as transuranic waste, the residues would be managed as HLW. The technical alternatives for managing the residues as HLW, however, would be the same as those for managing the residues under the LLW requirements. Thus, DOE expects that the potential environmental impacts that could result from managing the residues under the LLW requirements would be representative of the impacts if the HLW standards were applicable. For these reasons, this EIS does not present the management of tank residues as HLW as a separate alternative.

S.7.2 OTHER ALTERNATIVES CONSIDERED, BUT NOT ANALYZED

DOE considered the alternative of delaying closure of additional tanks, pending the results of research. For the period of delay, the impacts of this approach would be the same as the No Action Alternative. DOE continues to conduct research and development efforts aimed at improving closure techniques. DOE's evaluation of the No Action Alternative presents the impacts of delaying closure.

DOE considered an alternative that would represent grouting of certain tanks and removal of others. DOE has separately examined the impacts of both tank removal and grouting. Depending on the ability of cleaning to meet performance requirements for a given tank, the decision makers may elect to remove a tank if it is not possible to meet the performance requirements by using another method. This EIS captures the environmental and health and safety impacts of both options.

S.8 Comparison of Environmental Impacts Among Alternatives

Closure of the HLW tanks would affect the environment, as well as human health and safety, during the period of time when work is being done to close the tanks and after the tanks have been closed. For this EIS, DOE has defined the period of short-term impacts to be from the year 2000 through about 2030, or the period during which the HLW tanks would be closed. Long-term impacts would be those resulting from the eventual release of residual waste contaminants from the stabilized tanks to the environment. In this EIS, DOE has estimated these impacts over a period of 10,000 years.

S.8.1 SHORT-TERM IMPACTS

DOE evaluated short-term impacts of the tank closure alternatives on a number of environmental media. DOE also characterized the employment required for each alternative and estimated the cost to close a HLW tank using each alternative.

DOE compared impacts in the following areas:

- Geologic and Water Resources
- Nonradiological Air Quality
- Radiological Air Quality
- Ecological Resources
- Land Use
- Socioeconomics
- Cultural Resources
- Worker and Public Health Impacts
- Environmental Justice
- Transportation
- Waste Generation
- Utilities and Energy Consumption
- Accidents

In general, the No Action Alternative has the least impact on the environment over the short term, the Clean and Remove Tanks Alternative has the greatest, and the impacts of the Stabilize Tanks Alternative falls in between. Table S-2 shows those areas in which there are notable differences in impacts among the alternatives.

For the short term, No Action means continuing normal tank farm operations, including waste transfers, but not closing any tanks. The impacts, in terms of radiological and nonradiological air and water emissions and human health and safety, are the least of the three alternatives and in all cases are very small.

Table S-2. Summary comparison of short-term impacts by tank closure alternative.

Parameter	No Action Alternative	Stabilize Tanks Alternative: Fill with Grout Option	Stabilize Tanks Alternative: Fill with Sand Option	Stabilize Tanks Alternative: Fill with Saltstone Option	Clean and Remove Tanks Alternative	
						TC
Geologic Resources						EC
Soil backfill (m^3)	None	170,000	170,000	170,000	356,000	
Air Resources						EC
Nonradiological air emissions (tons/yr.):						
Particulate matter	None	4.5	3.1	1.7	None	L-4-7
Carbon monoxide	None	5.6	5.6	8.0	None	
Benzene	None	0.02	0.02	0.43	None	
Air pollutants at the SRS boundary (maximum concentrations-mg/m^3)[a]:						TC
Carbon monoxide – 1 hr.	None	1.2	1.2	3.4	None	
Volatile organic compounds – 1 hr.	None	0.5	0.5	2.0	None	
Annual radionuclide emissions (curies/year):	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	0.46	1.5×10^{-4}	L-11-7
Socioeconomics (employment – full time equivalents)						EC
Annual employment	40	85	85	131	284	
Life of project employment	980	2,078	2,078	3,210	6,963	
Worker Health and Safety						EC
Radiological dose and health impacts to involved workers						
Closure collective dose (total person-rem)	29.4[b]	1,600	1,600	1,800	12,000	
Closure latent cancer fatalities	0.012	0.65	0.65	0.72	4.9	
Occupational Health and Safety:						
Recordable injuries–closure	110[c]	120	120	190	400	
Lost workday cases–closure	60[c]	62	62	96	210	

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Table S-2. (Continued).

