SECTION 4.0
ENVIRONMENTAL IMPACT OF MANUFACTURING ALTERNATIVE CONTAINER SYSTEMS

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4.0 ENVIRONMENTAL IMPACTS OF MANUFACTURING ALTERNATIVE CONTAINER SYSTEMS

This chapter discusses the environmental impacts of manufacturing alternative container systems for the management of naval spent nuclear fuel and special case waste. For each alternative, the impacts on air quality, health and safety, material availability, waste generation, socioeconomics and environmental justice from manufacturing the various alternatives would be very small. No land-use impacts would be expected because manufacturing would likely occur at existing facilities. Disproportionately high and adverse impacts on minorities or low income groups are also not expected.

Additional information on the environmental impacts of manufacturing specific existing spent nuclear fuel containers can be found in Environmental Assessments prepared by the Nuclear Regulatory Commission (NRC 1994a,b). This chapter describes the environmental setting of a representative manufacturing facility, the analytical approaches used to assess environmental impacts of manufacturing, and the results of these assessments.

4.1 Overview

The evaluation of manufacturing impacts focuses on ways in which manufacturing the various container systems could affect environmental attributes and resources at a representative manufacturing site. The assessment is not site-specific because the ultimate location or locations of facilities chosen to manufacture hardware components for any of the alternatives is not known. The actual manufacturing site will be determined by competitive bidding open to all manufacturers, and ultimately more than one manufacturer might be selected if needed. To perform the assessment, a representative manufacturing site was defined based on five facilities that currently produce casks, canisters, and related hardware for the management of spent nuclear fuel. These facilities fabricate components on behalf of firms with cask and canister designs approved by the Nuclear Regulatory Commission. The operations of the five manufacturing facilities are used as the basis for the assessment of manufacturing impacts. It is likely that these facilities and their environmental settings would be representative of facilities that might be chosen to manufacture hardware components for any of the alternatives. The evaluation of environmental impacts from manufacturing Navy container systems considers fabrication processes used at existing facilities together with the total number of hardware components required to implement each alternative.

Illustrations of loading operations and schematic diagrams of the container systems and dry storage and transportation overpacks appear in Appendix D. These illustrations provide an overview of some of the key types of hardware that would have to be manufactured under the various alternatives.

4.1.1 Manufacturing Processes

The alternatives defined in Chapter 3 identify the major components required for each hardware system. The alternatives consider a variety of storage and transportation container designs which consist of a few different components: canisters (with storage, transportation, and possibly, disposal overpacks), casks (including storage casks, transportable storage casks, and M-140 transportation casks) and disposal containers (canisters and overpacks). The hardware components required for each alternative for naval spent nuclear fuel and special case waste are listed in Table 4.1.

The numbers are based on the assumption that a repository or centralized interim storage site would be opened by 2010. Additional storage containers (approximately 10%) for the Current Technology/Rail Alternative and storage overpacks (approximately 10%) for the Small Multi-Purpose Canister Alternative might be required if the opening of a repository were delayed 5 years. The additional equipment required by a delayed opening would not alter any conclusions for manufacturing of alternative container systems. The number of storage overpacks or containers might be slightly less if a repository or centralized interim storage site were opened before 2010. Note that a transfer overpack was not included in Table 4.1 because only three or four would be required at INEL.

For each alternative, basket assembly designs were developed for naval spent nuclear fuel based on: 1) the geometry of the fuel relative to the container geometry, 2) the structural capability of the basket assemblies to support the fuel in a hypothetical shipping accident, and 3) the fuel and basket weights relative to the weight capacity of the container. Using these basket assembly designs, the number of containers required for each alternative was projected for the estimated number of naval spent nuclear fuel assemblies identified for shipment to a repository or centralized interim storage site.

TABLE 4.1 Hardware Requirements for Each Alternative Container System for Naval Spent Nuclear Fuel and Special Case Waste

	Total Life of Project Requirement per Alternative[a,b]					
Hardware Component	MPC	NAA	CTR	TSC	DPC	SmMPC
Canisters	360	-	-	-	345	585
TSC	-	-	-	171	-	-
Storage overpacks	180	255	176	-	173	264
Storage containers	-	255	176	-	-	-
Transportation overpacks	18	-	-	-	18	30
M-140 transportation casks	-	28	28[c]	-	-	-
Disposal containers	-	360	360	360	360	-
Disposal overpacks	360	-	-	-	-	585

[a] Notation: Storage containers = single-purpose storage canisters or storage casks, MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.
[b] Assumes a repository or centralized interim storage site will be available by 2010.
[c] High-Capacity M-140 transportation cask

The designs and materials needed for the Multi-Purpose Canister Alternatives are based on the conceptual design described by TRW (1994) because no multi-purpose canister system yet exists. The designs and material needs for other cask and canister systems are based on information provided in Safety Analysis Reports submitted to the Nuclear Regulatory Commission for each system chosen to represent an alternative. Other similar containers could be developed and could be chosen. Fabricating the equipment is expected to involve manufacturing processes similar to those currently used to fabricate large storage and transportation containers and related transportation equipment.

The processes and materials that would be used or are expected to be used to manufacture each component of the system are described in Sections 4.1.1.1 through 4.1.1.3. As noted below, some uncertainty surrounds the specific materials that would ultimately be used for some of the hardware components in each alternative system being evaluated in this EIS. General descriptions of the hardware components are provided below.

4.1.1.1 Canisters and Canister Overpacks

Canisters. Canisters would likely be made by welding two stainless steel half-cylinders together, welding a thick circular plate onto the bottom of the cylinder, and securing a stainless steel basket assembly inside the cylinder. The basket assembly serves to position fuel assemblies inside the cylinder providing uniform spacing of the assemblies for better heat transfer control. Special neutron-absorbing materials would be added during manufacture of the baskets for criticality control. After the fuel assemblies were inserted, a heavy metal shield plug would be used to cover the open end and a stainless steel inner lid would be welded in place over the shield plug to close the container. A stainless steel honeycomb spacer would be placed over the inner lid and a stainless steel outer lid would be welded to the canister.

