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An Independent Review of the Accelerated Retrieval Project

PRODUCED FOR

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LIST OF ACRONYMS

AC	administrative controls
AK	acceptable knowledge
ARP	Accelerated Retrieval Project
BCP	baseline change proposal
BNFL	British Nuclear Fuels Limited
BOE	basis of estimate
CAD	computer-aided design
CCP	Central Characterization Project
CCTV	closed circuit television
CD	critical decision
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminants of concern
COO	conduct of operations
DAS	Drum Assay System
DEQ	Department of Environmental Quality
DPS	Drum Packaging System
DWP	detailed work plan
EDF	Engineering Design File
EE/CA	engineering evaluation/cost analysis
EM	Environmental Management
EPA	Environmental Protection Agency
ESH&Q	Environment, Safety, Health and Quality
FMM	Fissile Material Monitor
FSAR	Final Safety Analysis Report
FY	fiscal year
GEM	Glovebox Excavator Method
GPS	Global Positioning System
INEEL	Idaho National Engineering and Environmental Laboratory
IRT	Independent Review Team

ISMS	Integrated Safety Management System
M&O	management and operations (contractor)
MSA	Management Self-Assessment
NE	DOE Office of Nuclear Energy, Science, and Technology
NE-ID	U.S. Department of Energy, Idaho Operations Office
NEPA	National Environmental Policy Act
NTCRA	non-time-critical removal action
NTW	non-targeted waste
OU	operable units
P3	Primavera Project Planner
PCS	potentially contaminated soil
PGS	Packaging Glovebox System
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RFM	refueling machine
RFP	Rocky Flats Plant
RTP	return to pit
RWMC	Radioactive Waste Management Complex
SAR	Safety Analysis Report
SCBA	self-contained breathing apparatus
SDA	Subsurface Disposal Area
SOW	statement of work
SSB	soft-sided boxes
SSC	structure, systems, and components
TAN	Test Area North
TRU	transuranic
TSA	Transuranic Storage Area
TSR	technical safety requirements
VOC	volatile organic compound
WBS	work breakdown structure
WES	Weather Enclosure Structure
WIPP	Waste Isolation Pilot Plant

EXECUTIVE SUMMARY

The Department of Energy (DOE), Idaho Operations Office (NE-ID) has requested that an independent review be performed on the Accelerated Retrieval Project (ARP). Review activities were to include:

- Reviewing cost estimates for the Project and Subsurface Disposal Area (SDA) Early Actions
- Monitoring and analysis of project progress to date
- Identifying process or procedural issues that may adversely affect the cost and/or schedule of projects
- Providing recommended actions which can be utilized by NE-ID to resolve, avoid, and/or mitigate problems which could jeopardize the project's successful completion.

Areas covered by the review included four focus areas of interest: cost, schedule, technical approach, and industry practices. Each of these areas was analyzed to determine specific impacts on retrieval and segregation, packaging, characterization, and transportation of transuranic (TRU) waste.

Costs - The Independent Review Team (IRT) analyzed submitted cost estimates and provided recommendations that will assist NE-ID in developing a strategy that will reduce overall cost to DOE for the project.

Schedule - The IRT examined engineering, procurement, construction, and baseline change proposal (BCP) generated schedules, comparing them with associated documents to ascertain the status of the project and to identify any problems or potential problems that could impact a successful project completion.

Technical Approach - Each major task of the ARP was analyzed by the IRT to ascertain whether the proposed project fits certain criteria, including whether the process is efficient, safe, and a technically defensible way to accomplish the handling and removal of buried waste.

Industry Practices - The IRT analyzed the proposed work activities of the ARP against those current industry practices in the mining and remediation industries with regards to the retrieval and packaging of TRU waste. Characterization and transportation were not reviewed as there are no similar activities within private industry.

The IRT consisted of senior technical professionals with extensive experience in project management, cost analysis, environmental management, mining and remediation, and health and safety activities.

Review results indicated:

Cost and Project Control

The IRT recommends that the following cost considerations should be included in the management and operations (M&O) contractor's approach to the ARP.

1. Contingency/Planning Assumptions – Re-examine the basis for the contingency and the project assumptions to determine if they are realistic, identify cost impacts and earmark against contingency.

2. Earned Value Performance Measurement – Assign an appropriate earned value method to ensure the project objectives are met, and place the approved method under configuration control.

