APPENDIX B

ALTERNATIVE END STATES AND RECOMMENDATIONS

Alternative End State Definition and Application at SRS

The Savannah River Site (SRS) recommends four alternative end states with recommendations for implementation. The *SRS EM Performance Management Plan (PMP) Predecisional Draft* that was issued April 2004 is considered to be the SRS EM Cleanup project baseline. *For the purposes of this document, an alternative end state is defined as a significantly different cleanup approach or different end state relative to the* SRS EM PMP.

It is important to note that the proposed alternative end state and recommendations are considered to be "enablers" to accomplish the Environmental Management (EM) Cleanup Project by 2025 within the desired out year funding targets. Currently the SRS EM life-cycle baseline (technical scope, cost and schedule) is in the process of validation. After baseline validation, the alternative end states will be reassessed for changes to the EM Cleanup Project baseline.

The following alternative end states with associated implementation recommendations are submitted for consideration:

- Future Land Use and Exposure Scenario Modification
- Alternate Disposal for plutonium (Pu)-238 Contaminated Transuranic (TRU) Waste
- In Situ Decommissioning in lieu of Demolition
- Increased Liquid radioactive waste Defense Waste Processing Facility (DWPF) Canister Loading
- Area Completion

Total Risk Comparison for Alternative End States

- Alternative End State # 1: Future Land Use and Exposure Scenario Modification

The planned land use and exposure scenario—and, consequently, cleanup levels—for essentially all SRS areas is currently industrial. For many areas of SRS (see Alternate End State and Recommendation Table below), it is reasonable to anticipate that land use and exposure scenarios will be limited to infrequent maintenance activities (Alternate End State) as opposed to what would be expected in a typical industrial (Planned End State) land use scenario.

The total risk for the Alternative End State (AES) is less than Planned End State (PES). The resultant level of risk of both the AES (to a maintenance worker/receptor) and the PES (to an industrial worker/receptor) for Soil and Groundwater Project (SGP) waste units is essentially identical. The remaining "risk" (see explanation - Section 1.3, *Hazard and Risk Relationship*, in Chapter 1, *Introduction*) to a human receptor, regardless of receptor scenario, is assumed to fall within the 10^{-4} to 10^{-6} range with institutional controls. This "risk" is due to the exposure assumptions that factor into the assessment/calculation of receptor risk.

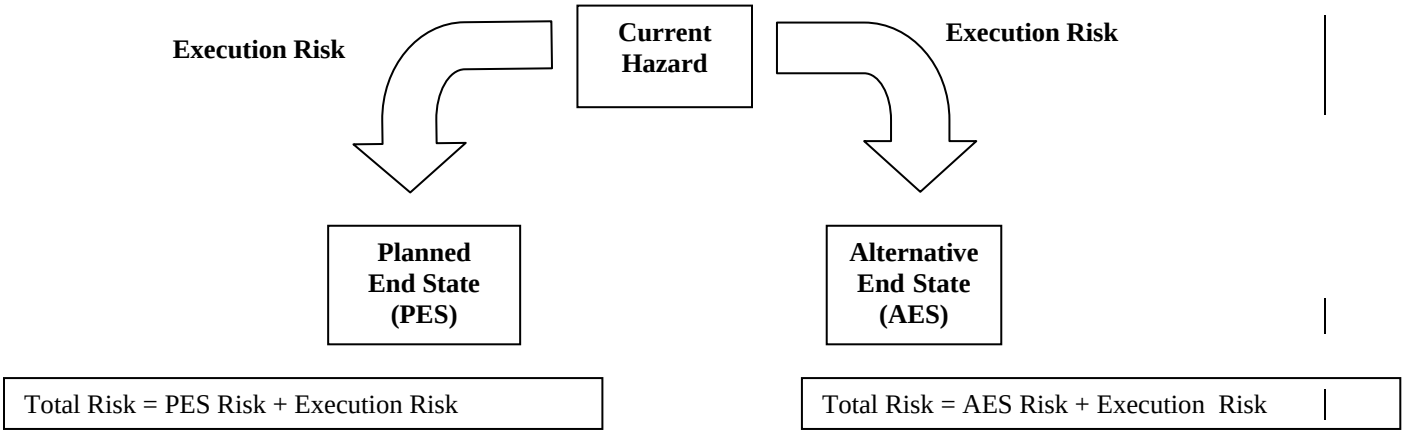
The largest factor that dictates the difference between the AES and PES is the amount of time an individual receptor is assumed to be exposed to contaminated material over a period of time. (See text box for generalized definitions for potential receptors.) The change in receptor (from industrial to maintenance) allows higher concentration(s) of contaminated material/media to remain while being equally protective of human health. This equates to a lower execution