Storage Overpacks. Storage overpacks, also referred to as storage vaults, would consist of large concrete and steel structures designed to hold sealed canisters during periods of dry storage. The concrete structure would be designed to maintain structural integrity during design-basis earthquakes, tornadoes, or other natural phenomena. Either horizontal or vertical dry storage systems could be used. Such systems are already in use and hold civilian spent nuclear fuel at many commercial nuclear power plants.

Transportation Overpacks. Transportation overpacks made of stainless steel plate would be welded to form inner and outer cylindrical shells. End plates and shield plugs would be welded to the bottom ends of the shells. A plate of stainless steel would be welded to the tops of the shells to form a flange onto which a top cover could be bolted. A lead or depleted uranium gamma shield liner would then be cast or otherwise formed and inserted between the two shells. A solid, high-hydrogen, neutron shield jacket would then be placed around the outer shell and a stainless steel jacket would be placed over the neutron shield to provide surface protection to the neutron shield during handling and shipment. With the canister inserted, shield plugs would then be put into the open end and the cover plate bolted on. Large removable impact limiters made of wood, plastic foam, aluminum honeycomb, or other crushable, impact-absorbing material would be placed over the ends to protect the cask and its contents during transportation.

Disposal Overpacks. Cylindrical overpacks constructed of highly corrosion-resistant metal alloys would be loaded with previously sealed multi-purpose canisters, and the overpack would be sealed and disposed of in a repository.

4.1.1.2 Casks

Casks are heavily shielded, robust containers that are sturdy enough to be transferred, stored, and transported without the need for an additional overpack for structural support and radiation shielding.

Transportable Storage Casks. Transportable storage casks would be manufactured by making inner and outer shell cylindrical stainless steel shells from stainless steel plate welded together. Casks would be made with a gap between the inner and outer shells. Stainless steel bottoms would be welded to both the inner and outer shells to close one end of each shell. Various forged or cast trunnions and other mechanical features would be welded to the outer shell during manufacture for handling, positioning, and securing. A top flange made of machined plate would be welded to both the outer and inner shells so that the inner shell would be suspended inside the outer shell leaving a uniform gap at the sides and bottom of the cask. The gap would be filled with appropriate material for radiation shielding. A basket assembly of stainless steel or other materials would be secured inside the inner shell. Radial copper fins would be fused to the outside of the outer shell to transmit heat away from the cask. The spaces between the copper fins would be filled with a high-hydrogen-content material for neutron shielding. A stainless steel cover plate would be bolted to the top flange to close the cask but allow easy access for future removal of the fuel elements at a repository or centralized interim storage site.

M-140 Transportation Casks. The M-140 transportation cask used for naval spent nuclear fuel is unique to the Naval Nuclear Propulsion Program. The M-140 transportation cask is a large stainless steel shipping container that is transported in the vertical position on a specially designed well-type railcar. The major components of the M-140 transportation cask include the shielded container, closure head, and protective dome. Internal baskets are installed inside the container to hold the irradiated fuel assemblies in place and can be modified to accept different sized fuel assemblies. The container is shipped dry. Cooling fins on the outside of the container are designed to dissipate the heat generated by the fuel.

The M-140 transportation cask and rail car weigh approximately 190 tons (approximately 172,000 kg) in the loaded condition. The container is approximately 16 ft (approximately 5 m) tall with a maximum outer diameter of 10.5 ft (approximately 3 m). The container body is made from stainless steel forgings with 14-in. (approximately 36-cm) thick walls and a 12-in. (approximately 31-cm) thick bottom. The closure head and protective dome have a total thickness of 17.5 in. (approximately 45 cm) of stainless steel.

High-Capacity M-140 Transportation Cask. The high-capacity M-140 transportation cask will be the same as the standard M-140 but will have a basket that holds more fuel assemblies.

Storage Cask. Typically a storage cask is a thick-walled, heavily shielded, cylindrical metal container with concrete or lead layers for shielding. It is a complete single unit that does not require specialized overpacks for loading, transfer, or storage.

4.1.1.3 Disposal Containers

Disposal containers would be made of stainless steel or other corrosion-resistant material and manufactured in the same general manner as canisters. The disposal containers for naval spent nuclear fuel assemblies would have an internal basket assembly to position the fuel assemblies inside the disposal container for heat transfer control. For added longevity an outer cylindrical container made of steel with a slightly larger diameter and slightly greater length would be manufactured in the same manner as the stainless steel inner container. The loaded stainless steel inner container would be placed into the outer container, and a steel cover plate would be welded to the outer container end as a final closure and seal of the contents.

Naval spent nuclear fuel arriving at a repository in multi-purpose canisters would be placed directly inside a disposal overpack, which would consist of the same double-walled (stainless steel inside, carbon steel outside) design that would be used for uncanistered spent nuclear fuel.

4.2 Existing Environmental Settings at Manufacturing Facilities

Assessment of the environmental impacts of manufacturing the various container systems assumed a representative manufacturing site based on information regarding the environmental attributes and resources at each of the five facilities currently producing spent nuclear fuel hardware systems. The assessment was not site-specific because the ultimate locations of facilities chosen to manufacture hardware components for any of the alternatives are not known. It is likely that these facilities and the environmental settings in which they are located would be similar to any facilities that might be chosen to manufacture hardware components for any of the alternatives. The evaluation of environmental impacts from manufacturing considers fabrication processes used at existing facilities, together with the total number of hardware components required to implement each alternative. Pertinent information on environmental settings for air quality, health and safety, and socioeconomics is provided in Sections 4.2.1 through 4.2.3. The environmental impacts on air quality, health and safety, material use, waste generation, socioeconomics, and environmental justice are provided in Sections 4.3 through 4.8. Other areas of impact are discussed in Section 4.9.