3. Maintain the current contractor ARP cost estimates to minimize additional expenditure of limited funds. Implement strict change control to the existing baseline.

4. Cost avoidance can be realized by providing redundant equipment. The combined cost is less than 1% of the total project cost, but could cost the project ~$112K per day if inoperable.

    - Backup Gradall XL5200 Excavator – Cost of backup excavator (~$260K)

    - Backup Telehandler at $75K

5. Cost savings could be realized through ARP staffing reductions in select areas.

6. Work Breakdown Structure – Establish NE-ID configuration control for the ARP Work Breakdown Structure. This control will ensure reliability of performance and cost data. This action will result in the appropriate level of detail for the collection of cost, providing an historical basis for future projects using this technical approach.

Schedule

The IRT has identified multiple concerns, all of which have the potential to impact schedule. The ARP BCP is consistent with industry standards and methods.

1. Review to date has mainly focused on BCP documented assumptions and their potential impact on schedule.

2. Schedule appears to be tied heavily to assumptions which historical data do not support.

3. Timing of project start in relation to the management and operation (M&O) contractor's current contract end date led to incomplete, inconclusive, or otherwise ineffective data upon which the M&O could properly estimate schedule beyond January 2005.

Technical Approach

The IRT recommends that the following should be included in the M&O contractor's technical approach to the ARP.

1. Calculate gamma dose rates for personnel in the Retrieval Enclosure and Drum Packaging System (DPS) and provide in Final Safety Analysis Report (FSAR).

2. Plan for improved lighting/visibility for retrieval enclosure operators.

3. Include a mockup for training in an uncontaminated testing area.

Industry Practices

The IRT recommends that the following industry practices should be included in the M&O contractor's approach to the ARP.

1. Plan for redundancy of equipment (excavator, forklift, etc.)

2. Reassess ARP staffing loads to delineate areas where staffing loads may be reduced without hindering the overall successful ARP completion.

3. Consider modification of planned work shift from one to two production shifts to maximize production.

4. Install real-time, Integrated Retrieval Management System utilizing Global Positioning System (GPS), data radiolinks, and on-board computer software such as computer-aided design (CAD).

General Recommendations

An approach to non-time-critical removal action (NTCRA) which relies on uncertainty management has been prescribed by DOE and the U.S. Environmental Protection Agency (EPA) and used at other sites throughout the DOE complex. The results at these sites have shown significant savings in both costs and schedule. It appears that the methodology specified in *"Uncertainty Management: Expediting Cleanup Through Contingency Planning,"* were not applied during ARP planning to arrive at similar cost and schedule benefits.

Glovebox Excavator Method (GEM) project data was used for the basis of the development of the ARP BCP. Using this data as a basis for the ARP is not consistent with the DOE/EPA guidance, because the GEM project employed a significantly different approach for waste retrieval. A bottoms-up planning approach would have helped the M&O contractor in realizing the potential cost and schedule benefits of uncertainty management. The bottoms-up planning would also have helped the M&O contractor in the quantification and qualification of a significant portion of their planning assumptions.

AN INDEPENDENT REVIEW OF THE ACCELERATED RETRIEVAL PROJECT

1. INTRODUCTION

The purpose for this document is to describe the process and results of an Independent Review of the Accelerated Retrieval Project (ARP) performed for the Department of Energy, Idaho Operations Office (NE-ID).

1.1 Background

The Radioactive Waste Management Complex (RWMC), located in the southwestern quadrant of the Idaho National Engineering and Environmental Laboratory (INEEL), encompasses a total of 72 hectares (177 acres) and is divided, by function, into the following three separate areas: (1) the Subsurface Disposal Area (SDA), (2) the Transuranic Storage area (TSA), and (3) the administration and operations area (see Figure 1). The SDA is the original landfill established in 1952 for the shallow land disposal of solid radioactive waste. The RWMC, including the SDA, is undergoing remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq.) in accordance with the *Federal Facility Agreement and Consent Order for the Idaho National Engineering and Environmental Laboratory* (NE-ID 1991). The Federal Facility Agreement and Consent Order designates the RWMC as a Waste Area Group 7, which is further subdivided into 13 operable units (OU). OU 7-13/14 is the combined OU for the comprehensive remedial investigation and feasibility study evaluating SDA contamination, risk, and associated remedial alternatives.