Parameter	No Action Alternative	Stabilize Tanks Alternative: Fill with Grout Option	Stabilize Tanks Alternative: Fill with Sand Option	Stabilize Tanks Alternative: Fill with Saltstone Option	Clean and Remove Tanks Alternative
Transportation					
Offsite round-trip truckloads (per tank)	0	654	653	19	5
Waste Generation					
Maximum annual waste generation:					
Radioactive liquid high-level waste (gallons)	0	600,000	600,000	600,000	1,200,000
Nonradioactive liquid waste (gallons)	0	20,000	20,000	20,000	0
Low-level waste (m^3)	0	60	60	60	900
Total estimated waste generation					
Radioactive liquid high-level waste (gallons)	0	12,840,000	12,840,000	12,840,000	25,680,000
Nonradioactive liquid waste (gallons)	0	428,000	428,000	428,000	0
Low-level waste (m^3)	0	1,284	1,284	1,284	19,260
Mixed low-level waste (m^3)	0	257	257	257	428
Utility and Energy Usage					
Water (total gallons)	7,120,000	48,930,000	12,840,000	12,840,000	25,680,000
Steam (total pounds)	NA	8,560,000	8,560,000	8,560,000	17,120,000
Fossil fuel (total gallons)	NA	214,000	214,000	214,000	428,000
Utility cost (total)	NA	$4,280,000	$4,280,000	$4,280,000	$12,840,000

TC
EC
EC
TC
EC

a. No exceedances of air quality standards are expected.
b. Collective dose for the No Action Alternative is for the period of closure activities for the other alternatives. This dose would continue indefinitely at a rate of approximately 1.2 person-rem per year.
c. For the No Action Alternative, recordable injuries and lost workday cases are for the period of closure activities for the other alternatives. These values would continue indefinitely.
NA = Not available.

> The primary health effect of radiation is the increased incidence of cancer. Radiation impacts on workers and public health are expressed in terms of latent cancer fatalities. A radiation dose to a population is estimated to result in cancer fatalities at a certain rate, expressed as a dose-to-risk conversion factor. DOE uses dose-to-risk conversion factors of 0.0005 per person-rem for the general population and 0.0004 per person-rem for workers. The difference is due to the presence of children in the general population, who are believed to be more susceptible to radiation. EC
>
> DOE estimates the doses to the population and uses the conversion factor to estimate the number of cancer fatalities that might result from those doses. In most cases, the result is a small fraction of one. For these cases, DOE concludes that the action would very likely result in no additional cancer in the exposed population.

Over the short term, the Clean and Remove Tanks Alternative has significantly greater impacts than the other alternatives. This is particularly notable in worker exposure to radiation and the resultant cancer fatalities, and in the numbers of on-the-job injuries. DOE's analysis estimates that implementation of the Clean and Remove Tanks alternative would result in about five cancer fatalities in the worker population, while the estimate for the
TC Stabilize Tanks Alternative is less than one, and the estimate for No Action is essentially zero. The Clean and Remove Tanks Alternative would result in the generation of twice as much liquid radioactive waste and about 15 times as much
EC LLW as the Stabilize Tanks Alternative. The waste generation would be the result of the activities required to clean the tanks so they could be removed from the ground, and from disposal of the tanks as LLW at another location
EC on the SRS.

As stewards of the Nation's financial resources, DOE decision makers must also consider cost of the alternatives. DOE has prepared rough estimates of cost for each of the alternatives.

L-4-15 L-2-12 L-6-2

These estimates, which are presented on a per tank basis, are as follows:

No Action Alternative:
<$100,000 (over the 30-year action period)

Stabilize Tanks Alternative:

- Fill with Grout Option:
  $3.8 - 4.6 million
- Fill with Sand Option:
  $3.8 - 4.6 million
- Fill with Saltstone Option:
  $6.3 million

