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# FAMS Decommissioning End-State Alternative Evaluation

G-AES-F-00002

May 25, 2006

Revision 0

**Washington Savannah River Company**
**Savannah River Site**
**Aiken, South Carolina 29808**

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# Revision Summary

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# Acronyms

| | |
|---|---|
| ABL | Actinide Billet Line |
| AHP | Analytic Hierarchy Process |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| BIO | Basis for Interim Operation |
| CEDE | Committed Effective Dose Equivalent |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CHA | Consolidated Hazard Analysis |
| D&D | Deactivation and Decommissioning |
| DOE | Department of Energy |
| DOE-SR | Department of Energy Savannah River Operations Office |
| EDE | Effective Dose Equivalent |
| ENV | Environment |
| FAMS | F-Area Material Storage |
| LOD | Letter of Direction |
| M&O | Management and Operations |
| NMM | Nuclear Material Management |
| NPH | Natural Phenomenon Hazard |
| OBU | Operations Business Unit |
| OML | Old Metallurgical Laboratory |
| PEF | Plutonium Experimental Facility |
| PuFF | Plutonium Fuel Form Facility |
| ROD | Record of Decision |
| S&M | Surveillance and Maintenance |
| SCDHEC | South Carolina Department of Health and Environmental Control |
| SDD | Site D&D |
| SGCP | Soil & Groundwater Closure Project |
| SPFF | Special Products Fabrication Facility |
| SRNL | Savannah River National Laboratory |
| WSMS | Washington Safety Management Solutions |
| WSRC | Washington Savannah River Company |

# Executive Summary

The FAMS decommissioning end-state alternative evaluation was performed in order to recommend a preferred end-state in support of the FAMS decommissioning project. A qualitative approach was used for this alternative analysis. The scope of this alternative analysis was established as addressing decommissioning options for the FAMS metallurgical building itself (specifically including the underground condensate/waste storage tank and old stack (293-F)), the sandfilter (294-2F), and the associated ventilation tunnel (both below and above ground portions).

A team of subject matter experts was assembled to participate in the alternative study with additional experts utilized as needed. The study was facilitated by Systems Engineering and followed a structured, disciplined approach. The decision criteria were weighted and the alternatives evaluated by applying the Analytic Hierarchy Process using the commercial decision analysis software package Expert Choice® 11.

The evaluation team recommends that the FAMS decommissioned end-state be:

1. **FAMS building -** "In-situ - entire building"; this alternative was defined as: the entire building remains, large voids filled, and openings sealed. The structure may be covered and/or capped, if required. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with applicable or relevant and appropriate requirements (ARAR). PuFF contamination would be fixed and then grouted (no decontamination). PEF contamination would also be fixed and then grouted. OML contamination would be fixed and then grouted. The old stack would be taken down to the level of the building. ABL would have all equipment removed prior to grouting the FAMS building. Normal deactivation would be completed in the remainder of the building, except for the holdup areas (PuFF, PEF, and OML). Process ventilation will have contamination fixed, additional support added as needed, and will be grouted in place.
2. **Sandfilter -** "In-situ - all voids filled/capped"; this alternative includes filling the voids in the sand as well as the freeboard above the sand. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
3. **Underground ventilation tunnel -** "In-situ - fill voids/no decontamination"; this alternative includes filling the underground ventilation tunnel voids without decontamination.
4. **Underground Condensate/Waste Tank -** "In-situ - fill voids"; this alternative includes filling the underground condensate/waste tank voids.

This recommendation is based on the weighted decision criteria listed in the table E.1 and the evaluation of the alternatives against the weighted decision criteria. The evaluation was sensitive to changes in the weights of the decision criteria and, therefore, if those weights are adjusted the alternative ranking could also be changed. The evaluation team reviewed the sensitivities and agreed to accept them.

The regulatory approach to be used for FAMS in-situ disposal (i.e., project scope not anticipated to be decommissioned to the slab) is the CERCLA remedial process, similar to the approach used by Soil & Groundwater Closure Project (SGCP). This approach is different from the typical removal action process advocated in WSRC 1C manual for decommissioning projects in which the Department of Energy (DOE) assumes lead agency authority. A Record of Decision (ROD) would be negotiated and approved by the DOE, the Environmental Protection Agency (EPA), and the South Carolina Department of Health and Environmental Control (SCDHEC). The negotiations between the DOE, EPA, and SCDHEC will determine the appropriate end state for FAMS, including the potential need for a cover and/or cap while awaiting F-Area Completion by SGCP.

| Decision Criteria Name | % Weight |
|---|---|
| **Minimize long term co-located worker, public, and environment (env.) risk** | **29%** |
| **Minimize short term co-located worker, public, and environment risk** | **23%** |
| **Minimize D&D worker risk** | **18%** |
| **Maximize stakeholder acceptance** | **12%** |
| **Minimize impact to F-Area closure** | **8%** |
| **Minimize D&D and S&M costs** | **4%** |
| **Minimize effort to dispose of waste** | **4%** |
| **Minimize schedule** | **2%** |

**Table E.1 FAMS Decommissioning Evaluation Decision Criteria**

# 1.0 Introduction

## 1.1 Purpose of Evaluation

Nuclear Material Management (NMM) completed a comprehensive study at the request of the Department of Energy Savannah River Operations Office (DOE-SR) in 2004 (Reference 11.1). The study evaluated the feasibility of removal and/or mitigation of the Pu-238 source term in the F-Area Material Storage (FAMS) facility during on-going material storage operations. The study recommended different options to remove and/or mitigate the Pu-238 source term depending on its location within the facility.

During April 2005, the Department of Energy (DOE) sent a letter of direction (LOD) to Washington Savannah River Company (WSRC) directing WSRC to implement a new program direction that would enable an accelerated shutdown and decommissioning of FAMS (Reference 11.2). Further direction in the LOD stated that effective December 1, 2006 the facility will be transitioned to begin deactivation and decommissioning (D&D) activities. To implement the LOD, Site D&D (SDD) and DOE agreed the planning end-state would be demolition of the FAMS structure to the building slab. SDD developed the D&D strategy, preliminary cost and schedule, and issued the deactivation project plan in December 2005 (Reference 11.3).

Due to concerns and questions regarding the FAMS planning end-state and in support of the project's Critical Decision 1, an alternative study was performed to evaluate the various decommissioning end-states and the methods by which those end-states are achieved. This report documents the results of the alternative evaluation which was performed in a structured decision-making process as outlined in the E7 Manual, Procedure 2.15, “Alternative Studies” (Reference 11.4).

## 1.2 Background

The FAMS facility was constructed in the 1950’s. It was originally designed as a blast resistant structure and has since been shown to satisfy current Design Basis Earthquake (DBE) and Design Basis Tornado (DBT) criteria. The FAMS facility has been used for a variety of missions. Two of the major missions located in the facility included the Special Products Fabrication Facility (SPFF) and the heat source production for the space program.

During the mid to late 1960’s, the FAMS facility housed the SPFF. The SPFF originally consisted of twenty-six (26) gloveboxes, which included material blending equipment, furnaces, cold press, hot press, welding equipment, and non-destructive assay facilities. Prior to 1975, the SPFF supported programs processing U-238, Np-237, and Pu-239 oxide.

To permit new facility construction in the mid 1970’s, the SPFF was decontaminated and decommissioned, except for the first nine (9) gloveboxes which were renamed the Actinide Billet Line (ABL). Construction began on the Plutonium Fuel Form Facility (PuFF), Plutonium Experimental Facility (PEF), and Old Metallurgical Laboratory (OML) to support heat source production (Pu-238) for the space program in 1975. During 1983 operations in the PuFF, PEF, ABL, and OML were discontinued.

The current mission of the FAMS facility is material storage. The material storage mission encompasses receipt, interim storage and surveillance of excess plutonium materials. Additional activities include the repackaging of material to allow reuse of the shipping containers and to package material for long term storage. The FAMS facility will be deinventoried, except for holdup material, and transferred to SDD for D&D.