risk (i.e., the hazard present while *achieving* the end state) for cleanup to maintenance levels, due to the fact that less (or no) remedial activity is needed to achieve levels protective of the maintenance worker. Thus the cleanup worker spends less time in the impacted area, and is less exposed to contaminated material.

Utilizing the approach as indicated in the schematic below, the AES, as proposed, would actually represent a decrease in total risk when considering the decrease in the execution risk as described in the preceding paragraph.

Future Industrial Worker
This scenario addresses long-term risks to workers who are exposed to unit-related constituents while working in an industrial setting. The future industrial worker is a person who works in an outdoor industrial setting that is in direct proximity to the contaminated media. EPA has established standard exposure assumptions that are utilized for the typical Future Industrial Worker scenario.

Maintenance Worker (Future)
The maintenance worker (future) is a receptor at an isolated, abandoned area that has not industrial or commercial activities planned for the future. The maintenance worker scenario addresses long-term risks to a receptor who may visit the abandoned area (i.e., having no future mission) on an infrequent or occasional basis. Maintenance activities, such as ant control, landscaping, site inspections, or perimeter security verification would make up the majority of the worker's time.



In order for the Department of Energy-Savannah River (DOE-SR) to attain the AES, two critical paradigm changes must occur. First, the regulatory community and the public must accept an atypical receptor scenario (maintenance worker) with corresponding input assumptions that represent realistic environmental conditions.

The Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response Directive No. 9355.7-04, *Land Use in the CERCLA Remedy Selection Process*, states that "reasonably anticipated future use of the land…is an important consideration in determining the appropriate extent of remediation. Future use of the land will affect the types…and frequencies of exposure that may occur, which in turn affects the nature of the remedy chosen."

Second, DOE must make a commitment to control the respective SRS area in perpetuity, prohibiting industrial, as well as residential land use of said areas.

The Maintenance Worker exposure scenario, based on reasonable anticipation that an area will have no future industrial/commercial activities or use, must be mutually agreed upon by the DOE, South Carolina Department of Health and Environmental Control (SCDHEC) and EPA as representing a credible, sustainable end state. This agreement will be necessary for each individual area.

There is also a potential concern that relegating one or more areas of SRS to a "no future industrial use or mission" status (warranting a Maintenance Worker, rather than Industrial, future exposure assumption) will be perceived as condemnation of SRS property, reducing the overall attractiveness of SRS for potential new missions or redevelopment.

Map B.1 depicts the potential areas of SRS that may be candidates for Maintenance-Long Term Stewardship scenario as described by this alternative

<u>Alternative End State # 2:</u> Alternate Disposal for Pu-238 Contaminated TRU Waste

TRU waste contaminated with Pu-238 is planned to be characterized, repackaged, and shipped to the Waste Isolation Pilot Plant (WIPP). The Pu-238 is stored in many types of containers, including large steel boxes, other boxes, 55-gallon drums, and boxes and drums inside of concrete culverts. Some of the Pu-238 waste containers are under an earthen cover.

There are 1800 cubic meters of this waste, containing 300,000 curies. The contamination control of this material has been demonstrated to be difficult and will require modification of existing facilities or new facilities. The current shipping container (TRUPACT II) cannot ship these waste containers either due to size or high Pu-238 curie loading.