4.2.1 Air Quality

The air quality attainment status representative of the manufacturing location was assessed with respect to ozone, carbon monoxide, and particulate matter. Air quality attainment areas are regions where the regulatory air standards are not exceeded. Nonattainment areas exist where sources of air pollution lead to air quality that currently violates state and/or federal regulations. For the counties in which the five manufacturing sites were located, an average of 3,800 tons (approximately 3,400 metric tons) of volatile organic compounds and 43,000 tons (approximately 39,000 metric tons) of nitrogen oxides, which are related to the production of ozone, were released into the environment in 1990, the latest year in which county-level data were available. There are no ambient air quality standards for volatile organic compounds. However, volatile organic compounds, nitrogen oxides, and, to a lesser extent, carbon monoxide are precursors to the formation of ozone in the atmosphere. Ozone has a human health air quality standard. The majority of existing sites were in nonattainment areas for ozone but not for carbon monoxide. All five sites were in attainment areas for particulates.

4.2.2 Health and Safety

There were no fatalities at any of the five existing manufacturing sites in 1994. To be conservative, representative data on the number of accidents and fatalities associated with cask and canister fabrication at the manufacturing location were based on national incidence rates for the relevant sector of the economy. In 1992, the last year for which statistics are available, the occupational fatality rate for the sector that includes all manufacturing was 3 per 100,000 workers; the occupational illness and injury rate for fabricated plate work manufacturing in 1992 was 6.3 per 100 full-time workers (U.S. Bureau of Labor Statistics 1994).

Hardware for each of the alternatives is expected to be manufactured in facilities that have had years of experience in rolling, shaping, welding, and then fabricating large metal canisters and casks. Machining operations at these facilities would involve standard procedures using established metal-working equipment and techniques. Trained personnel familiar with the manufacture of large metal canisters and casks and with the necessary equipment used to fabricate such items would typically be used. The injury and illness rate is expected to be equal to or lower than the industry rates.

4.2.3 Socioeconomics

Each of the five manufacturing facilities examined in this EIS is located in a Metropolitan Statistical Area. The counties composing each Metropolitan Statistical Area define the affected socioeconomic environment for each facility. The population of the affected environment associated with the five facilities ranged from about 431,200 to 967,300 in 1992 (U.S. Bureau of Census 1994). Output, which is the value of goods and services produced in the five locations, ranged from $18.2 billion to $55.3 billion in 1995. Income, which is wages, salaries, and property income, ranged from $9.2 billion to $26.4 billion in 1995. Employment ranged from 245,000 to 668,000 in 1995 (Minnesota IMPLAN Group 1995). Plant employment ranged from 25 to 995 in 1995. Based on this information the representative manufacturing location has a population of 643,000 and hosts a facility employing 483. Local output in the area is $29.6 billion, local income is $15.0 billion, and local employment is 385,000.

4.3 Impacts on Air Quality

Air emissions from manufacturing sites were conservatively estimated for production of the various casks and canisters. Criteria pollutants and hazardous air pollutants were predicted, and these emissions were compared with total annual emissions from existing manufacturing sites and with typical regional or county-wide emissions to determine the importance of these emissions to local air quality. Because the exact location of cask and canister manufacturing is not known for any alternative, potential emissions for existing manufacturing sites in both attainment and nonattainment areas were evaluated to provide a range of impacts.

Estimates to identify air emissions associated with the manufacture of canisters and casks were developed by using the emissions from similar canisters and casks currently manufactured based on the number of person-hours in the manufacturing process. These emissions were prorated on a per unit basis to calculate annual emissions at the typical manufacturing site, assuming that the emissions from similar activities would be proportional to the number of person-hours in the manufacturing process. To provide reasonable estimates of emissions, it was assumed that the volatile organic compounds used as cleaning fluids would fully evaporate into the atmosphere as a result of the cleaning processes used in the manufacture of canisters and casks for each alternative. Estimates of emissions were based on the total number of casks and canisters manufactured over 40 years for each alternative.

No plant expansions are expected for the manufacture of any alternative container system. Fabrication would be a normal part of the usual yearly work load of the site. Therefore, no additional air emission permits would likely be needed.

States in nonattainment areas for ozone might place requirements on many stationary pollution sources to achieve attainment in the future. This might include a variety of controls on emissions of volatile organic compounds and nitrogen oxides. Various options would be available to control emissions of these compounds to comply with emission limitations.

The analysis of air quality impacts associated with manufacturing considered whether the conformity requirements of a State Implementation Plan might apply to emissions from the manufacturing sites located in nonattainment areas. The Clean Air Act conformity rules could be met in that the planned casks and canisters would be part of the regular annual work load of the manufacturing facility. However, if an additional shift were added to handle this work load, emissions might be 50% greater than usual for the days on which the casks and canisters were manufactured on that shift. All of the alternatives were examined for additional emissions of volatile organic compounds and nitrogen oxides and compared with de minimis levels (de minimis refers to the emission levels below which the conformity regulations do not apply) for these compounds. Although the exact location or locations of the manufacturing facilities are not known at this time, there should not be a need for a general conformity determination for the manufacturing facility because the manufacturing activity would be part of the regular workload of the facility.