The SDA is a radioactive waste landfill with shallow subsurface disposal units consisting of pits, trenches, and soil vaults. Disposals of transuranic (TRU) and mixed waste, mostly from the Rocky Flats Plant (RFP) in Colorado, were allowed through 1970. The buried RFP TRU waste is located primarily in disposal Pits 2 through 5, 9 through 12, and trenches 1 through 10. Trenches 11-15 also may contain RFP TRU waste. Contaminants in the SDA include hazardous chemicals, remote-handled fission and activation products, and TRU radionuclides.

DOE issued a comprehensive guidance document, “Phased Response/Early Actions Under CERCLA,” which focuses on the use of early response actions as a means to achieve rapid and efficient risk reduction. This guidance covers several options, including early removal actions, interim remedial actions, and early final actions. Accordingly, the DOE Office of Nuclear Energy, Science, and Technology (NE) in consultation with the Idaho Department of Environmental Quality and the U.S. Environmental Protection Agency (EPA), Region 10, has concluded that it is appropriate to consider a non-time-critical removal action (NTCRA) to retrieve a limited portion of TRU waste within Pit 4 in support of the comprehensive remediation of OU 7-13/14. This NTCRA is referred to as the ARP. The NTCRA action area of focus includes approximately ½ acre of the eastern section of Pit 4. Figure 2 shows the layout of the SDA at RWMC. The CERCLA process requires preparation and public review of an Engineering Evaluation/Cost Analysis (EE/CA) before preparation of the action memorandum that will document official selection of the NTCRA alternative and associated details that support the official selection.[1]

The ARP introduces a new approach to the removal of buried TRU waste from the SDA, specifically the use of administrative controls (ACs) such as requiring comprehensive personal protective equipment (PPE) rather than safety-significant structures, systems, and components that have been used in the past, for meeting safety requirements. This new approach endeavors to streamline buried waste removal by reducing reliance on complicated systems for defense-in-depth with only a slight increase in worker risks.