EPA regulation 40 *Code of Federal Regulations* (CFR) 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*, and DOE Order 435.1, *Radioactive Waste Management*, allow disposal of TRU waste in a non-WIPP location and/or an exception to the definition of TRU waste. Waste, which DOE determines meets the EPA 40CFR191 performance objectives or that DOE and EPA determine does not need the degree of isolation required by the EPA regulation, can be disposed in a non-WIPP location.

Disposal at SRS of any small amount of Pu-238 waste would result in no significant impact to the public or the environment. Preliminary performance assessment calculations have shown that due to Pu-238's relatively short 88-

year half life, disposal at SRS would be protective of groundwater to EPA drinking water standards. Because Pu-238 has a short half life, uranium-234 becomes the contaminant of concern instead of Pu-238 from the radioactive decay process of the waste. Uranium-234 is not a transuranic isotope but is a common radioactive isotope in low-level waste that is disposed safely at SRS and other LLW disposal facilities across the country. Therefore, a performance assessment of near-surface disposal would show that groundwater, intruder, and public protection standards can be met.

Near-surface disposal would also avoid a significant worker exposure concern from repackaging the waste to meet stringent waste acceptance criteria for disposal at WIPP. Also, an estimated $180 million cost savings would be realized by disposal onsite versus building a unique, expensive facility to characterize and repackage the Pu-238 waste for shipment to WIPP (not including the disposal costs at WIPP).

The contamination control of Pu-238 material has been demonstrated to be difficult and will require modification of existing facilities or new facilities. Some of the Pu-238 waste is very high in Pu-238 oxide content and is stored in inner containers that have suspect integrity. (The outer concrete culverts/steel boxes ensure safe storage.) In order to ship this waste to WIPP, many of the containers would have to be opened in order to repackage the waste to meet transportation requirements and to remove WIPP-prohibited items. Existing facilities are not adequate to protect SRS workers from potential releases from the containers with the highest Pu-238 concentrations. Very costly new facilities or modifications to existing facilities would be required.

With the potential of not having the required facilities to allow workers to handle the waste and with the resulting increased exposure of workers handling the waste, an alternative—on-site disposal—will eliminate significant worker risk. The preliminary estimates of 1800 cubic meters of Pu-238 waste not shippable to WIPP are bounding estimates to ensure performance assessment calculations are conservative. The actual volume of Pu-238 waste that may be evaluated for this alternative end state will likely be far less.

The expected concept for disposal is to entomb the Pu-238 waste in a concrete monolith that would ensure risk mitigation through meeting the performance objectives for thousands of years. In fact the preliminary calculations have shown that the maximum concentration of Pu-238 in the groundwater over a period of 10,000 years would be very close to zero and the dose to the inadvertent intruder would be less than 20 percent of the regulatory limit. A full and complete performance assessment of the disposal design would be required along with independent technical reviews from a national panel should DOE decide to pursue this alternative, and stakeholders will have an opportunity to review the assumptions and analyses supporting it.

Any additional evaluation of this alternative would first require the removal of the earthen cover on TRU Pad 1 to determine the integrity of the waste containers and the ability to handle the waste. It is expected that the TRU Pad 1 waste will contain the most difficult Pu-238 waste to repackage for shipment to WIPP and the waste most probably appropriate for this alternative.

- Alternative End State #3: In-situ Decommissioning in lieu of Demolition

The *2002 EM PMP* end states were the "baseline" against which to evaluate potential alternative end states. In that *PMP*, the planned end state for SRS reactor buildings, chemical separations facilities (canyons), and other

hardened structures was deactivation and long-term surveillance and maintenance.

Since then SRS has planned and is executing a plan that takes all EM facilities to a final decommissioning end state of either demolition or in situ disposal. This approach reduces the long-term surveillance and maintenance that was envisioned by the *2002 EM PMP*. In situ disposal may be selected for a variety of facilities, ranging from hardened, contaminated nuclear facilities to non-contaminated water treatment facilities.