See the FAMS complex deactivation project plan (Reference 11.2) for additional information on the history of the FAMS facility and for the FAMS facility description.

### 1.3 Study Team Members

A team of subject matter experts was assembled to perform the FAMS decommissioning end-state alternative evaluation. The following people participated in the evaluation:

| | |
|---|---|
| Helen Belencan | DOE-SR / F-Area Closure Project |
| Pushpa Bhatia* | NMM Eng / Regulatory Programs |
| Dennis Bickford | SRNL / Materials Science & Technology |
| Ed Blush | SDD / Surveillance & Maintenance |
| Greg Burbage* | NMM Eng / Regulatory Programs |
| Gary Chandler | SDD / Engineering & Regulatory Programs |
| Stephen Chostner | SDD / Deactivation Engineering |
| Jim Cook | SRNL / Environmental Analysis |
| Dave Davis* | CBU / Liquid Waste Projects |
| Steve Etheridge | SDD / Environmental & Regulatory Support |
| Brenda Green | SDD / FAMS Complex Project Mgr |
| Bob Grimm | OBU / Systems Engineering |
| Jerry Hansen* | WSMS |
| P.K. Hightower | NMM / FAMS Operations |
| Chris Langton | SRNL / Stabilization Science Research |
| Clinton McCalla | NMM / K-Area Plant Engineering |
| Dennis McCaskill* | NMM / FAMS Project |
| Pat Nakagawa | SGCP / Program & Regulatory |
| Peyton Northington | SDD / Engineering & Regulatory Programs |
| Lisa Oliver | SDD / Environmental & Regulatory Support |
| Joe Quattlebaum | SDD / Radiological Engineering |
| Mark Rensch | OBU / Systems Engineering |
| John Reynolds | DOE-SR / F-Area Closure Project |
| Jesse Roach | SDD / Environmental & Regulatory Support |
| Joe Santos* | SDD / D&D Characterization |
| Randy Yourchak* | M&O / F-Area Closure Project |
| Elmer Wilhite | SRNL / Chemical Science & Technology |
| Mike Willis* | SDD / Deactivation Engineering |
| Mark Phifer* | SRNL / Environmental Restoration Technology |

*Individuals marked with an asterisk were utilized as additional resources off-line and did not attend any evaluation meetings.

## 2.0 Scope of Evaluation

The FAMS complex deactivation project plan (Reference 11.2) was written to include all buildings and structures within the FAMS perimeter fence plus the 246-3F, blend cabinet storage building. The study team members reviewed the list of facilities and area maps in order to establish the boundaries of the FAMS decommissioning end-state evaluation.

The scope of this alternative analysis was established as addressing only those decommissioning options for the FAMS metallurgical building itself (specifically including the underground condensate/waste storage tank, old stack (293-F)), the sandfilter (294-2F), and the associated ventilation tunnel (both below and above ground portions).

With the scope established as noted above, the overall FAMS decommissioning end-state evaluation was broken into four sub-evaluations; 1) the FAMS building (to include the above ground portions of the exhaust tunnel), 2) the sandfilter, 3) the underground condensate/waste tank, and 4) the underground ventilation tunnel. The four sub-evaluations were completed separately by the team in order to determine the final preferred FAMS decommissioned end-state.

# 3.0 Goals

The goals and objectives identified by the evaluation team for the FAMS decommissioning project are provided in Table 3.1. The goals and objectives provided the basis for creation of the decision criteria that were used to evaluate the end-state alternatives.

| Number | Goal/Objective Description |
|---|---|
| G.1 | Reduce the risks to D&D workers from residual radiological, chemical, biological, or physical hazards |
| G.2 | Reduce the risks to Co-located workers, the public, and/or environment from residual radiological, chemical, biological, or physical hazards |
| G.3 | Minimize future Surveillance and Maintenance cost for the facility |
| G.4 | Support future F-Area closure/completion |
| G.5 | Complete D&D by end of FY2012 (minimize schedule) |
| G.6 | Minimize Cost of D&D |
| G.7 | Optimize Work Sequence (tradeoff between learning to reduce risk vs. early deactivation to remove inventory earlier) |
| G.8 | Supports CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) Process |
| G.9 | Minimize generation of orphan waste (waste without known disposition path) |
| G.10 | Minimize waste generated |

**Table 3.1 FAMS Decommissioning Goals / Objectives**

# 4.0 Assumptions

The study team made the following assumptions in completion of the FAMS decommissioning end-state evaluation:

4.1. The sandfilter contains <1 gm Pu 238 based on facility process history and building assays. Note that the sandfilter and associated underground ventilation tunnel will be characterized prior to D&D activities.
4.2. "Filling of voids" does not include piping but does include large ducts.
4.3. Portion of ventilation tunnel attached to the FAMS building is considered part of the building and would have the same decommissioned end-state as the building.
4.4. MOU between NMM and SDD governs turnover and identifies condition of facility at turnover. Facility will still be operable but will be deinventoried of MC&A nuclear material (does not include hold up).
4.5. Deactivation involves removal/treatment of equipment and prepares the facility for decommissioning.
4.6. Decommissioning involves impact to the building structure (or the final activities involved in getting to the end state for in-situ).

4.7. Surveillance and maintenance (S&M) may be modified according to revised authorization basis when deactivation is completed.
4.8. Normal deactivation will be completed in the FAMS building except for the holdup areas (PuFF, PEF, and OML). The D&D alternatives for the holdup areas are specifically identified in Section 7.1.
4.9. FAMS and the 294-2F sandfilter may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.

# 5.0 Functions and Requirements

The mission statement for the FAMS complex D&D activities was established as:

> "Place FAMS, and its associated underground tunnel and sand filter in a safe, stable, and low-cost engineering state that meets the threefold decommissioning objectives: (1) to reduce the risks to workers, the public, and/or environment from residual radiological, chemical, biological, or physical hazards; (2) to minimize future Surveillance and Maintenance cost for the facility; and (3) to facilitate future "area closure/completion."

The top FAMS decommissioning function is developed from the mission statement and is listed in Table 5.1 below, function 1.0, along with the top level of sub-functions. The functional hierarchy is provided in Figure 5.1.

The functional flow for the top level set of functions identified for the FAMS decommissioning activity is provided in Figure 5.2, FAMS Complex Decommissioning Functional Flow Diagram. The FAMS operation & de-inventory function performed by NMM (0.ReferenceFunction) was included as a reference function for the current state of the FAMS facility and is not considered part of the decommissioning activity.

| Function No. | Function Name |
|---|---|
| 1 | Place FAMS complex in an end-state that meets decommissioning objectives |
| 1.1 | Turnover from NMM to SDD |
| 1.2 | Post-turnover surveillance & maintenance |
| 1.3 | Deactivation |
| 1.4 | Decommissioning |
| 1.5 | Post-decommissioning surveillance & maintenance |

**Table 5.1 FAMS Decommissioning Functions**

Turnover of the FAMS facility from NMM to SDD will be completed following; de-inventory of FAMS, except for holdup material listed in references 11.5-11.12, a D&D BIO is implemented, and D&D activities are ready to commence. There will be a period of surveillance & maintenance (S&M) between turnover of the facility and the beginning of facility deactivation. After deactivation is complete, there will be a period of S&M prior to starting the FAMS facility decommissioning phase. Following decommissioning, a period of long term surveillance and maintenance will begin.

The evaluation team identified requirements for the FAMS decommissioning end-state alternatives. The requirements are listed below. This list is in no way meant to be inclusive. These requirements were specifically identified as those being pertinent to alternative development.

REQUIREMENTS:

R.1 The following performance objectives shall be met:
- Dose to representative members of the public shall not exceed 25 mrem per year total effective dose equivalent (EDE) from all exposure pathways, excluding the dose from radon and its progeny in air.
- Dose to representative members of the public via the air pathway shall not exceed 10 mrem per year total EDE, excluding the dose from radon and its progeny.
- Release of radon shall be less than an average flux of 20 pCi/m2/s at the surface of the facility. Alternatively, a limit of 0.5 pCi/L of air may be applied at the boundary of the facility.