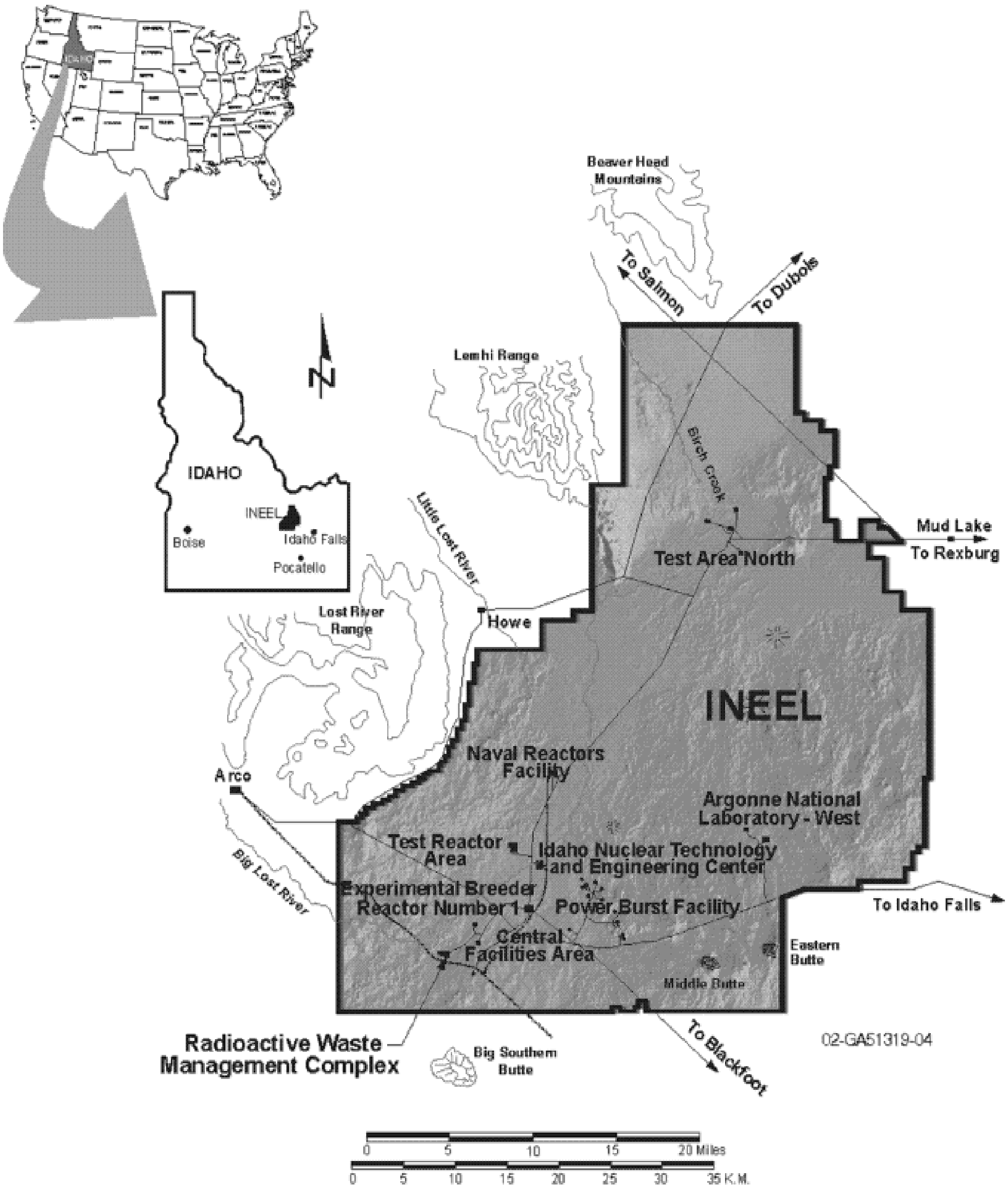

Figure 1. The map of the INEEL shows the location of the RWMC where Pit 4 is located.

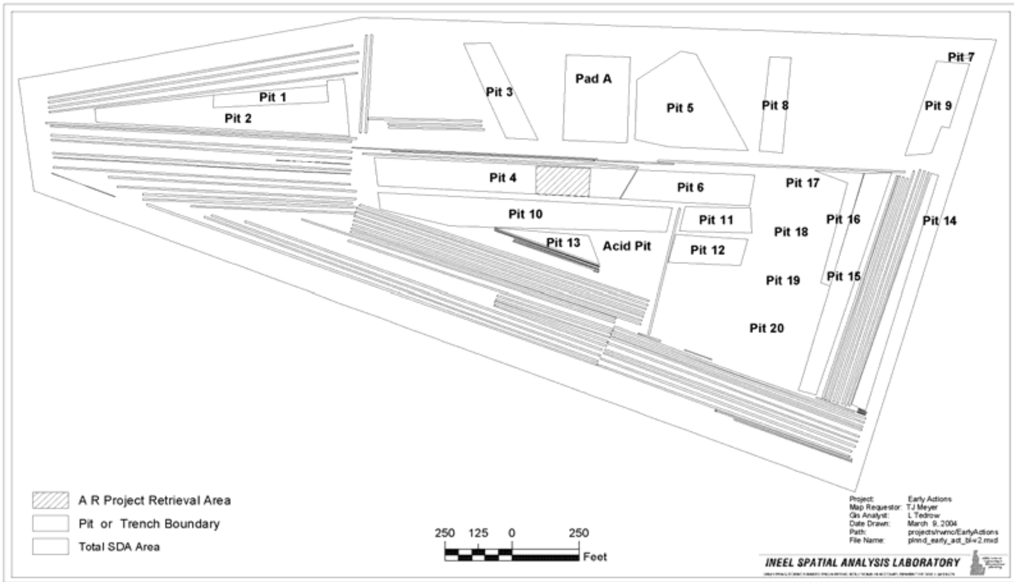

Figure 2. Layout of the SDA at the RWMC including Pit 4 located in the center of the drawing.

1.2 Scope

Included in this independent review are analysis and recommendations on ARP activities, such as the validation of project costs, review of schedule and technical approach, as well as a comparison and analysis of the ARP to current industry practices. Specifically, the functions of this review included:

- Validation of selected element costs
- Identification of process or procedural issues that may adversely affect the cost and/or schedule of projects
- Recommendation of actions that can be utilized by NE-ID to resolve, avoid, and/or mitigate problems which could jeopardize the project's successful completion.