All estimated emissions are very small compared to annual emissions from other sources, but variation exists among the alternatives. The annual average and the total 40 year emissions from the manufacture of components for each alternative are presented in Table 4.2. Nitrogen oxides would be the largest emission, varying from 0.063 to 0.14 tons/yr (approximately 0.057 to 0.13 metric tons/yr). Estimated annual average emissions of volatile organic compounds vary from 0.048 to 0.11 tons/yr (approximately 0.044 to 0.10 metric tons/yr). Annual emissions from other sources in the typical manufacturing location for all activities are estimated to be 3,800 tons/yr (approximately 3,400 metric tons/yr) of volatile organic compounds and 43,000 tons/yr (approximately 39,000 metric tons/yr) of nitrogen oxides. Annual average emissions due to cask and canister manufacturing under any of the alternatives would be less than 0.003% of local emissions for volatile organic compounds and 0.0003% for nitrogen oxides — both unlikely to result in air quality deterioration leading to nonattainment status for these compounds.

TABLE 4.2 Air Emissions at the Representative Manufacturing Location for Alternative Container Systems

		Air Emissions (tons) per Alternative[a]					
Compound		MPC	NAA	CTR	TSC	DPC	SmMPC
Volatile organic compounds	Total	2.7	2.3	2.0	1.9	2.6	4.4
	Annual Average	0.068	0.058	0.050	0.048	0.065	0.11
Nitrogen oxides	Total	3.5	3.1	2.7	2.5	3.4	5.7
	Annual Average	0.088	0.078	0.068	0.063	0.085	0.14

[a] Alternatives: MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.

Conversion factor: to convert tons to metric tons, multiply by 0.9072.

Where the manufacture of casks and canisters would involve the use of lead, it is unlikely that any lead fumes would be released into the environment. Manufacturers typically hire private companies to undertake manufacturing with lead, and these companies capture lead fumes and dispose of lead waste off-site. Some emissions of particulates and lead would occur with welding activities. However, as welding is an intermittent process, the associated emissions would be small for each alternative.

If a manufacturing site were located in a nonattainment area, limitations might be placed on increased emissions at the site in accordance with Title I of the Clean Air Act or on the basis of conformity requirements of the State Implementation Plan aimed at meeting the state's reduction in emissions of volatile organic compounds, nitrogen oxides, and carbon monoxide. For the manufacturing sites in attainment areas, air quality meets air quality standards and no additional limitations would be expected.

4.4 Impacts on Health and Safety

Data from the Bureau of Labor Statistics for metal fabrication and welding industries were used to compile baseline occupational health and safety information for industries fabricating and welding steel and steel objects similar to each alternative cask and canister system. The expected number of injuries and fatalities were computed by multiplying the number of worker-years by the injury and fatality rate for each occupation.

Table 4.3 shows the expected number of injuries, illnesses, and fatalities for each alternative based on the number of casks and canisters that would be produced over 40 years. Injuries and illnesses would range from 33 for the Transportable Storage Cask Alternative to 76 for the Small Multi-Purpose Canister Alternative. Expected fatalities over 40 years would range from 0.016 for the Transportable Storage Cask Alternative to 0.036 for the Small Multi-Purpose Canister Alternative.

TABLE 4.3 Total Number of Injuries, Illnesses, and Fatalities over 40 Years at the Representative Manufacturing Location for Alternative Container Systems[a]

	Number per Alternative[b]					
Parameter	MPC	NAA	CTR	TSC	DPC	SmMPC
Injuries and Illnesses	46	41	35	33	45	76
Fatalities	0.022	0.019	0.017	0.016	0.022	0.036

[a] Assumes one worker-year of effort of a fabricated plate manufacturing worker to produce one canister or cask (excluding storage overpacks).

[b] Alternatives: MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.

The number of canisters and casks required over the life of each alternative would not place unusual demands on existing manufacturing facilities. None of the alternatives is likely to lead to a deterioration in worker safety and a resultant increase in accidents.

4.5 Impacts on Material Use

4.5.1 Material Use

Calculation of the quantity of materials used for the fabrication of each alternative canister or cask systems is based on engineering specifications of each relevant hardware component. This information has been provided by existing manufacturers for systems currently being produced or under licensing review or has been taken from conceptual design specifications for those technologies still in the planning stages. Data on per unit material quantities for each component were combined with information on the number of canisters or casks to be manufactured under each alternative. Also assessed was the impact of manufacturing the components for each alternative on the total U.S. production (or availability in the United States, if not produced in this country) of each relevant input material. Results of the assessment are expressed in terms of percent impact on total U.S. domestic production.

Table 4.4 lists the estimated total quantities of materials that would be required for each alternative over a 40 year period if a repository or centralized interim storage site facility were available in 2010. For each alternative the largest material requirement by weight, excluding concrete which is readily available, would be carbon steel, which ranges from 8,700 to 14,800 tons (approximately 7,890 to 13,400 metric tons). Smaller quantities of additional materials would be required, the most important of these being stainless steel and aluminum.

TABLE 4.4 Material Use for Alternative Container Systems

	Total Material Use (tons) per Alternative[a]					
Material	MPC	NAA	CTR	TSC	DPC	SmMPC
Aluminum	550	480	420	520	600	450
Carbon steel	10,400	12,100	11,000	8,700	12,300	14,800
Chromium[b]	2,800	3,100	1,500	3,700	2,200	3,100
Concrete	20,700	29,300	20,200	0	19,900	19,100
Copper	19	0	0	140	0	11
Depleted uranium	940	0	0	0	0	1,100
Lead	86	0	0	5,400	630	120
Nickel[c]	1,800	2,000	990	2,400	1,400	2,000
Stainless steel	9,800	10,700	5,300	12,900	7,700	10,800

[a] Alternatives: MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.
[b] Stainless steel assumed to be 29% chromium.
[c] Stainless steel assumed to be 18.5% nickel.
Conversion factor: to convert tons to metric tons, multiply by 0.9072.