R.2 Personnel exposure shall be maintained ALARA.

R.3 The decommissioning alternative selected shall be technically feasible and constructible.

R.4 The FAMS decommissioned end state shall comply with an excess lifetime cancer risk (ELCR) less than $10E^{-4}$. (Reference Section 1.3.1, Hazard Released, in the SRS End State Vision document dated July 26, 2005.)

R.5 FAMS deactivation and decommissioning shall comply with all applicable DOE Orders, State and Federal Laws and Regulations (DOE O 435.1 Change 1 Radioactive Waste Management was specifically noted). Natural Phenomenon Hazards (NPH) will be covered by the Consolidated Hazard Analysis Process (CHAP) as specified in WSRC 11Q manual (Reference 11.13) and SCD-11 (Reference 11.14).

R.6 FAMS deactivation and decommissioning shall comply with all applicable Site Policies and Procedures (the Facility Disposition Manual, Procedure Manual 1C was specifically noted).

R.7 The mitigated site boundary dose of 5 Rem 50yr CEDE shall not be exceeded.

R.8 The mitigated 100 meter co-located worker dose of 100 Rem 50yr CEDE shall not be exceeded.

R.9 The SDD waste minimization program shall be implemented for this D&D project.

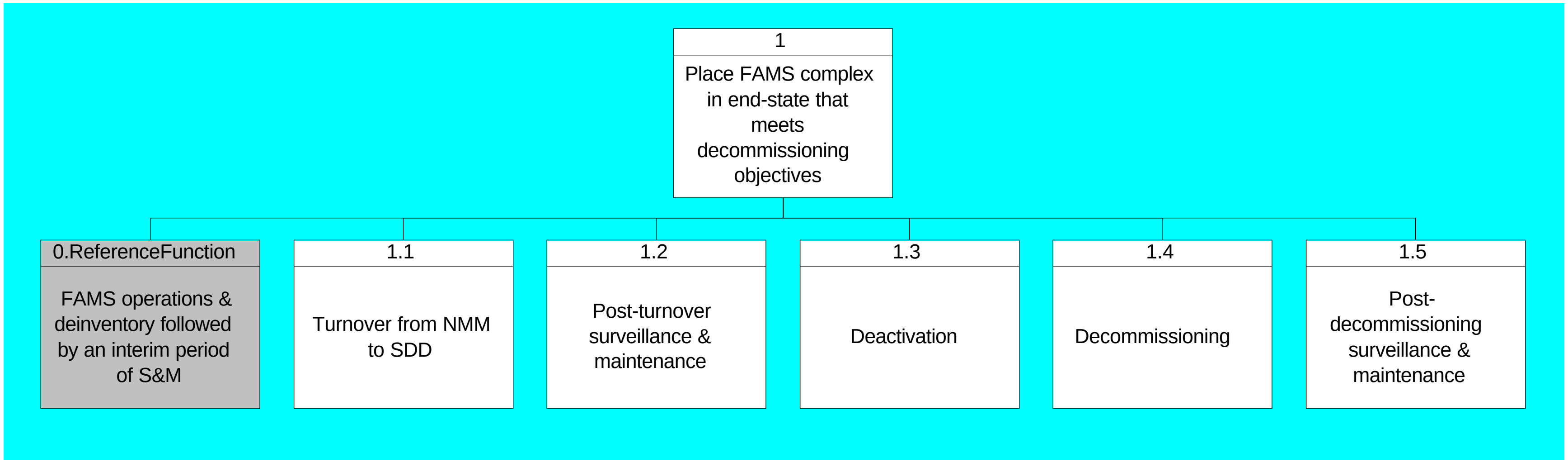


**Figure 5.1 FAMS Decommissioning Functional Hierarchy Diagram**

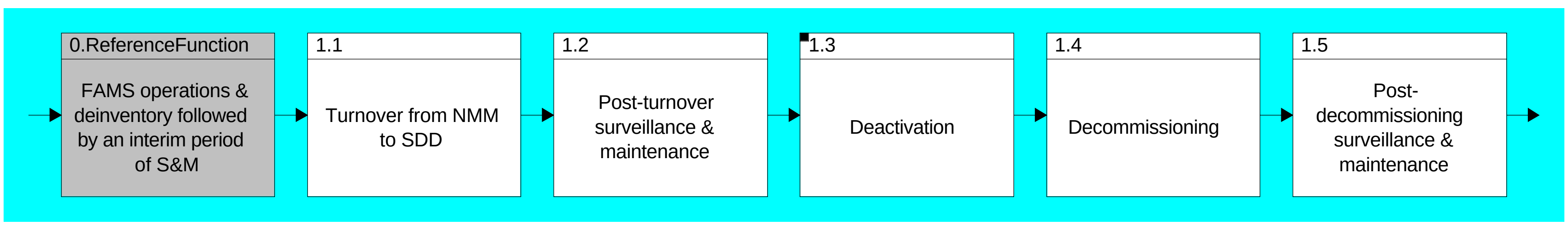


**Figure 5.2 FAMS Decommissioning Functional Flow Diagram**

# 6.0 Decision Criteria

## 6.1 Description of Criteria

The set of decision criteria generated by the evaluation team are listed below:

**Minimize D&D worker risk**
**Minimize short term co-located worker, public, and environmental risk**
**Minimize long term co-located worker, public, and environmental risk**
**Minimize impact to F-Area closure**
**Minimize schedule**
**Minimize D&D and S&M costs**
**Minimize waste disposal effort**
**Maximize stakeholder acceptance**

The descriptions associated with each of the criteria can be found in Table 6.1. These criteria were developed from the goals and objectives identified for the FAMS decommissioning project and by consideration of important factors in the selection of an alternative end-state.

| Decision Criteria Name | Decision Criteria Description |
|---|---|
| **Minimize D&D worker risk** | Minimize risk to D&D workers from residual radiological, chemical, biological, or physical hazards |
| **Minimize short term co-located worker, public, and env. risk** | Minimize short term risk to Co-located workers, the public, and the environment from residual radiological, chemical, biological, or physical hazards. Short term risk is defined as the risk during deactivation and decommissioning activities. |
| **Minimize long term co-located worker, public, and env. risk** | Minimize long term risk to Co-located workers, the public, and the environment from residual radiological, chemical, biological, or physical hazards. Long term risk is defined as the future risk after deactivation and decommissioning activities have been completed. |
| **Minimize impact to F-Area closure** | Minimize impact to F-Area closure/completion. This criterion measures how well an alternative complements the F-Area closure/completion plan. The F-Tank closure and assumed F-Canyon in-situ disposal (Site Closure Plan) should be considered for the evaluation. An alternative that would require additional work by SGCP after D&D in order for F-Area closure to be completed will receive a lower score than an alternative that would not require additional work. Additionally, an alternative that requires more work than necessary for D&D than is consistent with F-Area closure would also receive a lower score than an alternative that minimizes the amount of D&D work, and associated risks, required. |
| **Minimize schedule** | Minimize schedule required for completion of the D&D activity. Funding for FAMS D&D has been identified through 2012. An alternative that would allow D&D to occur prior to 2012 would be preferred to an alternative requiring additional funding past the 2012 date. |

| Decision Criteria Name | Decision Criteria Description |
|---|---|
| **Minimize D&D and S&M costs** | Minimize both D&D and future, long term surveillance and monitoring costs. This criterion considers both the costs associated with the D&D activity and the long term surveillance and monitoring costs following decommissioning. An alternative that minimizes the total costs will be preferred. |
| **Minimize effort to dispose of waste** | Minimize the effort required to dispose of D&D waste. Labor, cost, and safety associated with removal of the D&D waste are considerations. |
| **Maximize stakeholder acceptance** | Maximize acceptance for the D&D activity from the public and regulators. (The team assumed stakeholder acceptance would be higher for disposal of material in 'approved' waste disposal sites as opposed to in-situ disposal). |

**Table 6.1 Decision Criteria Descriptions**

## 6.2 Decision Criteria Weights

The decision criteria were weighted by applying the Analytic Hierarchy Process (AHP) using the commercial decision analysis software package Expert Choice® 11. The evaluation team performed a series of pairwise comparisons on the criteria with respect to their relative importance to the overall goal of selecting the FAMS decommissioning end-state. See Appendix C for more information on the pairwise comparisons.