1.3 Independent Review Team

Selection of members of the Independent Review Team (IRT) was based upon their extensive experience in project management, cost analysis, project control, environmental remediation management, mining remediation and engineering, and health and safety activities. In addition, the team possesses knowledge and experience in environmental compliance with the CERCLA, National Environmental Policy Act (NEPA), Resource Conservation and Recovery Act (RCRA) and other federal, state, and DOE regulations. They have been involved with the Waste Isolation Pilot Plant- (WIPP) related activities at the INEEL including the 3100 m^3 Project, and have performed on various environment management projects within the DOE complex. In addition, some team members have had extensive experience with several mining and mining remediation projects. IRT members and assignments were as follows:

Team Lead	Tom Lewallen
Costs and Project Control	Craig Hewitt, Jerald Barbre
Schedule	Joe Gordon, Craig Hewitt
Technical Approach	Jim Cook, Scott Ploger
Industry Practices	Lynn McCloskey, Andy Johnson

A brief biography of each of the team members is contained in Appendix A of this document.

IRT activities took place from March 23 through April 30, 2004. On April 6, a project review presentation was provided by the M&O contractor and a "mid-review" briefing by the IRT was presented on April 12th to NE-ID ARP personnel as well as M&O contractor personnel. A presentation was provided to NE-ID Environmental Management (EM) April 15th. Also on April 15 a draft report was provided to the NE-ID Project Manager. The IRT incorporated DOE comments and comments from the April 15 presentation in a later draft delivered on April 22. Comments were provided to the IRT by the M&O contractor on April 28th and incorporated as appropriate. A final presentation and the final report were provided to the DOE on April 30, 2004.

1.4 Project Status

At the time of assignment of this project review to the IRT, most of the design specifications had been prepared and long lead items, including the retrieval enclosure, storage enclosure, and Gradall Excavator, had been purchased. The subcontract for design and fabrication of the Drum Packaging System (DPS) was awarded the week of March 29, 2004. Numerous other designs and subcontract awards are still being pursued.

Removal of the retrieval area overburden began on March 18, 2004, but was abruptly stopped when a waste drum was partially exposed on March 20, 2004. Overburden removal was restarted the week of April 5, 2004.

Revisions to the draft EE/CA,[2] Health and Safety Plan,[3] Final Safety Analysis Report (FSAR),[4] and other documents are being prepared. Discussions are ongoing with several agencies for various removal action requirements and/or waivers.

Because of problems associated with the characterization of targeted waste stored in standard waste boxes (SWBs), a recommendation was made by the M&O contractor and NE-ID to package the targeted waste in 55-gallon drums. An ICP Baseline Change Proposal (BCP), RWMC-04-021,[5] was prepared to include the DPS. The revised BCP for the DPS was approved by the M&O contractor management on April 6, 2004 and submitted to NE-ID for approval on April 9, 2004.

Other changes to note since the initiation of the review:

- Overburden removal was stopped to reassess the need for respiratory protection for the workers performing overburden removal activities. Overburden removal activities were restarted on April 17, 2004 with the workers wearing respirators.
- The week of April 5, 2004 the M&O contractor decided to change the storage facility floor to concrete from the original gravel flooring.
- A revised Health and Safety Plan was issued on April 6, 2004 by the M&O contractor. The changes to the plan appear to be minor and will have no bearing on the project review.
- A design change is being made to the Retrieval Enclosure to provide better lighting in the enclosure and at the dig face.
- The M&O contractor has purchased a 15" trenching bucket for the excavator. The 15" bucket was not mentioned in previous discussions with the contractor.
- Discussions are on-going with the regulatory agencies regarding the projects' concepts and methodologies.
- Revised M&O contractor estimate (4-28-04 factual review) for targeted TRU waste. Revised estimate from 6,046 to 12,500 drums. Storage capacity estimate was revised to ~10,000 drums. A statement was also made about changing retrieval operations from 13 months to ~18 months. Due to the timing of the new information, impacts to schedule and costs from the revised estimates were not evaluated for this report.

2. AREAS OF REVIEW

The areas covered by this review included four focus areas of interest: cost and project control, schedule, technical approach, and industry practices. Each of these areas was analyzed to determine specific impacts on retrieval and segregation, packaging, characterization, and transportation of TRU waste. A description of the approach used for each analytical activity is given in the sections below, followed by recommendations.