Clean and Remove Tanks Alternative:
>$100 million

The labor and waste disposal requirements of the Clean and Remove Tanks Alternative would result in a cost of more than $100 million per tank, compared to about $6.3 million for the most costly option (Fill with Saltstone) of the TC
Stabilize Tanks Alternative. While the Clean and Remove Tanks Alternative would effectively eliminate the future radiation dose at the seepline, under the Fill with Grout Option TC
this seepline dose would be within the 4 millirem-per-year drinking water standard, which would equate to 0.000002 latent cancer fatality. Thus, DOE would spend $4.9 billion (for all 49 HLW tanks) to reduce a projected dose that already would be less than 4 millirem. The Clean and Remove Tanks Alternative would EC
result in about 12,000 person-rem (4.9 latent cancer fatalities) within the population of SRS workers performing these activities. TC

There are some differences in impacts among the three options of the Stabilize Tanks TC
Alternative in the short term, but none are significant. The Fill with Grout Option would TC
use about four times as much water (from groundwater sources) as the other options. The Fill with Saltstone Option would employ the TC
most workers and result in more occupational injuries and a very slightly increased risk of cancer fatalities for workers. It would also be the most costly of the three options.

DOE evaluated the impacts of potential accidents related to each alternative. The highest consequence accidents would be transfer errors (spills) and seismic events during TC
cleaning. Both of these accidents could happen during cleaning under the Stabilize Tanks Alternative and the Clean and Remove Tanks

Alternative, and there is no difference in the consequences.

S.8.2 LONG-TERM IMPACTS

In the long term, the important impact to consider is the effect on the environment and human health of residual waste contaminants that will eventually find their way to the accessible environment. DOE estimated long-term impacts by completing a performance evaluation that includes fate and transport modeling for the No Action Alternative and Stabilize Tanks Alternative over a period of 10,000 years, to determine when certain impacts (e.g., radiation dose and the associated health effects) would reach their peak value. There are always uncertainties associated with the results of analyses, especially if the analyses attempt to predict impacts over a long period of time. These uncertainties could result from assumptions used, the complexity and variability of the process(es) being analyzed, the use of incomplete information, or lack of information. The uncertainties involved in estimating impacts over the 10,000-year period analyzed in this EIS are described in Chapter 4 and Appendix C of the EIS. Table S-3 shows those areas in which there are notable differences in impacts among the alternatives.

Any waste that migrates through the groundwater and outcrops at a stream location (called a "seepline" in the EIS) would result in radiological doses and possible consequent health effects to individuals exposed to water containing the contaminants. Because of the long travel time from the closed and stabilized tank to the groundwater outcrop, the impacts would be substantially reduced, compared to what they might have been if the contaminants came into the accessible environment more quickly. This can be seen clearly by comparing the long-term impacts of the No Action Alternative to the impacts of the Fill with Grout Option of the Stabilize Tanks Alternative. Figure S-7 graphically illustrates this point. The pattern of the peaks in the graph results from the simplified and conservative approach used in the modeling, such as the simplifying assumption that the tanks would release their entire inventories simultaneously and completely.

If the Clean and Remove Tanks Alternative were chosen, residual waste would be removed from the tanks and the tank systems themselves would be removed and transported to SRS radioactive waste disposal facilities. Long-term impacts at these facilities are evaluated in the *Savannah River Site Waste Management EIS* (DOE/EIS-0217). That EIS analyzed the long-term impacts of the low-activity waste vaults at two locations: a hypothetical well 100 meters downgradient from the facility, and in the Savannah River. At the 100-meter well, the calculated radiation dose from the low-activity waste vaults is approximately one-one thousandth of the peak 100-meter well dose from HLW tank closure activities presented in this EIS

Under this alternative, some land in E Area would be permanently committed to disposal and would therefore be unavailable for other uses or for ecological habitat. After removal of the tanks and subsequent CERCLA actions, some land and habitats could become available for other uses.

The fate and transport modeling indicates that movement of residual radiological contaminants from closed HLW tanks to nearby surface waters via groundwater would also be limited by the three stabilization options under the Stabilize Tanks Alternative. Based on the modeling results, all three stabilization options under the Stabilize Tanks Alternative would be more effective than the No Action Alternative. The Fill with Grout Option would be the most effective of the three tank stabilization options, as far as minimizing long-term movement of residual radiological contaminants.