For each facility slated for in-situ disposal, it must also be demonstrated that the hazards have been removed or immobilized such that the remaining risk levels following in situ disposition are acceptable.

One or more facilities will be decommissioned in situ in all SRS areas except for A, M, N, and T Areas.

The first major facility scheduled for in situ disposal is P Reactor to support P-Area Closure in FY 2013. In preparation for that project, appropriate end state alternatives that are protective, reasonable, compliant with appropriate regulations, and consistent with the planned future use and end state for its area will be developed for evaluation

Since the EM PMP and planned end state condition for these facilities is now "in-situ disposal," it is no longer an alternative end state warranting a comparison to an existing plan.

This alternative end state will not be retained in this form for evaluation in any future versions of the *SRS End State Vision*, since it merely describes what is now the planned end state for the selected locations such as the reactors, canyons, and hardened facilities.

- Alternative End State # 4: Increased Liquid radioactive waste DWPF Canister Loading

The *2002 EM PMP* assumed that 6000 canisters of liquid radioactive waste would have to be made to complete the mission of the Defense Waste Processing Facility (DWPF). Increasing the amount of liquid radioactive waste that could be vitrified in each canister was identified in the March 2004 *Risk-Based End State Vision* for the Savannah River Site as a "variance," or alternative to the 2002 PMP end state.

The *2004 EM PMP*, however, already incorporates significantly increased waste loading in each canister, as a result of system engineering enhancements, reducing the estimated total number now to be 5060 canisters. Therefore, this previously identified variance is now a planned end state and no comparison to the original (2002 PMP) end state is warranted.

Technical factors, including the durability of the glass formed in the vitrification process at DWPF, limit the waste content of each canister. Work continues to overcome these technical limitations so that more waste can be included in each canister produced, resulting in fewer canisters needing to be filled, stored on SRS, and ultimately shipped to the federal repository, with commensurate reductions in worker and transportation risks.

This alternative end state will not be retained for evaluation in any future versions of the *SRS End State Vision*, since it merely describes what the standard mode for canister loading at SRS is now.

- Alternative #5 Area Completion

SRS had provided Alternative #5 as a component of Variance #2 in the March 2004 *Risk-Based End State Vision*. SRS decided to eliminate the methodology in the March 2005 End State Vision submittal due to the successful incorporation and implementation of the methodology as the standard or routine approach to environmental restoration activities at SRS. It

is being reinstated in this version to recognize: 1) that SRS has instituted Area Completion as the primary component of its Federal Facility Agreement (FFA) (see Section 1.5.1, *Clean Up Accomplished* in Chapter 1, *Introduction*); and 2) that cleanup efficiencies and effectiveness are realized as a result of its implementation.