3. VALIDATION OF PROJECT COST AND PROJECT CONTROL

The IRT provided analysis of the ARP with particular emphasis on the reasonableness of the cost estimates, the soundness of the technical basis for the estimates, and then provided recommendations that will assist DOE in developing a strategy to reduce overall cost for the project.

3.1 Cost Analysis Summary

The "Limited TRU Retrieval Alternative" Fiscal Year (FY) 2004 – 2007 Total Life Cycle Project Baseline Estimate is ~$205.5M.[6] The process and tools with which the project planning has been accomplished appear to have been applied by knowledgeable contractor staff. These planning tools are powerful, effective, and recognized across the industry complex as essential in successful project management. The Contractor's planning process lends itself to a disciplined, well documented approach to configuration control. Overall, the planning tools and process employed by the contractor are conducive to successful baseline management.

However, while the planning process, tools, and knowledgeable contractor staff are considered highly effective and capable in cost estimating and baseline management, there are areas of weakness with the data, assumptions, and strategy contained within the planning estimates. Areas of concern are discussed in the following sections.

3.2 Life Cycle Baseline Cost Estimating Process

The contractor's cost estimating process includes the utilization of: a Basis of Estimate (BOE), Primavera Project Planner (P3) Resource Loaded Schedule Reporting, and Cobra Price Reporting. The approach lends itself to a well-documented cost, scope, and schedule estimating process capable of providing support to a full range of projects when used as intended.

Each planned activity is uniquely identified (at a minimum) by:

- P3 Activity ID
- P3 Activity Title
- Cost Element
- Work Breakdown Structure (WBS) Code

3.2.1 Basis of Estimate

The BOE[6-9] serves as the supporting information for the Detailed Work Plan (DWP). The DWP identifies the scope to be performed, the duration of the activity, key assumptions/exclusions, resource requirements, etc. The BOE includes the substantive documentation utilized in the development of the estimate, including the estimator's documented rationale and any adjustments to the substantive documentation based on the estimator's judgment. The BOE must be documented, and stand in ready defense of the project estimate, adequately supporting the estimator's conclusion.

3.2.2 P3 Resource Report

From the BOE, resource codes and requirements (hours) are then entered into P3.[10-13] P3 provides a resource-loaded schedule of activities by WBS Code, activity ID #, Description, Resource, Cost Account, and Resource Budget Quantity (e.g. labor hours, subcontract dollars, purchases, etc.)

3.2.3 Cobra Reports

Each P3 resource-loaded activity is then priced out via Cobra,[6-9] providing a monthly breakdown of the activity in terms of dollars.

3.2.4 The Cost Estimating Process Assessment

The cost estimating tools are representative of those typically utilized throughout the government and industry. The data and reporting made available via the system tools are supportive of project management and analysis. The IRT believes that the described process is reasonable; however, this is not an attestation of the acceptability of the M&O contractor's estimating approach as a whole. The contractor staff contacted and interviewed during the review appeared knowledgeable of both the cost estimating process described and the tools used to quantify the estimates.

3.2.5 Cost Analysis Assumptions

The cost review involved analysis of several key documents.[6-9] Document reviews were made with the following key assumptions:

1. Cost estimates provided are immature and will continue to evolve as the project is executed.

2. Contractor rates used in the current and evolving cost estimates are NE-ID approved and consistent with the contractor's current Disclosure Statement.

3. Costs for the Retrieval and Storage Enclosures, project equipment/materials, and WIPP were not reviewed.

3.3 Reasonableness of Cost Estimate

3.3.1 Contingency

Per the DOE/EPA guidance document *Uncertainty Management: Expediting Cleanup Through Contingency Planning,*[10] "Some degree of uncertainty in environmental restoration projects always exist. This inherent uncertainty may result from incomplete knowledge of the nature and extent of contamination, an inability to predict a technology's performance under site-specific conditions, or new or changing regulatory requirements. Although these inherent uncertainties present a significant challenge to effective project management, recognizing and planning for them helps to ensure that projects stay on schedule and within budget." This guidance prescribes specific steps to follow to manage around uncertainties:

1. Identify Expected Conditions and Potential Deviations

2. Evaluate Deviations (for their possible impact on implementation and potential for negating achievement of objectives)

3. Develop Appropriate Contingency Plans

It is not apparent to the IRT that this guidance is being followed by the M&O. In particular, at the direction of the M&O contractor's management, ~$57.6M of contingency has been established. This equates to 28% of the total Project funding of ~$205.5M. In discussion with contractor staff, there was no documented basis for this level of contingency. This is in sharp contrast to the GEM Project, which used a risk application tool to arrive at the contingency which linked estimating software with risk analysis software.[11]

In a briefing held on April 12, 2004 with M&O Contractor and NE-ID representatives, two uses were identified for the stated contingency. Note: Each of the items identified as below by the M&O Contractor as uses of contingency are easily identifiable and quantifiable. Neither of the items described are considered by the IRT to be valid uses of contingency, because they are probable and quantifiable.

