Council on Radiation Protection (NCRP) in NCRP (1987) involuntary individual risks less than about 10^{-6} per year are generally acceptable. Furthermore, NCRP considers an individual risk level of less than 10^{-7} per year as a "negligible level of risk." Since the proposed action would result in an average lifetime (rather than annual) individual risk of less than 10^{-7}, DOE concludes that the transportation risks are small. Furthermore, the relative differences in average risk associated with the use of ports along the three coasts are small.

When the port-specific risks are considered, rather than coastal average risks, the same conclusions outlined above hold. Therefore, DOE concluded that although selecting a port of entry based on a minimum-risk approach is desirable when possible, it offered no clear advantages given that the total risks and relative risks of all the alternatives considered are small. This is especially true when the other evaluative criteria factors identified previously are taken into account.

Based on these considerations and the results presented in Table B-1, initial screening conclusions regarding the port-of-entry groups along the three coasts are as follows:

- For transportation to SRS, ports along the Atlantic Coast are preferable because they minimize transportation distances and risks compared to ports on the Gulf and Pacific Coasts.

- For transport to LANL, since the differences in transportation risks for ports along each of the three coasts are not significantly different (within a factor of 1.6), transportation distance then becomes a discriminating factor. Generally, for exclusive use per unit distance travelled, ocean transport is more costly, and requires more time, people, and fuel than highway transport. Due to the significantly longer total highway transport and ocean transport distances involved, the Pacific coast ports are less preferable than the Atlantic and Gulf Coast ports. For the same reason, but to a lesser degree, the Gulf Coast ports are less preferable than the Atlantic Coast ports.

- Minimizing ocean transport distances also minimizes the probability of loss of cargo at sea in case of an accident. This consideration is more of a concern from a material loss and recovery viewpoint rather than from a hazards viewpoint. As

discussed in Appendix A, such a loss at sea would not be expected to pose any real hazard to the environment or result in any exposures to people. Note also that based on the information presented in Section A.2.1 of Appendix A that accident rates in the Gulf of Mexico are approximately twice those in the Atlantic. Thus, this is another reason for preferring Atlantic coast ports to Gulf coast ports for shipment to LANL.

Given that Atlantic coast ports in general were found to be preferable for shipments to both SRS and LANL to those on the Gulf and Pacific coasts, a second tier screening of Atlantic coast ports based on the evaluative criteria identified above is now considered. Transportation distances and risks for the 15 Atlantic coast ports-of-entry for transport to SRS and LANL, are presented in Appendix C (Table C-1, C-4, and C-5). The results for the Atlantic Coast ports-of-entry are summarized below:

- The transportation distances from St. Petersburg for the Atlantic coast ports-of-entry are within a factor of 1.2 of each other for transport to SRS, and within a factor of 1.1 for transport to LANL.

- The transportation risks associated with the Atlantic coast ports-of-entry and transport to SRS are within a factor of 3.0 of each other, ranging from 1.5×10^{-3} to 4.6×10^{-3} fatalities. The risks for transport to LANL are within a factor of 1.2 of each other, ranging from 6.5×10^{-3} to 8.1×10^{-3} fatalities. As discussed above, DOE considers these risks and their relative differences to be small, with a selection of a port-of-entry along the Atlantic Coast based on a risk-minimum approach offering no clear advantage when other evaluative factors are taken into account.

Based on this information and considering the other qualitative criteria identified in Section B.2, DOE has selected Hampton Roads, VA as the preferred port of entry for the proposed action. The principle reasons for this selection are as follows:

- Differences in relative risk among the alternative ports of entry along the Atlantic coast are small given the uncertainties in the analysis.

- Hampton Roads, VA has a number of commercial and U.S. Naval port facilities that could be used, thus maximizing flexibility in the required port activities under the proposed action.

- Hampton Roads has a full time port risk management staff and is experienced in handling cargo vessels importing foreign radioactive material, such as spent fuel (DOE1991b).

- The presence of the U.S. Naval port facilities would increase safety and help to assure the secure transfer of cargo from the Russian vessel to the SSTs in preparation for highway transport. In addition the emergency response capabilities and assets available at those port facilities would be advantageous in the event of an accident.

When DOE considered the commercial and U.S. Naval port facilities in the Hampton Roads area in light of the above conclusions, the Norfolk Naval Base was selected as the preferred port facility. Besides meeting basic criteria, it also would provide enhanced safeguards and security during the transfer operations of the Pu-238 fuel cargo from the Russian vessel to the SSTs. Representatives of the U.S. Navy have stated that the proposed action would be more compatible with existing operations at the Norfolk Naval Base than with operations at other U.S. Naval port facilities in the area.