Table 4.5 compares the annual U.S. production capacity to the total 40 year requirements of the materials required for each alternative. Most chromium, which is an important constituent of stainless steel, is imported into the United States and is classified as a Federal Strategic and Critical

Inventory material. For comparative purposes, the data in the table were estimated as a percentage of the 1992 chromium inventory quantity rather than the U.S. production quantity.

Except for depleted uranium and lead, total material consumption for each alternative for the 40 year period of manufacturing would be less than 1.0% of the annual U.S. production. Since manufacturing would be spread across the 40 year period, the actual amount of material use in any given year would be much less than 1% of the annual U.S. production. The use of lead or steel would not produce a noteworthy increased demand and should not significantly impact the supply of either material. Use of aluminum, steel, stainless steel (nickel and chromium), concrete, and copper for the fabrication of storage and disposal components for each of the alternatives would not impact the supply of these commodities adversely.

The total amount of depleted uranium used over a 40 year period (in multi-purpose canisters only) would range from 6.4% to 7.5% of total U.S. annual production. Although considerably higher in relative terms than the use of other key materials, these requirements are small. Given the limited alternative uses of this material and the large current inventory of surplus depleted uranium hexafluoride owned by DOE, such impacts should be considered to be positive.

Lead or steel could be substituted for depleted uranium for radiation shielding in some cases. If other materials are used for this purpose, the thickness of the substituted material would increase in inverse proportion to the ratio of the density of the substituted material to the density of the depleted uranium. If lead or steel were used, the shielding thickness would increase by about 170% and 240%, respectively, resulting in a much larger container. Therefore, the use of depleted uranium is preferred.

TABLE 4.5 The Total Amount of Material Used Over 40 Years, Expressed as a Percent of Annual U.S. Domestic Production, for Each Alternative Container System

	Alternative[a]					
Material	MPC	NAA	CTR	TSC	DPC	SmMPC
Aluminum	0.012	0.011	0.009	0.012	0.013	0.010
Chromium[b]	0.22	0.24	0.12	0.29	0.18	0.25
Concrete	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	0	0	0.007	0	0.001
Depleted uranium	6.4	0	0	0	0	7.5
Lead	0.021	0	0	1.3	0.15	0.029
Nickel	0.066	0.072	0.036	0.086	0.052	0.073
Steel[c]	0.018	0.020	0.016	0.018	0.019	0.023

[a] Notation: MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister; < = less than.

[b] Chromium is compared with Federal Strategic and Critical Inventory.

[c] "Steel" includes the amount of steel in the stainless steel, assumed to be 52.5%.

4.5.2 Recycling and Management of End-of-Life Equipment

It is expected that all container system components not disposed of with the naval spent nuclear fuel, including the storage and transportation containers, overpacks or casks and dual-purpose canisters would be reused or recycled. Some pieces of equipment may need to be decontaminated prior to recycling. It is possible that some low-level radiological waste may result but it is not expected that the large pieces of equipment (canisters and casks) would need to be disposed of as radiological waste. Table 4.6 provides information on the container system components for all alternatives which would be reused or recycled.

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TABLE 4.6 End-of-Life Hardware for Reuse or Recycling for Each Alternative Container System for Naval Spent Nuclear Fuel and Special Case Waste

	Hardware per Alternative[a]					
Hardware Component	MPC	NAA	CTR	TSC	DPC	SmMPC
Canisters	-	-	-	-	345[b]	-
TSC	-	-	-	171[bc]	-	-
Storage overpacks	180	255	176	-	173	264
Storage containers	-	255[b]	176[b]	-	-	-
Transportation overpacks	18[c]	-	-	-	18[c]	30[c]
M-140 transportation casks	-	28[b]	28[bd]	-	-	-

[a] Notation: Storage containers = single-purpose storage canisters or storage casks, MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.

[b] Hardware would require radiological decontamination.

[c] Hardware contains lead shielding.

[d] High-Capacity M-140 transportation cask.

4.5.2.1 Multi-Purpose Canister Alternative

For the Multi-Purpose Canister Alternative about 180 storage overpacks and 18 transportation overpacks would need to be managed at the end of the program. The scrap metal (including lead) would be recycled, if possible. The concrete in the storage overpacks would be managed as non-radiological solid waste. These materials are not expected to be radiologically contaminated because the naval spent nuclear fuel would be contained within the multi-purpose canister. The canisters and the disposal overpacks would be disposed of with the naval spent nuclear fuel.

4.5.2.2 The No-Action Alternative

For the No-Action Alternative about 255 storage overpacks, 255 storage containers and 28 casks would need to be managed at the end of the program. The concrete in the storage overpacks would be managed as non-radiological solid waste and the scrap metal recycled. The casks and storage containers would be reused or radiologically decontaminated prior to recycling. The disposal containers along with the naval spent nuclear fuel would be disposed of in the repository.

4.5.2.3 The Current Technology/Rail Alternative

For the Current Technology/Rail Alternative about 176 storage overpacks, 176 storage containers and 28 casks would need to be managed at the end of the program in the same manner described for the No-Action Alternative.

4.5.2.4 The Transportable Storage Cask Alternative

At the end of the program about 171 casks for the Transportable Storage Cask Alternative would be reused or radiologically decontaminated prior to recycling. It is expected from the cask design, which includes lead shielding material, that the lead would not be radiologically contaminated. The metal portions would be recycled following any radiological decontamination of surfaces. The disposal containers and naval spent nuclear fuel would be placed in a repository.

4.5.2.5 The Dual-Purpose Canister Alternative

At the end of the program about 345 canisters for the Dual-Purpose Canister Alternative would be reused or radiologically decontaminated prior to recycling. In addition 173 storage overpacks and 18 transportation overpacks would be prepared for recycling of metals including lead and disposal of the concrete as non-radiological solid waste. The disposal containers and naval spent nuclear fuel would be placed in a repository.