1. To pay for ~$200K - ~$300K of unplanned/unscheduled overtime resulting from the two-crew, 4 X 4 “sliding” 7/12 hour shifts.

2. To pay for any project delays.

The lack of a justifiable contingency basis, beyond the M&O contractor project manager’s unsupported judgment, does not present a defensible approach to the establishment of the contingency amount. In fact, both the basis and the amount of the contingency place the project at risk of potentially losing funds that are not directly tied to requirements. The credibility of the contingency process approach and amount is further challenged by the unrealistic assumption that the ARP will be accomplished without delays of any kind. Such delays can be anticipated and quantified. Based on the IRT’s experience, this assumption is inconsistent with most projects. More specifically, the ARP has observed the effect of project delays, as demonstrated when unexpected contact was made with a waste barrel during the initial excavation of the overburden. The IRT believes that contact with the subject barrel could have been reasonably expected and the delay quantified, which further supports the position that contingency for “unknown – unknowns” is too high.

Given the current budget constraints within DOE and the government in general, contingency at the current level leaves the project at risk to external influences with respect to losing the funding to other priority projects within DOE. This could come in the form of Congressional Rescissions or DOE Headquarters (DOE-HQ) taxes.

Recommendation

Re-examine project assumptions to determine if they are realistic with regard to delays and consistent with the DOE/EPA guidance document *Uncertainty Management: Expediting Cleanup Through Contingency Planning.*

Review the M&O contractor’s GEM and ARP FY 2002, FY 2003 and FY 2004 variance explanation excerpts identified in the “Cost Estimates” section to identify areas where delays did and are likely to re-occur. Examples of potential ARP delays include: discussions with the state of New Mexico, regulators, delays resulting from process or equipment failures, and/or simple weather delays. Develop a contingency plan that includes the delays experienced with GEM and the unrealistic assumptions stated in the M&O contractor’s ARP BOEs. Assign estimated values to the delays and identify the cost value against the contingency, resulting in the establishment of the true contingency availability for unknowns, while minimizing the risk to the project’s contingency funding from external influences that are competing for the same dollars. The contingency plan also provides a basis for a defensible contingency and reflects a more probable project outcome. Where judgment is required as the basis for contingency, adequately document the rationale for use of judgment in order to make the decision understandable and defensible.

Perform a lessons learned on the M&O contractor’s conceptual approach to the establishment or basis of project contingency.

3.3.2 Cost Estimates

Many of the cost estimates/BOEs reviewed consistently cited rationale as "Unrecorded Observation," "Similar Activity," and "Historic Data." Supporting narrative often referenced the GEM project recorded history that was extrapolated and adjusted based on the duration of the project. Calculated cost estimates (in part based on GEM) are less reliable than bottoms-up detailed planning that reflects what it takes to perform the specific scope. The GEM Project is sufficiently different from the ARP that it is not considered by the IRT to be a reliable basis of estimate. The contractor should avoid using the cost of a previous scope, with assumed similarities, to develop the estimated costs of performing the ARP.

3.3.2.1 GEM IRT Analysis

3.3.2.1.1 FY 2002 GEM

A review of the FY 2002 GEM schedule, performance, and actual cost data reveals GEM was behind schedule with a variance of $(284K) and overrun, with a cost variance of $(766K). (See Table 1 for GEM cost, schedule, and performance data.) Note: variance dollars in the M&O contractor's explanations may be different than Table 1 as the contractor only identifies major variances. Table 1 reflects total variances.

As previously stated Section 3.3.2, Cost Estimating above, the GEM Project served in part as a template for the M&O contractor's ARP BOEs. The following excerpts have been extracted from the M&O contractor's variance explanations (which are included in their entirety in Appendix D), and are intended to demonstrate why the use of the GEM financial data **is not** an appropriate cost model for the ARP.