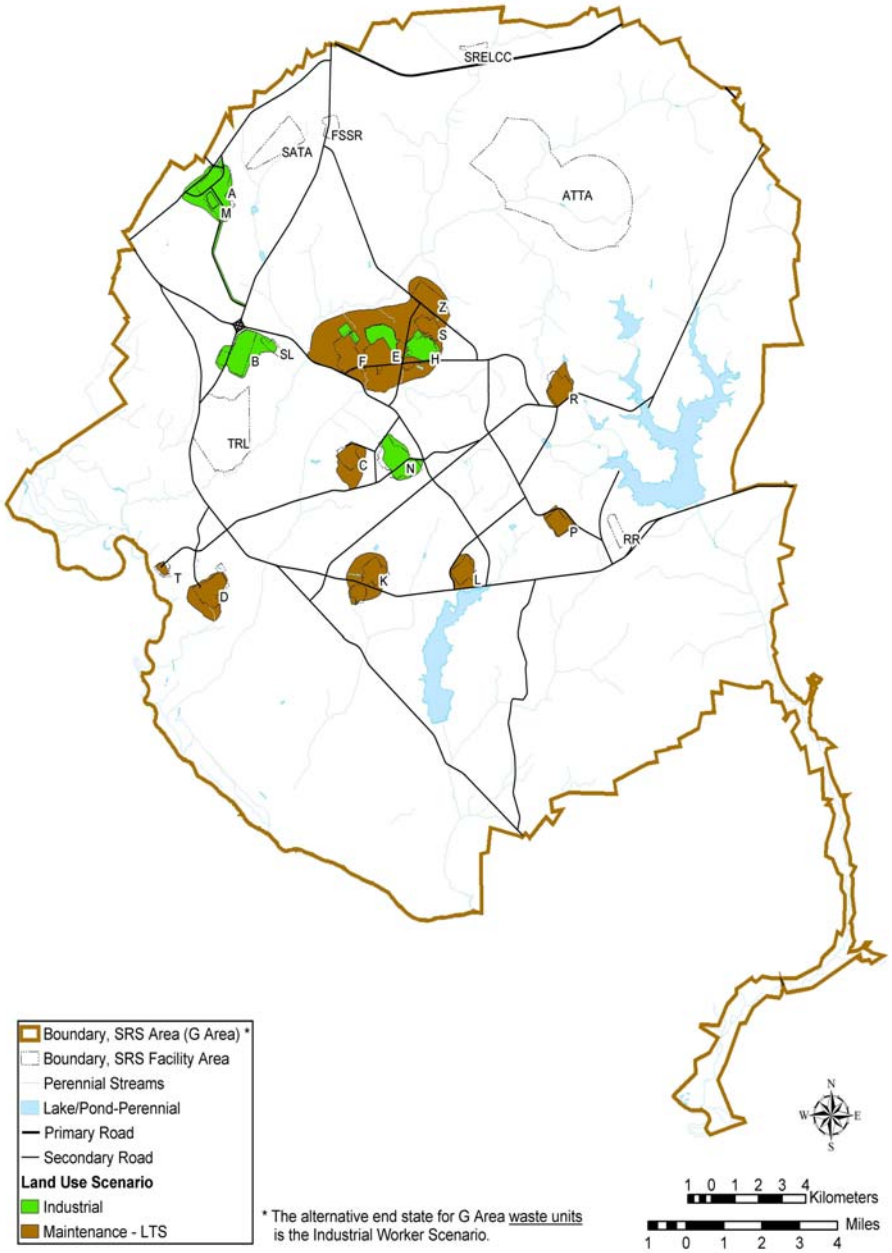
In the past, SRS addressed all inactive waste units and EM facilities hazards on an individual basis; that is, each waste unit and/or EM facility is characterized, assessed, and remediated as a single entity. There are at least twelve major heavy industrial areas at SRS. The industrial areas are generally fenced and contain buildings, pipelines, roads, railroads, and other industrial infrastructure. The areas generally range in size from tens to hundreds of acres. These areas contain numerous waste units and facilities slated for decommissioning. There are obvious advantages in addressing the area as a whole, performing characterization and assessments collectively, potentially remediating groups of hazards at one time, and integrating the closure of D&D facilities in conjunction with Soil and Groundwater Project facilities with subsequent deletion of substantial acreage from the National Priorities List. The three FFA parties are in the process of negotiating the details on the methodology to accomplish this and have called the approach the Area Completion. It is anticipated the modified exposure scenario presented in the Exposure Scenario Modification subsection (Alternative #1) will be applied to entire areas as well as for individual hazards, dependent upon future land use or mission. All SRS process/industrial areas are to be evaluated for Area Completion.

As a result of three party acceptance of the 2005 FFA Appendix E, which institutes the Area Completion approach to all of the heavy industrial areas at SRS; it is no longer an alternative end state warranting a comparison to an existing planned end state. That is, Area Completion is now SRS's Planned End State.