4.5.2.6 The Small Multi-Purpose Canister Alternative

For the Small Multi-Purpose Canister Alternative about 264 storage overpacks and 30 transportation overpacks would be managed at the end of the program in the same manner as the Multi-Purpose Alternative describes.

4.6 Impacts on Waste Generation

The primary material used in the fabrication of each container system would be stainless steel, with either depleted uranium or lead used for canister and cask shielding. The manufacture of shielding would generate hazardous or low-level radioactive waste depending on the material used. Other organic and inorganic chemicals generated by the manufacture of each alternative container system and the amounts generated have also been identified.

The annual volumes and quantities of waste produced for each alternative per canister and cask were estimated. These data were compared on the basis of information collected from current cask and canister manufacturers, and projected number of canisters and casks required. The same sources were used to estimate the amounts of waste for disposal.

The potential for impacts was evaluated in terms of existing and projected waste-handling and disposal procedures and regulations. Current fabrication facilities are regulated by the U.S. Environmental Protection Agency and the Occupational Safety and Health Administration.

Fabrication of the alternative container systems would produce liquid and solid waste at the manufacturing locations. To control volume and toxicity of wastes generated, manufacturers would comply with existing regulations. Pollution prevention and reduction practices would be implemented (see Section 4.14).

4.6.1 Liquid Waste

The liquid waste produced during manufacturing would consist of spent lubricating and cutting oils from machining operations and the cooling of cutting equipment. This material is currently recycled for reuse. Ultrasonic weld testing would generate some unpotable water containing glycerin. Water used for cooling and washing operations would be treated for release by filtration and ion exchange, which would remove contaminants and permit discharge of the treated water into the sanitary system.

Table 4.7 lists the estimated amounts of liquid waste generated by the shaping, machining, and welding of the stainless steel and steel alloy vessels required for each alternative. The annual average amount of liquid waste generated would range from 0.12 to 0.27 tons/yr (approximately 0.11 to 0.24 metric tons/yr), depending on the alternative chosen. The small quantities of waste produced during manufacturing of each alternative would not exceed the capacities of the existing equipment for waste stream treatment at the manufacturing facility.

4.6.2 Solid Waste

The solid waste generated during manufacturing operations is shown in Table 4.7. The annual average amount of solid waste generated would range from 0.016 to 0.036 tons/yr (approximately 0.015 to 0.033 metric tons/yr). This waste would consist of nickel, manganese, copper, and chromium. These chemicals could be added to existing steel product manufacturing waste streams for treatment and disposal or recycling.

The analysis assumes that depleted uranium incorporated into the canisters would be delivered to the manufacturing facility properly shaped to fit inside the canister and encased in stainless steel. This practice would not result in any waste being generated at the manufacturing location. Depleted uranium waste would be recycled at the depleted uranium manufacturing location and would not pose a threat to worker health and safety at the container manufacturing location. Lead used for gamma shielding would be cast between stainless steel components of the canisters and casks. Although it is unlikely that any substantial quantity of lead waste would be produced under any of the alternatives, if it were generated it would be recycled.

TABLE 4.7 Annual Average Waste Generated at the Typical Manufacturing Location for Alternative Container Systems

	Waste Generated (tons) per Alternative[a]					
Waste Type	MPC	NAA	CTR	TSC	DPC	SmMPC
Liquid waste	0.16	0.14	0.12	0.12	0.16	0.27
Solid waste	0.022	0.019	0.017	0.016	0.022	0.036

[a] Alternatives: MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.

Conversion factor: to convert tons to metric tons, multiply by 0.9072.

4.7 Impacts on Socioeconomics

The assessment of socioeconomic impacts resulting from fabrication activities involved three elements. Engineering cost data for existing and proposed spent nuclear fuel management systems provided information on the unit cost for the various components of each existing and planned storage, transportation, and disposal technology. Second, information on the handling of naval spent nuclear fuel under each alternative provided the total number of containers and associated components to be manufactured. Finally, economic data for the county or counties composing the environmental setting for each facility were used to calculate the direct and secondary economic impacts of cask and canister manufacture on the local economy. Direct effects would occur as manufacturing facilities purchased materials, services, and labor required for each container system. Secondary effects would occur as industries and households supplying the industries that are directly affected adjusted their own production and spending behavior in response to increased production and income thereby generating additional socioeconomic impacts. Impacts were measured in terms of output (the value of goods and services produced), income (wages, salaries, and property income), and employment.

The socioeconomic analysis of manufacturing used county-level input-output economic calculations provided by a computer program called IMPLAN to project impacts of fabrication on the local economy (Minnesota IMPLAN Group 1995; see also Appendix C). To perform the analysis, IMPLAN output, income, and employment multipliers were calculated for each of the counties in which the five existing manufacturing facilities are located. Multipliers are used to estimate the secondary effects on an area's economy in response to the introduction of direct effects on its economy. The county-specific multipliers were then averaged to produce composite multipliers for a representative manufacturing location. The composite multipliers were used to analyze the impacts of each alternative.

The assessment of socioeconomic impacts was limited to estimating the direct and secondary impacts of manufacturing activities. No assessment was made of the impacts of manufacturing activities on local jurisdictions. Such an analysis would include the estimation of impacts on county, municipal government, and school district revenues and expenditures. Because production of casks and canisters would likely take place at existing facilities alongside existing product lines, it is unlikely that there would be any substantial population increase due to workers moving into the vicinity of the manufacturing sites in any given year under any alternative. Due to this lack of demographic impacts, no significant change in the disposition of local government or school district revenues and expenditures would be likely to occur. Because substantial population increases would not be expected, impacts on other areas of socioeconomic concern, such as housing and public services, were not considered.