Conservative modeling, which exaggerates concentrations at wells close to the tank farms, estimates that doses from groundwater at wells 1 meter and 100 meters distant from the tank farms, and at the seepline in Fourmile Branch, would be very large under the No Action Alternative. Under the Stabilize Tanks Alternative, doses would be much smaller, but incremental doses at the 100-meter well for the Fill with

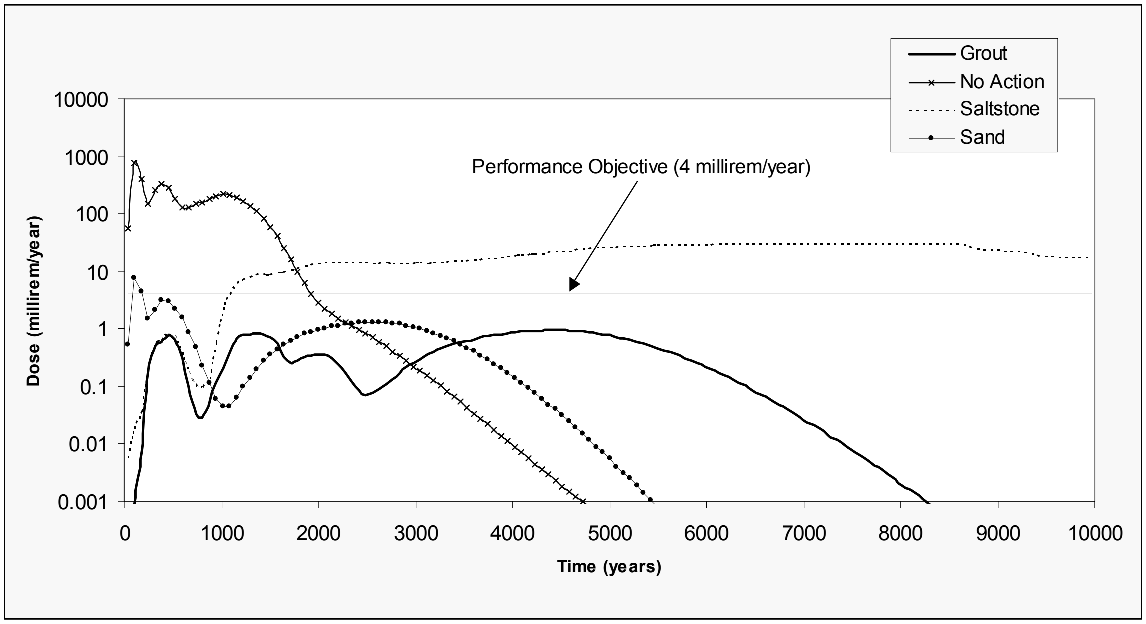
Table S-3. Summary comparison of long-term impacts by tank closure alternative.[a]

Parameter	No Action Alternative	Stabilize Tanks Alternative: Fill with Grout Option	Stabilize Tanks Alternative: Fill with Sand Option	Stabilize Tanks Alternative: Fill with Saltstone Option	
					TC
Surface Water					EC
Movement of contaminants	Limited movement of residual contaminants in closed tanks to downgradient surface waters	Almost no movement of residual contaminants in closed tanks to downgradient surface waters	Almost no movement of residual contaminants in closed tanks to downgradient surface waters	Almost no movement of residual contaminants in closed tanks to downgradient surface waters	
Maximum dose from beta-gamma emitting radionuclides in surface water (millirem/year)[b]					
Upper Three Runs	0.45	(c)	4.3×10^{-3}	9.6×10^{-3}	
Fourmile Branch	2.3	9.8×10^{-3}	0.019	0.130	
Groundwater					EC
Groundwater concentrations from contaminant transport – F-Area Tank Farm:					
Drinking water dose (mrem/yr.)					
1-meter well	35,000	130	420	790	
100-meter well	14,000	51	190	510	
Seepline, Fourmile Branch	430	1.9	3.5	25	EC
Groundwater concentrations from contaminant transport – H-Area Tank Farm:					
Drinking water dose (mrem/yr.)					
1-meter well	9.3×10^{6}	1×10^{5}	1.3×10^{5}	1×10^{5}	
100-meter well	9.0×10^{4}	300	920	870	
Seepline:					EC
North of Groundwater Divide	2,500	2.5	25	46	
South of Groundwater Divide	200	0.95	1.4	16	
Maximum Groundwater Concentrations of Nitrates[d]					EC
1-meter well	270	21	22	440,000	
100-meter well	69	4.7	4.9	180,000	
Seepline	3.4	0.1	0.2	3,300	

Table S-3. (Continued).