The weighted decision criteria are shown in Figure 6.1 below. The highest weighted criterion was "Minimize long term risk to the co-located worker, public and environment" at 29% of the total weight. The next three highest weighted criteria were "Minimize short term risk to the co-located worker, public and environment", "Minimize risk to the D&D worker", and "Maximize stakeholder acceptance" at 23%, 18%, and 12% respectively. The remaining four criteria were each less than 10% of the total weight.

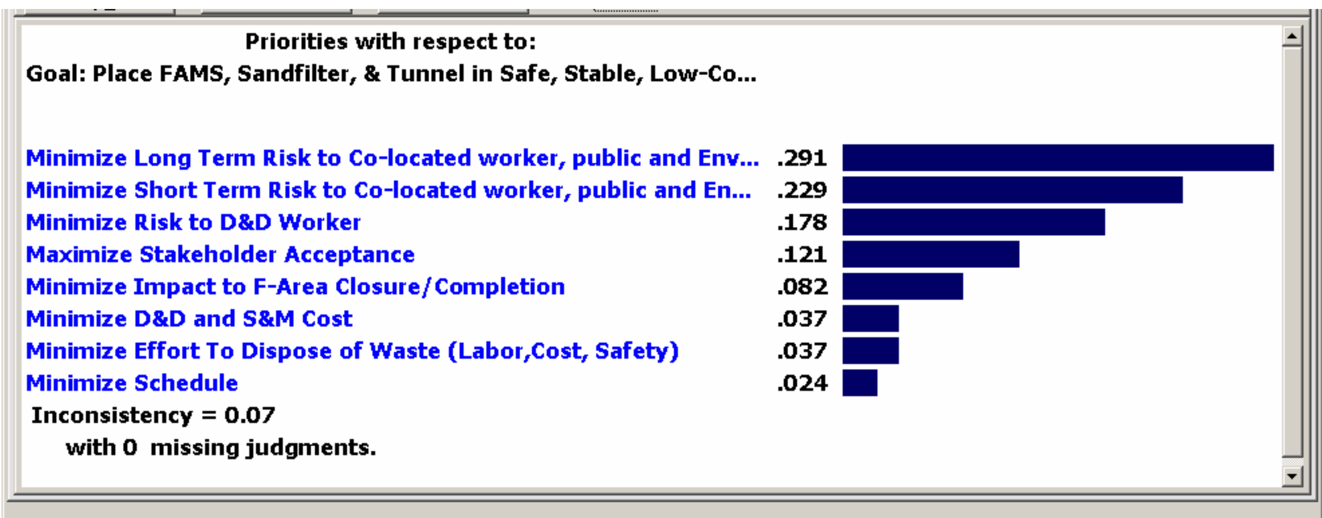


**Figure 6.1 Decision Criteria Weights**

It should be noted that the criteria were reviewed for applicability at the beginning of each sub-evaluation. The team determined that the criteria were applicable as developed and therefore the criteria and their weights were the same throughout the evaluation.

# 7.0 FAMS Building Evaluation

There are several areas of great concern in the FAMS building. These holdup areas have differing materials and amounts of materials and include the PuFF, PEF, OML, ABL, and their supporting ventilation systems (References 11.5 through 11.12). In developing alternatives for FAMS building end-states, the team reviewed the building history and current states for these areas. The primary concern for the PuFF, PEF, and OML is Pu 238 and the main concern for the ABL is Np 237 (Reference 11.15). The old stack, that was used and removed from service before construction of PuFF, PEF, or OML, was also included as an area of concern due to its close proximity to the FAMS building and the biological hazard associated with it.

During the discussions and alternative brainstorming of these areas, the team determined that the alternative end states and methods for reaching the end-states for PEF and OML primarily are dependent upon what happens to the PuFF. Also, the team determined that the appropriate end-state for the ABL, regardless of the FAMS building end-state, was removal of all equipment due to the Np-237 history, which has a long half life (2.14E+06 years) and high mobility in groundwater. The half life of Pu-238 is much shorter (8.78E+01 years), making the fix and grout scenario much more viable (Reference 11.1). And, finally, it was apparent to the team that the end-state of the old stack was dependent on the end-state of the overall building structure.

Because of this, the team focused on the overall end-state of the building and PuFF during the alternative identification activity. Given a FAMS building end-state and options for PuFF in reaching the end-state, the PEF, OML, and old stack D&D methods were easily defined without debate.

Except for the holdup areas, it was assumed that normal deactivation would be completed in the remainder of the building.

## 7.1 Alternative Identification

The alternative identification phase of the evaluation began with a brainstorming exercise. The goal of brainstorming was to generate ideas without regard to feasibility or attractiveness of the idea. During brainstorming the team did not evaluate the ideas but rather simply recorded the alternatives and used them to generate additional ideas. The alternatives would be screened for feasibility and alignment with the requirements in the next step.

It should be noted that an issue was identified following completion of the evaluation with respect to performance of a cap. A SME cautioned that, under certain conditions, a cap could potentially result in greater water infiltration, of a grouted FAMS building, than without the cap. As a result, the SME met with the team prior to issuing this report to discuss the issue. It was determined by the team that the evaluation was acceptable as completed. The team further noted that the report should indicate that the final determination of a cover and/or cap would be performed by the CERCLA process. The CERCLA process will evaluate the need for a cover and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.

The brainstorming activity began with identification of building end-states. These alternative end-states and descriptions are listed below:

BRAINSTORMED FAMS BUILDING ALTERNATIVES

1. **In-situ - entire building**: Entire building remains, large voids filled, and openings sealed. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
2. **In-situ - partial / PuFF cells**: PuFF cells remain (first floor only), all other parts of building removed, and openings sealed. The remaining PuFF cells and slab structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the

facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.

3. **In-situ - partial / first floor**: Entire first floor remains, 2nd floor removed, 1st floor large voids filled, and openings sealed. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
4. **In-situ - entire building / no cover or cap**: Entire building remains with only the 1st floor large voids filled and openings sealed. Second floor no fill. No cover or cap.
5. **Total removal - building and slab**: Entire building demolished including removal of slab.
6. **Removal of building to slab - cover and cap**: Entire building demolished with slab remaining, cover and/or cap on slab (tunnel under cells will be filled, tunnel considered part of the slab). The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
7. **Removal of building to slab - no cover or cap**: Entire building demolished with slab remaining, no cover and cap on slab (tunnel under cells will be filled, tunnel considered part of the slab).
8. **No action**: No D&D completed. Close the doors and walk away.

Following brainstorming, the alternatives were screened against the requirements found in Section 5.0. Alternative 4, In-situ - entire building/no cover or cap, was eliminated because the team felt that it would not meet requirements R.1 and R.8 and posed an unacceptable risk to follow-on workers as well as an assumed unacceptability to stakeholders. Alternative 8, No action, was eliminated because it would not meet requirements R.1, R.2, R.4, R.5, R.6, R.7, and R.8. Additionally, as with Alternative 4, the No action alternative would pose an unacceptable risk to follow-on workers and would be unacceptable to stakeholders. Based on the knowledge of the subject matter experts on the team, the other alternatives passed the screening against the requirements. The list of screened FAMS building end-states is given below:

SCREENED FAMS BUILDING ALTERNATIVES

1. **In-situ - entire building**
2. **In-situ - partial / PuFF cells**
3. **In-situ - partial / first floor**
5. **Total removal - building and slab**
6. **Removal of building to slab - cover and cap**
7. **Removal of building to slab - no cover or cap**

There are three in-situ alternatives and three building removal alternatives. The possible PuFF deactivation and decommissioning methods for the in-situ and removal alternatives are different. However, the PuFF D&D alternative methods for the three in-situ end-states are all the same. Similarly, the D&D alternative methods for the three removal end-states are also all the same. The brainstormed PuFF D&D methods are listed below:

BRAINSTORMED PuFF IN-SITU ALTERNATIVES

1. **In-situ - decon, fix, grout**: Decontaminate and remove as much material as possible, spray fixative, then fill with grout.
2. **In-situ - fix, grout**: Apply fixative then grout. No Decontamination.
3. **In-situ - grout**: Grout only, no fixative or decontamination.
4. **In-situ - encapsulate cells with grout**: No action taken inside cells. Surround cells with secondary structural wall and fill grout around cells.