Average annual impacts were calculated for the manufacturing period associated with each alternative. Impacts of each alternative are compared to the baseline in the representative location in 1995, with all results expressed in millions of 1995 dollars. No attempt was made to forecast local economic growth or inflation rates for the representative location because of the non-site-specific nature of the analysis. The impacts of manufacturing all major components of each alternative, which includes canisters with various overpacks, casks, and disposal containers, were calculated in the analysis.

Table 4.8 presents the impacts of each alternative on output, income, and employment in the representative manufacturing location. The results presented include the percent impact of each alternative relative to overall output, income, and employment in the economy of the manufacturing location. Additional information on the socioeconomic impacts of each alternative is presented in Appendix C.

4.7.1 Local Output

Average annual output impacts of each alternative range from about \$10 million for the Dual-Purpose Canister Alternative to about \$15 million for the Small Multi-Purpose Canister Alternative (Table 4.8). Output generated from each alternative would increase total local output from between 0.04% and 0.05% on average over the entire manufacturing period.

4.7.2 Local Income

Average annual income impacts of each alternative range from between \$6 million to about \$8 million (Table 4.8). Income generated from each alternative would increase total local income from between 0.04% and 0.05% on average over the entire manufacturing period.

4.7.3 Local Employment

Average annual employment impacts of each alternative range from between 130 person-years for the Dual-Purpose Canister Alternative to 180 person-years for the Small Multi-Purpose Canister Alternative (Table 4.8). Employment generated from each alternative would increase total local employment from between 0.03% and 0.05% on average over the entire manufacturing period.

TABLE 4.8 Socioeconomic Impacts for Alternative Container Systems at the Representative Manufacturing Location

Alternative	Average Annual Output[a]		Average Annual Income[a]		Average Annual Employment	
	$\$10^6$	% impact[b]	$\$10^6$	% impact[b]	person-years	% impact[b]
Multi-Purpose Canister	11	0.04	6	0.04	140	0.04
No-Action	12	0.04	7	0.04	150	0.04
Current Technology/Rail	12	0.04	6	0.04	140	0.04
Transportable Storage Cask	12	0.04	7	0.04	150	0.04
Dual-Purpose Canister	10	0.04	6	0.04	130	0.03
Small Multi-Purpose Canister	15	0.05	8	0.05	180	0.05

[a] Annual output and income impacts are expressed as millions (10^6) of 1995 dollars.
[b] % impact refers to percent compared with the 1995 local baseline rounded to the nearest 0.01%.

4.8 Impacts on Environmental Justice

The purpose of this environmental justice assessment is to determine if disproportionately high and adverse health or environmental impacts associated with any of the alternatives considered in this EIS would affect minority or low-income populations, as outlined in Executive Order 12898 and the President's accompanying cover memorandum (February 11, 1994). Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations. An adverse environmental impact is a deleterious environmental impact determined to be unacceptable or above generally accepted norms. A disproportionately high impact refers to an impact (or risk of an impact) in a low-income or minority community that significantly exceeds that on the larger community.

For purposes of this study, definitions of minority and low income are consistent with those used by the U.S. Bureau of the Census in the 1990 census of population and housing (U.S. Bureau of Census 1992). Minority populations consisted of individuals who reported themselves as belonging to Black (persons who defined themselves as Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; White Hispanic; and “Other Race” categories. Low-income populations consisted of those families that fell below the 1989 poverty line.

The environmental justice assessment considered human health and environmental impacts from the examination of impacts on air quality, waste generation, and health and safety for each alternative canister and cask system. The assessment used demographic data to provide information on the degree to which minority or low-income populations would be affected disproportionately. The evaluation identifies as areas of concern those in which disproportionately high and adverse impacts affect minority and low income populations.

This evaluation of environmental justice considered the characteristics of five facilities that currently manufacture casks or canisters for spent nuclear fuel. Table 4.9 presents the percent minority and low-income population associated with these five facilities. For each facility the analysis considered a region defined by a 10-mi (approximately 16-km) radius around the site. The percentages of minority and low-income persons composing the population of each of the states in which existing manufacturing facilities are located are presented as references for the purpose of defining disproportionality. Except for the Akron, Ohio facility, the percentages of minority and low-income population are below those of the state in which each is located.

TABLE 4.9 Percent Minority and Low-Income Populations in Typical Manufacturing Locations, 1990

	Minority Population (%)		Low-Income Population (%)	
Existing Manufacturing Locations	Local[a]	State	Local[a]	State
Westminster, Mass.	8.6	12.0	8.1	8.9
Greensboro, N.C.	22.6	24.9	8.6	13.0
Akron, Ohio	14.4	12.9	13.4	12.5
York, Pa.	6.9	12.2	9.6	11.1
Chattanooga, Tenn.	20.0	20.1[b]	13.6	15.5[b]

[a] Local percentages refer to populations within a 10-mi (approximately 16-km) radius of each facility.
[b] Weighted averages over portions of the two states of Tennessee and Georgia.
Source: Data from U.S. Bureau of the Census (1992, 1994).

4.8.1 Environmental Justice Assessment

To explore potential environmental justice concerns, this assessment examined the composition of populations living within 10 mi (approximately 16 km) of five manufacturing facilities used to identify the number of minority and low-income individuals in each area. This radius was selected because it would capture the most broadly dispersed environmental consequence associated with the manufacturing activities considered in this EIS, namely impacts to air quality. The number of persons contained in each target group within the circumscribed area was compared with the total population in its respective area to yield the proportion of minority and low-income populations within 10 mi (approximately 16 km) of each facility.