Parameter	No Action Alternative	Stabilize Tanks Alternative: Fill with Grout Option	Stabilize Tanks Alternative: Fill with Sand Option	Stabilize Tanks Alternative: Fill with Saltstone Option	
					TC
Ecological Resources					EC
Maximum absorbed dose to aquatic and terrestrial organisms (in millirad per year):					
Sunfish dose	0.89	0.0038	0.0072	0.053	
Shrew dose	24,450	24.8	244.5	460.5	
Mink dose	2,560	3.3	25.6	265	
Public Health					EC
Radiological contaminant transport from F-Area Tank Farm:					
Adult resident latent cancer fatality risk	2.2×10^{-4}	9.5×10^{-7}	1.8×10^{-6}	1.3×10^{-5}	
Child resident latent cancer fatality risk	2.0×10^{-4}	8.5×10^{-7}	1.7×10^{-6}	1.2×10^{-5}	
Seepline worker latent cancer fatality risk	2.2×10^{-7}	8.0×10^{-10}	1.6×10^{-9}	1.2×10^{-8}	
Intruder latent cancer fatality risk	1.1×10^{-7}	4.0×10^{-10}	8.0×10^{-10}	8.0×10^{-9}	
Adult resident maximum lifetime dose (millirem)[e]	430	1.9	3.6	26	
Child resident maximum lifetime dose (millirem)[e]	400	1.7	3.3	24	
Seepline worker maximum lifetime dose (millirem)[e]	0.54	0.002	0.004	0.03	
Intruder maximum lifetime dose (millirem)[e]	0.27	0.001	0.002	0.02	
Radiological contaminant transport from H-Area Tank Farm:					
Adult resident latent cancer fatality risk	8.5×10^{-5}	3.5×10^{-7}	5.5×10^{-7}	6.5×10^{-6}	TC
Child resident latent cancer fatality risk	7.5×10^{-5}	3.3×10^{-7}	5.5×10^{-7}	6.5×10^{-7}	
Seepline worker latent cancer fatality risk	8.4×10^{-8}	(f)	4.0×10^{-10}	6.8×10^{-9}	
Intruder latent cancer fatality risk	4.4×10^{-8}	(f)	(f)	3.2×10^{-9}	
Adult resident maximum lifetime dose (millirem)[e]	170	0.7	1.1	13	
Child resident maximum lifetime dose (millirem)[e]	150	0.65	1.1	1.3	
Seepline worker maximum lifetime dose (millirem)[e]	0.21	(c)	0.001	0.017	
Intruder maximum lifetime dose (millirem)[e]	0.11	(c)	(c)	0.008	

a. The Clean and Remove Tanks Alternative is not presented in this table because the residual waste (and tank components) would be removed from the tank farm areas and transported to SRS radioactive waste disposal facilities; impacts of this facility are evaluated in the *SRS Waste Management EI*S (DOE/EIS-0217).
b. For comparison, the average annual background radiation dose to a member of the public is approximately 360 millirem per year.
c. The radiation dose for this alternative is less than 1×10^{-3} millirem.
d. Given in percent of EPA Primary Drinking Water Maximum Contaminant Levels (MCL). A value of 100 is equivalent to the MCL concentration.
e. Calculated based on an assumed 70-year lifetime.
f. The risk for this alternative is less than 4.0×10^{-10}.



L-2-13

Figure S-7. Predicted drinking water dose over time at the H-Area seepline north of the groundwater divide in the Barnwell-McBean and Water Table Aquifers. EC

TC Saltstone Option would still exceed the average annual dose a person receives from natural and man-made sources (about 360 millirem per TC year). The same is true for the Fill with Sand and Fill with Saltstone Options in the H-Area Tank Farm at the 100-meter well. The doses decrease substantially with distance from the tank farm.

TC The greatest long-term radiological impacts to groundwater and surface water occur under the No Action Alternative. For this alternative, the Maximum Contaminant Level for beta-gamma radionuclides is exceeded at all points of TC exposure. On the other hand, the Fill with Grout Option shows the lowest long-term impacts at all exposure points, and the Maximum Contaminant Level for beta-gamma radionuclides is met at the TC seepline for this alternative. Impacts for the Fill with Grout Option would occur later than under TC the No Action Alternative or the Fill with Sand Option. The Fill with Saltstone Option would delay the impacts at the seepline, but would TC result in a higher peak dose than either the Fill with Grout or Fill with Sand Options.