BRAINSTORMED PuFF REMOVAL ALTERNATIVES

1. **Decon, fix, remove**: Decontaminate and remove as much material as possible, spray fixative, and remove equipment and cells.
2. **Fix, remove**: Apply fixative, no decontamination, remove equipment and cells.

The PuFF D&D methods were also screened against the requirements in Section 5.0. The only alternative that failed to meet the requirements was the 'In-situ - encapsulate cells with grout" option. That D&D method would leave a void and would therefore not meet requirement R.3 for technical feasibility. The void doesn't mitigate future subsidence. It may also result in "bath tub" leaching water accumulation and leaching of contaminants with subsequent migration of solubilized contaminants.

SCREENED PuFF IN-SITU ALTERNATIVES
1. **In-situ - decon, fix, grout**
2. **In-situ - fix, grout**
3. **In-situ - grout**

SCREENED PuFF REMOVAL ALTERNATIVES
1. **Decon, fix, remove**
2. **Fix, remove**

Combining the three different FAMS building in-situ end-states with the three PuFF in-situ D&D methods, along with the three different FAMS building removal end-states and the two PuFF removal D&D methods into one evaluation, results in an unmanageable number of alternatives to evaluate. As a result, the FAMS evaluation was broken into two PuFF sub-evaluations to select the preferred 1) PuFF in-situ D&D method and the 2) PuFF removal D&D method. After selection of the PuFF in-situ and removal D&D methods, the FAMS building end-states could be more easily evaluated. Refer to Sections 7.2.1 and 7.2.2 for the PuFF in-situ and removal evaluations.

After completion of the PuFF in-situ and removal evaluations, the team completed the definition of the FAMS building end-state alternatives by defining the methods for PEF, OML, and the old stack.

Table 7.1.1, found on the next page, summarizes the FAMS building end-state alternatives that were developed.

| No. | FAMS Building End State | PuFF D&D Method | PEF D&D Method | OML D&D Method | Old Stack D&D Method | ABL D&D Method |
|---|---|---|---|---|---|---|
| 1 | In-Situ - Entire Building: Entire building remains, large voids filled, and openings sealed. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR. | Apply fixative then grout. No Decontamination. | Fix contamination and grout in place. | Fix contamination and grout in place. | Take down to level of building. | Remove all equipment. |
| 2 | In-Situ - Partial / PuFF Cells: PuFF cells remain (first floor only), all other parts of building removed, and openings sealed. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR. | Apply fixative then grout. No Decontamination. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Take down to level of PuFF cells. | Remove all equipment. |
| 3 | In-Situ - Partial / First Floor: Entire first floor remains, 2nd floor removed, 1st floor large voids filled, and openings sealed. The structure may be and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR. | Apply fixative then grout. No decontamination. | Fix contamination and grout in place. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Take down to level of first floor. | Remove all equipment. |
| 5 | Total Removal - Building and Slab: Entire building demolished including removal of slab. | Decontaminate and remove as much material as possible, spray fixative, and remove equipment and cells. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Take down to ground. | Remove all equipment. |
| 6 | Removal of Building to Slab - Cover and Cap: Entire building demolished with slab remaining, cover and/or cap on slab (tunnel under cells will be filled, tunnel considered part of the slab). The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR. | Decontaminate and remove as much material as possible, spray fixative, and remove equipment and cells. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Take down to ground. | Remove all equipment. |
| 7 | Removal of Building to Slab - No Cover or Cap: Entire building demolished with slab remaining, no cover and cap on slab (tunnel under cells will be filled, tunnel considered part of the slab). | Decontaminate and remove as much material as possible, spray fixative, and remove equipment and cells. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Fix contamination, remove gloveboxes, ventilation, and equipment. | Take down to ground. | Remove all equipment. |

**Table 7.1.1 FAMS Building Alternatives**

## 7.2 Evaluate Alternatives

As described in Section 7.1 above, the FAMS building end-state sub-evaluation was completed by first evaluating the PuFF in-situ alternatives and then the PuFF removal alternatives. With the PuFF D&D methods selected for both the in-situ and removal end-states, the FAMS building end-states were evaluated.

### *7.2.1 PuFF In-Situ Alternative Evaluation*

The team evaluated the three PuFF in-situ alternatives against the weighted decision criteria listed in Section 6.2. As with the weighting of the decision criteria, the evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The evaluation team performed a series of pairwise comparisons on the alternatives with respect to each of the decision criteria. The results of the evaluation are shown in Figure 7.2.1.1 below.

The "In-situ - fix, grout" alternative was the highest ranked alternative at 0.384 followed by the "In-situ - decon, fix, grout" alternative with a score of 0.361. The "In-situ - grout" alternative received the lowest ranking with a score of 0.255.

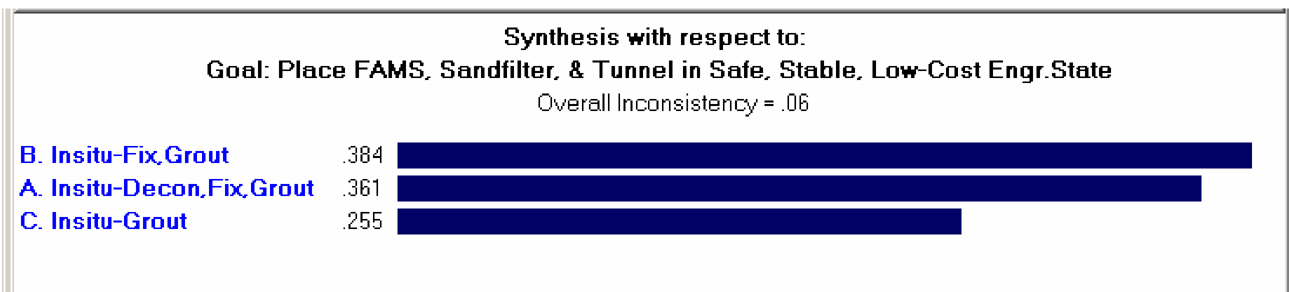


**Figure 7.2.1.1 PuFF In-Situ Alternative Ranking**

The alternative ranking figures for each of the individual decision criteria are included in Appendix A. An example is provided below. Figure 7.2.1.2 shows how the PuFF in-situ alternatives rank with respect to the "Minimize risk to D&D worker" decision criterion only. The "In-situ - fix, grout" alternative ranks highest due to the limited hands-on work in the cells and the spraying of fixative to control the spread of contamination.

Compare that to the "In-situ - decon, fix, grout" alternative which has the highest amount of hands-on cell work and also the highest potential for spreading the Pu 238 during the decontamination stages. That results in the "In-situ - decon, fix, grout" alternative receiving the lowest score. The "In-situ - grout" alternative was ranked in the middle because it did not involve the decontamination step but it did not fix the contamination prior to grouting which the team considered to be more likely to allow the potential spread of contamination compared to the fix then grout option.