Alternative end states and Recommendations				
ID No.	**Description of Alternative End State**	**Impacts (in Terms of Scope, Cost, Schedule & Risk)**	**Barriers in Achieving End State Vision**	**Recommendations**
1	**<u>Alternative End State:</u> Future Land Use and Exposure Scenario Modification.** Proposed Future Land Use and associated receptor exposure scenario is Maintenance – Long Term Stewardship for previous industrial operations areas with no planned industrial reuse. (Current Planned End State/Future Land Use is Industrial with no Residential Land Use. Risk determination for Human receptors assumes an Industrial worker exposure scenario.)	**<u>Scope</u>: Exposure Scenario Modification.** SRS is currently in discussions with EPA Region IV and SCDHEC to establish and apply more appropriate exposure scenarios for selected areas of the site that are not planned to support any future mission. Justification for this modified receptor is that due to the lack of a mission, a maintenance worker or long-term stewardship worker will spend significantly less time at the unit, or in the area, than the day to day industrial worker. This modified exposure scenario will afford the three parties of the Federal Facility Agreement (DOE, EPA, DHEC) less conservative, yet realistic, input parameters that are utilized to calculate risk, based on the hazards present. Therefore, the end state calculated cancer risk will remain consistent between current/planned and vision approaches ($<10^{-6}$ residential and 10^{-4} to 10^{-6} worker with institutional controls); the change will be realized in the receptor specific inputs for the type of worker needed for the mission associated with the unit and/or area (e.g., industrial worker exposure = 2000 hrs/yr, while a maintenance/long term stewardship worker realizes 200 hrs/yr of exposure). It is assumed the scenario most likely to be applied for specific SRS facilities and/or areas without future missions will equate to an order of magnitude risk change that will be less conservative (i.e., if current industrial worker cancer risk calculates a 10^{-4} risk, then the vision maintenance worker risk will calculate a 10^{-5} risk). *Note: The Maintenance/Long-Term Stewardship exposure scenario described above (200 hours/year) is for illustration only. The actual*	**Regulatory Acceptance**. Approach deviates from routine/typical regulatory accepted methodology/protocol for evaluating risk. **Land Use.** Lack of binding/promulgated DOE land use policy for site.	Public and other stakeholders recommend Congressional Authorization to ensure perpetual federal ownership and LTS responsibility for SRS's fixed boundaries.

Alternative end states and Recommendations				
ID No.	**Description of Alternative End State**	**Impacts (in Terms of Scope, Cost, Schedule & Risk)**	**Barriers in Achieving End State Vision**	**Recommendations**
		exposure parameters for this estimating risk to this hypothetical receptor would be negotiated by DOE, SCDHEC, and EPA. **Current and Current Future Land Use is Industrial with No Residential Land Use.** Alternative end state proposes to revise Future Land Use as follows: • Continue Industrial: A,B,E-part, F-part, G, H, M, and N • **Maintenance-LTS: T,D,C, F-part, E-part, H-part, K,L,P,R,S,Z** • For facilities and/or resources that will be preserved and maintained as cultural resources as defined by the National Historic Preservation Act, appropriate land use and exposure scenarios will be negotiated that will accommodate any activities associated with these respective facilities/resources.		