TC DOE does not envision relinquishing control of the area around the tank farms. However, DOE recognizes that there is uncertainty in projecting future land use and the effectiveness of institutional controls considered in this EIS. TC If, in the future, people were unaware of the presence of the closed waste tanks and chose to live in homes built over the tanks, they would have essentially no external radiation exposure under the Fill with Grout Option or the Fill with Sand Option. TC Residents could be exposed to external radiation under the Fill with Saltstone Option, due to the presence of radioactive saltstone near the ground surface. If it is conservatively assumed that all shielding material over the saltstone would be removed by TC erosion or excavation, a resident living on top of a closed tank, at 1,000 years after tank closure would be exposed to an effective dose equivalent of 390 millirem/year, resulting in an estimated 1 percent increase in risk of latent cancer fatality from a 70-year lifetime of exposure. For the No Action Alternative, external exposures to onsite residents would be expected to be unacceptably high, due to the potential for contact with residual waste.

The risk of incurring a fatal cancer as a result of radiation doses is also greater under the No Action Alternative than under any of the Options

TC TC of the Stabilize Tanks Alternative. The preferred Option, Fill with Grout, would result in the least risk of a fatal cancer of all the options under the Stabilize Tanks Alternative.

TC Model results show some adverse impacts to aquatic and terrestrial organisms under the No Action Alternative, but much smaller exposures under the options of the Stabilize and Tanks Alternative.

TC To assist in addressing cumulative impacts, SRS prepared a report, referred to as the Composite Analysis, that calculated the potential cumulative impact to a hypothetical member of the public over a period of 1,000 years from releases to the environment from all sources of residual radioactive material expected to remain in the SRS General Separations Area, which contains all SRS waste disposal facilities, chemical separations facilities, HLW tank farms, and numerous other sources of radioactive material. The impact of primary concern was the increased probability of fatal cancers. The *Composite Analysis* also included contamination in the soil in and around the HLW tank farms resulting from previous surface spills, pipeline leaks, and Tank 16 leaks as sources of residual radioactive material. The Composite Analysis considered 114 potential sources of radioactive material containing 115 radionuclides.

From a land use perspective, the F- and H- Area Tank Farms are zoned Heavy Industrial and are within existing heavily industrialized areas. The alternatives evaluated in this EIS are limited to closure of the tanks and associated equipment. They do not address other potential sources of contamination co-located with the tank systems, such as soil or groundwater contamination from past releases or other facilities. Consequently, future land use of the tank farm areas is not solely determined by the alternatives for closure of the tank systems. For example, the Environmental Restoration program may determine that the tank farm areas should be capped to control the spread of contaminants through the groundwater. Such decisions would constrain future use of the tank farm areas. Any of these options under the Stabilize Tanks Alternative would render the tank farm areas least suitable for other uses, as the closed filled tanks would remain in the ground. The Clean and Remove Tanks Alternative would have somewhat less impact on future land use because the tank systems would be removed. However, DOE does not expect the General Separations Area, which surrounds the F- and H-Area Tank Farms, to be available for other uses.

S.9 Comments Received on Draft EIS

DOE summarized the comments received on the Draft EIS and grouped them in seven major categories, as discussed below.

<u>**Alternatives**</u>

Several comments questioned DOE's choice of alternatives for analysis or suggested additional alternatives that DOE should have considered. Specific topics included requests for clarification of the intent of the No Action Alternative, consideration of offsite disposal of tanks under the Clean and Remove Tanks Alternative, and a suggestion that DOE should cut up some of the tanks and place the components inside other intact tanks before grouting them. Several comments expressed concern or requested clarification about specific elements of the alternatives, including how transfer lines would be treated under the various alternatives and whether removed tank components would be disposed of in the SRS E-Area vaults under the Clean and Remove Tanks Alternative. EC

Response:

DOE finds that the suggested new and modified alternatives either are not reasonable or were effectively addressed by the analysis presented in the EIS. Therefore, DOE did not change the alternatives considered in the EIS (other than modifying the Clean and Stabilize Tanks Alternative). However, clarifying information was added to the EIS as a result of several of these comments, as described in the responses to individual comments in Appendix D.