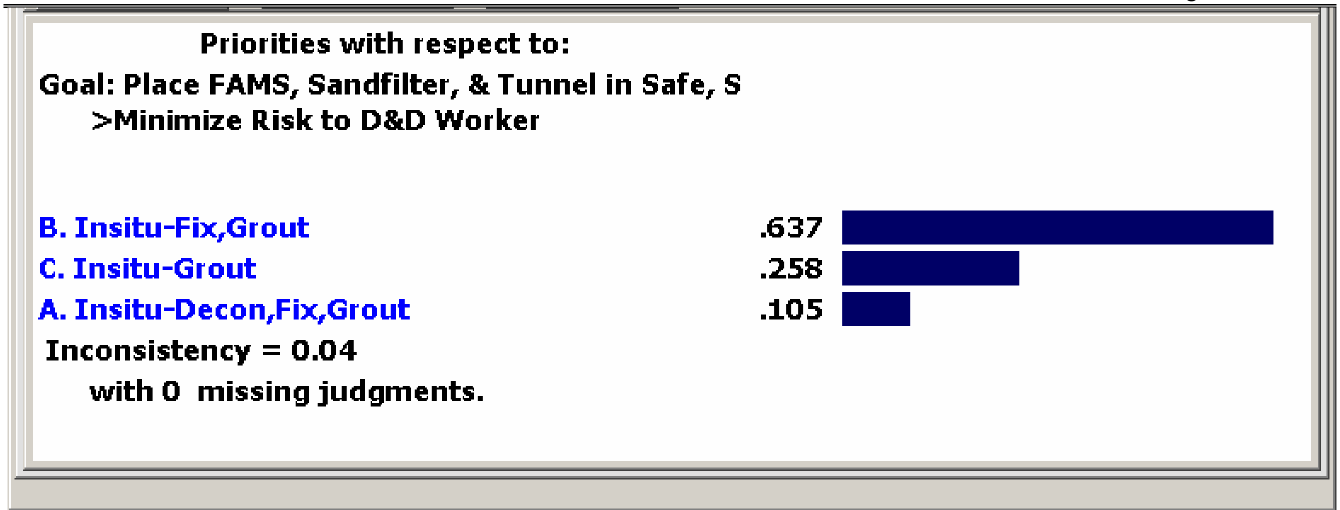


**Figure 7.2.1.2 PuFF In-Situ Ranking For Minimize Risk to D&D Worker**

### *7.2.2 PuFF Removal Alternative Evaluation*

The team evaluated the PuFF removal alternatives against the weighted decision criteria listed in Section 6.2. The evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The results of the evaluation are shown in Figure 7.2.2.1 below.

The "Decon, fix, remove" alternative was the highest ranked alternative at 0.64. The "Fix, remove" alternative had a score of 0.36. The alternative ranking figures for each of the individual decision criteria are included for review in Appendix A.

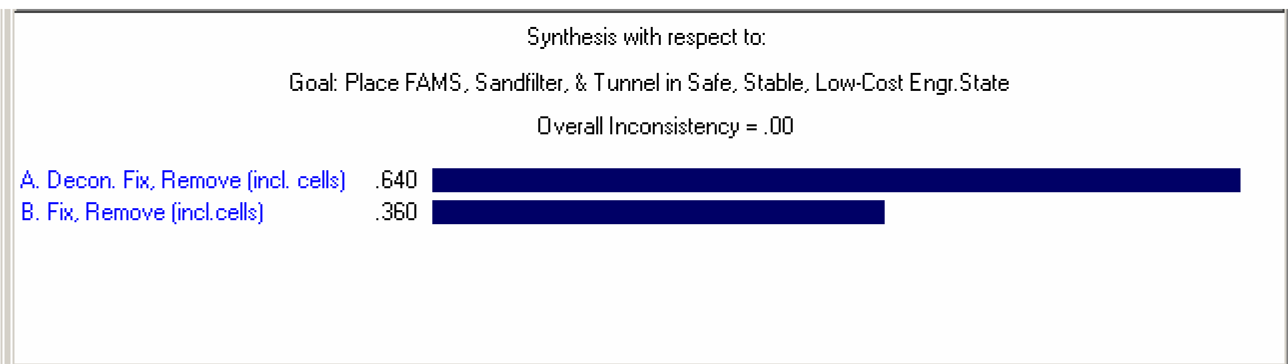


**Figure 7.2.2.1 PuFF Removal Alternative Ranking**

### *7.2.3 FAMS Building Alternative Evaluation*

The team evaluated the FAMS Building alternatives against the weighted decision criteria listed in Section 6.2. The evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The results of the evaluation are shown in Figure 7.2.3.1 below.

The "In-situ - entire building" alternative was the highest ranked alternative at 0.237. The "Total removal - building and slab" and "Removal of building to slab - cover and cap" alternatives followed with scores of 0.193 and 0.180 respectively.

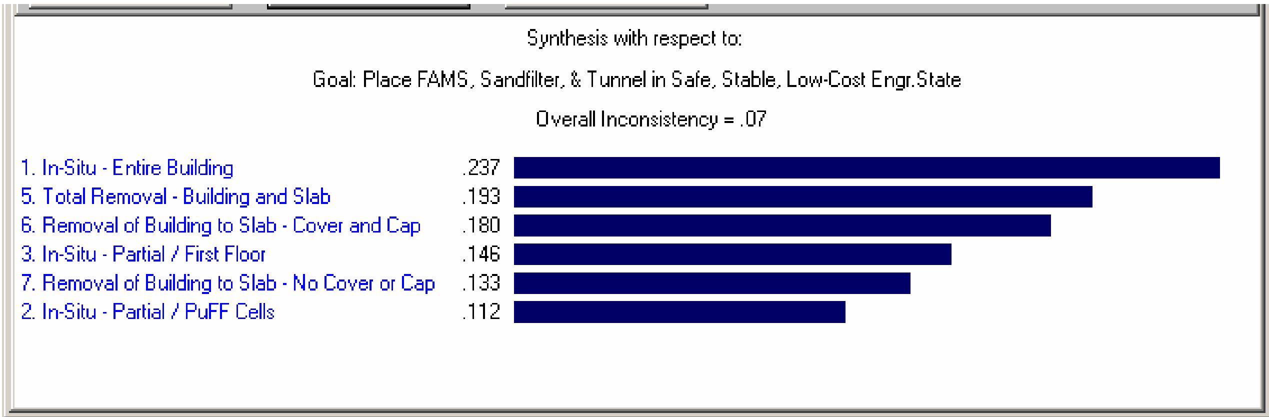


**Figure 7.2.3.1 FAMS Building Alternative Ranking**

The alternative ranking figures for each of the individual decision criteria are included for review in Appendix A.

## 7.3 Sensitivity Analysis

### *7.3.1 PuFF In-Situ Sensitivity Analysis*

Upon completion of the PuFF alternative ranking (see Figure 7.2.1.1), the team performed a sensitivity analysis to assess the evaluation's sensitivity to changes in weights of the decision criteria. Each of the criteria weights are varied by ±10% and if the alternative ranking doesn't change, the evaluation is said to be insensitive. If there is a change in ranking, the evaluation is sensitive to changes in criteria weights. See Appendix B for the sensitivity graphs.

The PuFF in-situ evaluation is sensitive to changes in five of the eight criteria weights. If the "Minimize risk to D&D worker" criterion is decreased by 10% (to 8%) the "In-situ - decon, fix, grout" alternative is ranked highest. Similarly, if the "Minimize short term risk to co-located worker, public, and environment" criterion is decreased by 10%, the "In-situ - decon, fix, grout" alternative is ranked highest. If the "Minimize long term risk to co-located worker, public, and environment", "Minimize impact to F-Area closure/completion", and Maximize stakeholder" criteria are increased by 10%, the "In-situ - decon, fix, grout" alternative is ranked highest. There is no sensitivity to changes in the weights of the "Minimize schedule", "Minimize D&D and S&M cost", and "Minimize effort to dispose of waste" criteria.

Given the sensitivities in the evaluation, the team closely reviewed the decision criteria weights and alternative scores with respect to each criterion. The team determined that the criteria weights and alternative scores were appropriate and accepted the sensitivities.

### *7.3.2 PuFF Removal Sensitivity Analysis*

As in the PuFF in-situ evaluation, the team performed a sensitivity analysis on the PuFF removal evaluation. The Puff removal evaluation is insensitive to changes in decision criteria weights. See Appendix B for the sensitivity graphs.