A geographic information system was used to define areas within 10 mi (approximately 16 km) of each facility. Linked to 1990 census data, this analytical tool enabled the identification of block groups within 10 mi (approximately 16 km) of each facility. In cases where the 10 mi boundary cut block groups, the geographic information system calculated the fraction of the total area of each interested block group lying within the prescribed distance. This fraction provided the basis for estimating the total population in the area, as well as the minority and low-income components, calculated as proportional to the percentage of the block group area within the boundary.

The analysis indicated that for one site (Akron, Ohio) the proportion of minority population within the area associated with a manufacturing facility was higher than the proportion of minority population in the associated state (Table 4.9). The difference between the percentage of minority population living within the 10-mi (approximately 16-km) radius and the state is 1.5%. Because very small impacts are anticipated for the total population from manufacturing activities associated with all alternatives, there would be no disproportionately high and adverse impacts to the minority population near this facility.

The percentage of the total population that consists of low-income families living within a 10-mi (approximately 16-km) radius of a manufacturing facility would also exceed that of the associated states in one instance (Akron, Ohio). The difference in this case was only 0.9%. Because very small impacts are anticipated for the total population there would be no disproportionately high and adverse impacts on the low-income population living near the facility.

Only small human health and environmental impacts resulting from the manufacture of each alternative cask and canister system are anticipated, so high and adverse impacts that would disproportionately affect minority or low-income populations similarly are not expected.

4.9 Other Areas of Impact

Since facilities exist which are capable of meeting the projected container system requirements, the assessment concludes that no new construction would be needed and there would be no change in land use for the fabrication of the additional containers. Similarly, cultural, aesthetic, and scenic resources would remain unaffected by the fabrication of the additional containers. Ecological resources, including wetlands, would not be affected since existing facilities can accommodate the fabrication of the additional containers and no new or expanded facilities would be required. No discernible increase in noise, traffic, or utilities would be expected from the fabrication of the additional containers.

Water consumption and effluent discharge during manufacture of the additional container systems would be typical of the heavy manufacturing facility and would represent only a small change, if any, from the existing use of the facilities selected. Similarly, effluent discharges would not increase enough to cause difficulty in complying with applicable local, state, and federal regulatory limits and it would not be expected that the effluent discharges would result in any discernible increase in pollutant activity.

4.10 Cumulative Impacts

The manufacture of alternative container systems, which would be used for naval spent nuclear fuel dry storage and transportation to a repository or storage at a centralized interim storage site, represents 1% to 4% of the total number of container systems for both naval and civilian spent nuclear fuel which would be manufactured for all spent nuclear fuel available for emplacement in a geologic repository or storage at a centralized interim storage site during the time period from 2010 to 2035 (TRW 1995). The total amount of material used over the 40-year period for naval spent nuclear fuel and special case waste container systems is less than 0.3% of the annual material use except for depleted uranium and for lead. The Transportable Storage Cask Alternative would require about 1.3% of annual U.S. domestic production of lead. The multi-purpose canister options would require between 6.4% and 7.5% of annual U.S. domestic production of depleted uranium. The cumulative environmental impacts resulting from the manufacturing of container systems would be small. The naval spent nuclear fuel container system manufacturing impacts, which include special case low-level radioactive waste would not result in discernible environmental consequences for the duration of the program.

4.11 Unavoidable Adverse Effects

Most of the impacts associated with manufacturing container systems would be unavoidable. Manufacturing alternative container systems would consume nonrenewable resources (energy and various metals) and produce some emissions and wastes. These materials would be needed to ensure adequate isolation of naval spent nuclear fuel from the environment and as shielding to reduce external radiation dose to regulatory levels. Casks would be reused whenever possible throughout the life of the project to minimize impacts. Under some alternatives, naval spent nuclear fuel would be removed from various canisters and eventually placed in a disposal container. For the No-Action, Current Technology/Rail, and Dual-Purpose Canister Alternatives, recycling canisters might eventually be feasible and would reduce impacts of material use. Even without recycling, the amounts of materials needed for production would be small compared with national levels of use and supply. Emission releases and waste disposal would comply with existing regulations.

4.12 Irreversible and Irretrievable Commitment of Resources

Manufacturing canisters, casks, and other components of these container systems would result in the consumption of nonrenewable materials. Although some of the components might eventually be recyclable, other materials would be processed as waste or disposed of at the repository. Manufacturing would also consume nonrenewable fuels (mostly fossil-based products). The amounts of these materials needed for the program are not considered to be a significant commitment of resources.

4.13 Relationship Between Short-Term Use of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The alternative container systems would ultimately lead to permanent disposal of much of the naval spent nuclear fuel. Indefinite storage or disposal are the only viable options for isolation of this material under existing laws and regulations. Although there would be short-term impacts resulting from implementing any of the alternatives (e.g., minor air quality impacts at manufacturing locations) and some relatively small long-term impacts resulting from the consumption of nonrenewable resources in manufacturing canisters and casks, these impacts would be incurred to improve long-term productivity. Long-term productivity of the environment would not be compromised by any of the alternatives under consideration.

4.14 Impact Avoidance and Mitigative Measures

4.14.1 Pollution Prevention

Under Executive Order 12856, Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements, the Navy is required to eliminate or reduce the unnecessary acquisition of products containing extremely hazardous substances or toxic chemicals. Although the alternative container systems would contain lead or depleted uranium, these substances are necessary to safely and efficiently shield spent nuclear fuel. Therefore, the Navy would use current technologies for pollution prevention and would meet pollution prevention standards for the manufacture of alternative container systems.

4.14.2 Potential Mitigative Measures

Under each alternative, only very small adverse impacts are anticipated, associated with air quality, health and safety, and the generation of solid and liquid waste. These impacts are expected to be relatively minor and within regulatory limits governing releases to the environment. It is also expected that manufacturers would provide adequate measures to minimize risks to workers, the public, and the environment through employee health and safety training programs and waste reduction and recycling programs. No additional mitigation is proposed.