B.1 - Alternative End State No. 1



Alternative end states and Recommendations				
ID No.	**Description of Alternative End State**	**Impacts (in Terms of Scope, Cost, Schedule & Risk)**	**Barriers in Achieving End State Vision**	**Recommendations**
2	**<u>Alternative End State:</u> Alternate Disposal for Pu-238 TRU Contaminated Waste**	**<u>Scope</u>**: TRU waste contaminated with Pu-238 is planned to be characterized, repackaged, and shipped to WIPP. The Pu-238 is stored in many types of containers including large steel boxes, other boxes, 55 gallon drums, and boxes and drums inside of concrete culverts. Some of the Pu-238 waste is under soil cover. There are 1800 cubic meters containing 300,000 curies (0.3 million). The contamination control when opening containers with high concentrations of this material has been demonstrated to be difficult and will require modification of existing facilities or new facilities. The current shipping container (TRUPACT II) cannot ship these waste containers either due to size or high Pu-238 curie loading. The WIPP Land Withdrawal Act, EPA regulation 40CFR191 and DOE Order 435.1 allows an exception to the definition of TRU waste. Waste that DOE and EPA have determined does not need the degree of isolation required by the EPA regulation. The determination is based on an evaluation of a disposal concept including a performance assessment to demonstrate protection of human health and the environment. Through a Performance Assessment of near surface disposal it can be shown that groundwater protection, intruder, and public protection standards can be met. Disposal in near surface disposal would avoid a significant worker exposure issue because containers would not need to be opened. Also an ~ $180M total potential cost savings to EM ($48M to SRS EM) would be realized by disposal onsite vs. characterization, repackaging, and shipment to WIPP (not including the disposal costs at WIPP).	Political barrier of State of SC willingness to allow disposal of additional 300,000 curies of Pu (thousands, however, not millions). Most of this would be mixed waste. SCDHEC has regulatory authority over the mixed waste and their approval would be required to remove mixed waste labels based on SRS process knowledge justification. SCDHEC does not have regulatory authority over the portion that is not labeled as mixed.	As TRU program moves toward completion, TRU not containing Pu-238 will be shipped to WIPP. This alternative for TRU containing Pu-238 will be evaluated in FY 2009, after the rest of the TRU has been dispositioned.

Alternative end states and Recommendations				
ID No.	**Description Of Alternative End State**	**Impacts (in Terms of Scope, Cost, Schedule & Risk)**	**Barriers in Achieving End State Vision**	**Recommendations**
3	**Alternative End State: In Situ Decommissioning in lieu of Demolition**	**Scope:** The 8-7-02 *SRS EM PMP* stops at deactivation for the Reactor and Canyon facilities and does not address decommissioning (demolition or in situ disposal) as a final end state for the Reactor and Canyon facilities. Planned End State now includes decommissioning and in situ disposal for the Reactor and Canyon facilities. In Situ decommissioning is ~50% less costly than demolition and risk assessments will identify this as a lower overall risk.	Exact end state condition for in-situ decommissioning needs better definition through technical evaluation of alternatives.	Further study will inform this end state. Not retained for evaluation in future version of the *SRS End State Vision*.
4	**Alternative End State: Increased Liquid Radioactive Waste DWPF Canister Loading**	**Scope:** *2002 EM PMP* assumed that 6000 LRW canisters would have to be produced at DWPF to complete the LRW mission at SRS. In the 2004 EM PMP, the assumed canister loading had already increased significantly through LRW system engineering improvements. Will not be retained as an Alternative End State in the Final SRS ESV, since higher canister loading has already been realized.	Further increases in canister loading are limited by technical factors such as the durability of the glass when higher amounts of waste are present.	Continue research and testing to improve glass durability, making further increases in canister loading possible. Not retained for evaluation in future versions of the *SRS End State Vision*.

Alternative end states and Recommendations				
ID No.	**Description Of Alternative End State**	**Impacts (in Terms of Scope, Cost, Schedule & Risk)**	**Barriers in Achieving End State Vision**	**Recommendations**
5	**Area Completion**	**Scope:** In the past, SRS addressed all inactive waste units and EM facilities hazards on an individual basis; that is, each waste unit and/or EM facility is characterized, assessed, and remediated as a single entity. There are at least twelve major heavy industrial areas at SRS. The industrial areas are generally fenced and contain buildings, pipelines, roads, railroads, and other industrial infrastructure. These areas contain numerous waste units and facilities slated for decommissioning. There are obvious advantages in addressing the area as a whole, performing characterization and assessments collectively, potentially remediating groups of hazards at one time, and integrating the closure of D&D facilities in conjunction with Soil and Groundwater Project facilities with subsequent deletion of substantial acreage from the National Priorities List.	None. DOE, EPA, and SCDHEC are in the process of negotiating the details on the methodology to accomplish this and have called the approach the Area Completion.	As a result of three party acceptance of the 2005 FFA Appendix E which institutes the Area Completion approach to all of the heavy industrial areas at SRS; it is no longer an alternative end state warranting a comparison to an existing planned end state. That is, Area Completion is now SRS's planned end state.