### *7.3.3 FAMS Building Sensitivity Analysis*

The sensitivity analysis on the FAMS building evaluation showed some sensitivity to changes in the decision criteria weights. Decreasing the weight of the "Minimize risk to D&D worker" and the "Minimize short term risk to co-located worker, public, and environment" criteria by 10% result in the "Total removal - building and slab" alternative receiving the highest score. Increasing the weight of the "Minimize long term risk to co-located worker, public, and environment" criterion by 10% results in the "Total removal - building and slab" and "In-situ - entire building" alternatives receiving almost equal scores. Increasing the weight of the "Minimize impact to F-Area closure / completion" criterion results in the "Removal of building to slab - cover and cap" and "In-situ - entire building" alternatives receiving almost equal scores. There is no sensitivity to changes in the weights of the "Minimize schedule", "Minimize D&D and S&M cost", and "Minimize effort to dispose of waste" criteria.

See Appendix B for the sensitivity graphs.

## 7.4 FAMS Building Conclusions

The evaluation team recommends that the decommissioned end-state of the FAMS facility be in-situ of the entire building. The "In-situ - entire building" alternative was defined as: the entire building remains, large voids filled, and openings sealed. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR. (see discussion in Section 7.1). PuFF contamination would be fixed and then grouted (with no decontamination). PEF contamination would also be fixed and then grouted. OML contamination would be fixed and then grouted. The old stack would be taken down to the level of the building. ABL would have all equipment removed prior to grouting the FAMS building.

Process ventilation is located throughout many areas on the first and second levels of FAMS. This ventilation will not be removed but will have contamination fixed, have additional support added as needed, and then grouted in place.

This recommendation is based on the weighted decision criteria listed in section 6.2 and the evaluation of the alternatives against the weighted decision criteria. It should again be noted that the FAMS building evaluation was sensitive to changes in the weights of the decision criteria and, therefore, if those weights are adjusted the alternative ranking could also be changed.

# 8.0 Sandfilter Evaluation

## 8.1 Alternative Identification

As in the FAMS building evaluation, the team brainstormed for sandfilter end-state alternatives. The brainstormed alternatives and descriptions are listed below:

BRAINSTORMED SANDFILTER ALTERNATIVES

- 1S.a **In-Situ - All Voids/Capped**: All voids filled (including sand). The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
- 1S.b **In-Situ - All Voids/No Cap**: All voids filled (including sand). Not covered or capped.
- 2S.a **In-Situ - Freeboard/Capped**: Freeboard (represents • 60% of volume) filled. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.
- 2S.b **In-Situ - Freeboard/No Cap**: Freeboard (represents • 60% of volume) filled. Not covered or capped.
- 3S.a **In-Situ - Sand Removal/Capped**: All sand removed, voids filled. The structure may be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system

and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.

3S.b **In-Situ - Sand Removal/No Cap**: All sand removed, voids filled. Not covered or capped.
4S **Total Removal - Building and Slab**: Complete removal of structure and sand then backfilled.
5S **Seal Penetrations**: No decontamination, no grout, seal all penetrations, not covered and capped.
6S **No Action**: No decontamination, no grout, penetrations not sealed, not covered and capped. Lock doors.

NOTE: As indicated in the alternative descriptions above, the same cap issue as described in Section 7.1 is applicable to the sandfilter building.

The brainstormed alternatives were screened against the requirements found in Section 5.0. Alternatives 2S.a, 2S.b, 5S and 6S were screened out for not meeting R.3. Like the PuFF "In-situ - encapsulate cells with grout" alternative, they leave voids, which are not allowed due to the potential for the structure to collapse. Additionally, the team could not assure that the 5S and 6S alternatives could meet R.5. The "No-action" alternative also would not meet R.1 due to the possibility of air emissions with no seals on the penetrations. The list of screened sandfilter alternatives is provided below:

SCREENED SANDFILTER ALTERNATIVES
1S.a **In-Situ - All Voids/Capped**
1S.b **In-Situ - All Voids/No Cap**
3S.a **In-Situ - Sand Removal/Capped**
3S.b **In-Situ - Sand Removal/No Cap**
4S **Total Removal - Building and Slab**

## 8.2 Evaluate Alternatives

The team evaluated the sandfilter alternatives against the weighted decision criteria listed in Section 6.2. The evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The results of the evaluation are shown in Figure 8.2.1 below.

The "In-situ - all voids/capped" alternative was the highest ranking at 0.278. The "In-situ - all voids/no cap" and "Total removal - building and slab" alternatives had the next highest scores at 0.252 and 0.216, respectively. "In-situ - sand removal/no cap" had the lowest score.

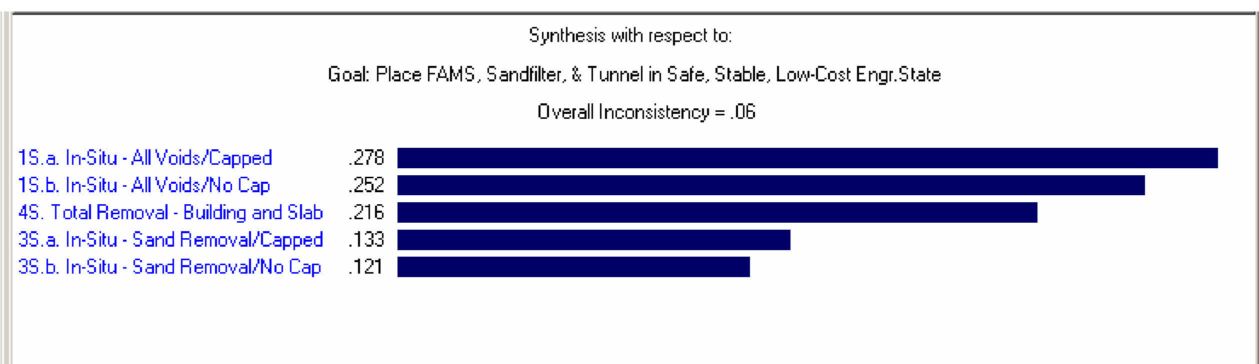


**Figure 8.2.1 Sandfilter Alternative Ranking**

The alternative ranking figures for each of the individual decision criteria are included for review in Appendix A.

## 8.3 Sensitivity Analysis

The sandfilter sensitivity analysis showed some sensitivity to changes in criteria weights on three of the decision criteria. Increasing the weight of the "Minimize long term risk to co-located worker, public, and environment" and the "Maximize stakeholder acceptance" criteria brings the "In-situ - all voids/capped" and "Total removal - building and slab" alternatives to an equal score. Likewise, increasing the weight on the "Minimize D&D and S&M cost" criterion brings the rankings about equal on the "In-situ - all voids/capped" and "In-situ - all voids/no cap" alternatives.

See Appendix B for the sensitivity graphs.

### 8.4 Sandfilter Conclusions

The evaluation team recommends the decommissioned end-state for the sandfilter be the "In-situ - all voids filled/capped" alternative. This alternative includes filling the voids in the sand as well as the freeboard above the sand. The structure may then be covered and/or capped, if required. The CERCLA process will evaluate the need for a cover system and/or cap over the facility to address principal threat source material, mitigate potential groundwater impacts, and comply with ARAR.

This recommendation is based on the weighted decision criteria listed in section 6.2 and the evaluation of the alternatives against the weighted decision criteria. It should again be noted that the sandfilter evaluation was sensitive to changes in the weights of the decision criteria and, therefore, if those weights are adjusted the alternative ranking could also be changed.

## 9.0 Underground Tunnel Evaluation

### 9.1 Alternative Identification

The list of brainstormed underground tunnel alternatives is provided below:

BRAINSTORMED UNDERGROUND TUNNEL ALTERNATIVES

- 1T **In-Situ - Seal Penetrations**: Seal penetrations and leave in place, no decontamination, and no fill.
- 2T **In-Situ - Decon**: Decontaminate, seal penetrations, and leave in place (no fill).
- 3T.a **In-Situ - Fill Voids/No Decon**: Seal penetrations and fill voids (no decontamination).
- 3T.b **In-Situ - Fill Voids/Decon**: Decontaminate, seal penetrations and fill voids.
- 4T **Removal**: Completely remove underground section of tunnel and backfill.

The brainstormed alternatives were screened against the requirements found in Section 5.0. Alternatives 1T and 2T were screened out for not meeting R.3 because they leave voids. The void doesn't mitigate future subsidence and potentially causes failure of the tunnel structure. It may also result in "bath tub" leaching water accumulation and leaching of contaminants with subsequent migration of solubilized contaminants. The list of screened alternatives is below:

SCREENED UNDERGROUND TUNNEL ALTERNATIVES

- 3T.a **In-Situ - Fill Voids/No Decon**
- 3T.b **In-Situ - Fill Voids/Decon**
- 4T **Removal**

### 9.2 Evaluate Alternatives

The team evaluated the underground tunnel alternatives against the weighted decision criteria listed in Section 6.2. The evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The results of the evaluation are shown in Figure 9.2.1 below.

The "In-situ - fill voids/no decon" alternative scored highest with 0.381 and was followed by the "In-situ - fill voids/decon" and "Removal" alternatives with scores of 0.332 and 0.287, respectively.

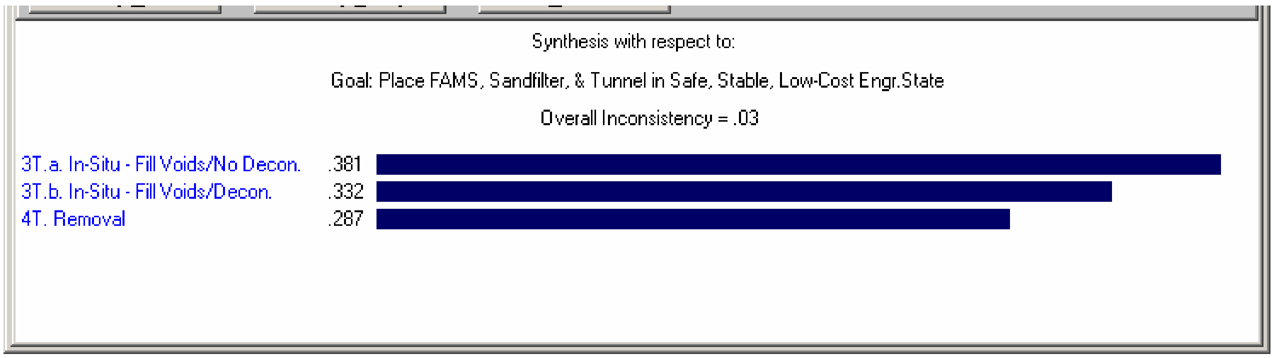


**Figure 9.2.1 Underground Tunnel Alternative Ranking**

The alternative ranking figures for each of the individual decision criteria are included in Appendix A.

## 9.3 Sensitivity Analysis

The underground tunnel evaluation was sensitive to changes in the weights of two of the decision criteria. Decreasing the weights of the "Minimize risk to D&D worker" and "Minimize short term risk to co-located worker, public, and environment" criteria result in the "In-situ - fill voids/decon" alternative replacing the "In-situ - fill voids/no decon" alternative as the highest scoring alternative.

See Appendix B for the sensitivity graphs.

## 9.4 Underground Tunnel Conclusions

The evaluation team recommends the decommissioned end-state for the underground tunnel be the "In-situ - fill voids/no decontamination" alternative. This alternative includes filling the tunnel voids without decontamination.

This recommendation is based on the weighted decision criteria listed in section 6.2 and the evaluation of the alternatives against the weighted decision criteria. It should again be noted that the underground tunnel evaluation was sensitive to changes in the weights of two decision criteria and, therefore, if those weights are adjusted the alternative ranking could also be changed.

# 10.0 Underground Condensate/Waste Tank

## 10.1 Alternative Identification

The list of brainstormed underground condensate/waste tank alternatives is provided below:

BRAINSTORMED UNDERGROUND CONDENSATE/WASTE TANK ALTERNATIVES

- 1W **Removal**: Completely remove tank and backfill.
- 2W **In-Situ - Seal Penetrations**: Leave tank in place and seal lines (no decontamination, voids not filled).
- 3W **In-Situ - Fill Voids**: Fill tank with grout and seal penetrations.

The brainstormed alternatives were screened against the requirements found in Section 5.0. Alternative 2W was screened out for not meeting R.3 because it would leave a void. The list of screened alternatives is below:

SCREENED UNDERGROUND CONDENSATE/WASTE TANK ALTERNATIVES

- 1W **Removal**

3W **In-Situ - Fill Voids**

## 10.2 Evaluate Alternatives

The team evaluated the underground condensate/waste tank alternatives against the weighted decision criteria listed in Section 6.2. The evaluation was completed by applying the AHP using the commercial decision analysis software package Expert Choice® 11. The results of the evaluation are shown in Figure 10.2.1 below.

The "In-situ - fill voids" alternative scored highest with 0.526. The "Removal" alternative scored 0.474.

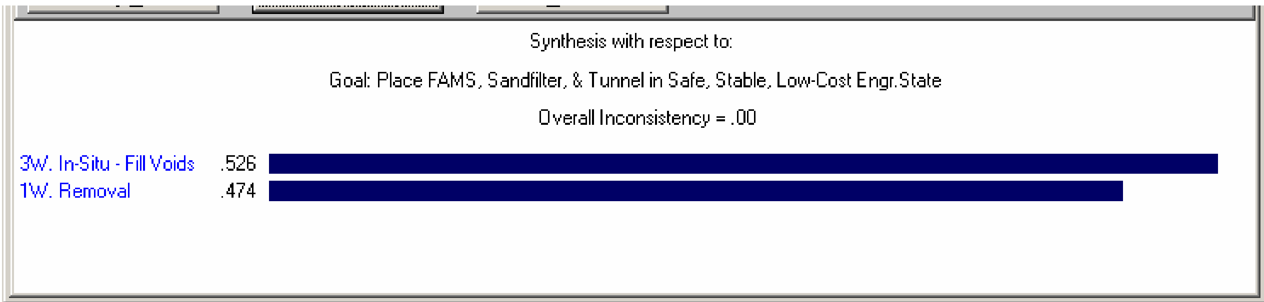


**Figure 10.2.1 Underground Condensate/Waste Tank Alternative Ranking**

The alternative ranking figures for each of the individual decision criteria are included in Appendix A.

## 10.3 Sensitivity Analysis

The underground condensate/waste tank evaluation is sensitive to changes in the decision criteria weights. Decreasing the weight of the "Minimize risk to D&D worker" and "Minimize short term risk to co-located worker, public, and environment" criteria causes the "Removal" alternative to score highest. Increasing the "Minimize long term risk to co-located worker, public, and environment" and the "Minimize impact to F-Area closure/completion" criteria brings the alternative scores together. Finally, increasing the "Maximize stakeholder acceptance" criterion results in the "Removal" alternative to score highest.

See Appendix B for the sensitivity graphs.

## 10.4 Underground Waste Tank Conclusions

The evaluation team recommends the decommissioned end-state for the underground condensate/waste tank be the "In-situ - fill voids" alternative. This alternative includes filling the underground waste tank voids.

This recommendation is based on the weighted decision criteria listed in section 6.2 and the evaluation of the alternatives against the weighted decision criteria. Note that the underground waste tank evaluation was sensitive to changes in the weights of the decision criteria and, therefore, if those weights are adjusted the alternative ranking could also be changed.

## 11.0 References

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# FAMS Decommissioning End-State Alternative Evaluation

G-AES-F-00002

May 25, 2006

Revision 0

Addition Page

NOTE: Appendices A, B and C have been removed to reduce the number of pages for this release of information. These appendices consist of pages 34 through 107.