Schedule Variance $(284K)

1. Negative schedule variance ($284K) resulted from the delay in procurement activities for the Weather Enclosure Structure (WES)

2. Delays in fabrication and installation of mock-up facilities, and delays in the Fissile Material Monitor (FMM) fabrication.

Cost Variance $(859K)

The OU 7-10 GEM Project work package negative cost variance of ($859K) resulted from the following:

1. Project Management costs were higher than planned in response to increased resource needs to resolve critical decision (CD)-2/3 external independent review comments

2. Addition of a second deputy project manager

3. Additional project records costs to meet document throughput and requests

4. Costs to complete the Project Execution Plans

5. Additional cost for emerging issues such as waste handling

6. The engineering overrun was the result of resolving more design issues/ comments than anticipated

7. Additional resources required to prepare GFE purchases previously planned to be purchased by subcontractors

8. Additional time for vendor data review and response and underestimate of the volume of technical editing required

9. A negative cost variance of ($393K) in Procurement due to earlier than planned progress payments for glove box and retrieval confinement structure required to maintain schedule

10. Negative cost variance of ($108K) in Construction due to exclusion of Construction Management pool account adder excluded from baseline.

3.3.2.1.2 FY 2003 GEM

A review of the FY 2003 GEM schedule, performance, and actual cost data reveals GEM was now further behind schedule with a variance of $(5,910K), and significantly overrun with a cost variance of $(6,012K). (See Table 1 for GEM cost, schedule, and performance data.) Note: variance dollars in the M&O contractor's explanations may be different than Table 1 as the contractor only identifies major variances. Table 1 reflects total variances.

Again, excerpts from the contractor's variance explanation are provided as follows:

Schedule Variance $(5,786K)

1. The OU 7-10 GEM Project schedule variance is a result of performing specific activities in a different sequence than originally planned

2. Early-start schedule for the start of excavation activities on September 16, 2003, has been extended because of delays in:

   - Integrated system testing

   - Operator qualification and integrated training

   - Development of maintenance procedures

3. Delays evolving from training and readiness preparation,

4. Re-performance of the contractor operations Management Self Assessment (MSA)

5. Although the September 2003 baseline start of excavation is 6 months ahead of the enforceable milestone, the early-start schedule for excavation activities will be delayed until December, 2003

6. The early start date for performance of the MSA was based on an aggressive plan that recognized risk in early completion, but would have resulted in additional schedule float relative to the enforceable milestone date.

Cost Variance $(6,158K)

The OU 7-10 GEM Project negative cost variance due to:

1. Additional construction costs for design changes

2. Overtime required to maintain schedule

3. Subcontractor change orders and incentive payments

4. Additional tent vestibules, and repair of cracked Packaging Glovebox System (PGS) glass

5. Increase in operation costs due to additional radiological control technician requirements

6. Growth in mockup facility requirements, and an underestimated cost of materials, assembly, and management for the mockup facility

7. Schedule cost impacts due to the re-performance of the contractor MSA

8. Additional engineering costs due to design changes resulting from operations mockup experience, field design changes, PGS window glass replacement, and additional engineering to support turnover and warranty items

9. Growth in project management and administration as a result of additional resources required to support emerging waste handling issues

10. Response to agency comments

11. Actual labor costs higher than planned

12. Addition of testing and turnover supervisor and personnel

3.3.2.1.3 FY 2004 GEM

A review of the FY 2004 GEM schedule, performance, and actual cost data revels GEM is still behind schedule with a variance of $(2,563K), and still currently overrun with a cost variance of $(4,955K). (See Table 1 for GEM cost, schedule, and performance data.) Note: variance dollars in the M&O contractor's explanations may be different than Table 1 as the contractor only identifies major variances. Table 1 reflects total variances.

Again, excerpts from the contractor's variance explanation are provided as follows:

Schedule Variance $(633K)

The OU 7-10 GEM Project schedule variance ($633K) is a result of:

1. Delays and re-scoping of the facility shutdown activities

Cost Variance $(3,197K)

The OU 7-10 GEM Project negative cost variance of ($3,658K) is due to:

1. Addition of the management self-assessment (MSA) recovery team that was not included in the FY 2004 baseline plan

2. Purchase of additional operational materials and spares

3. 20-day slip in start of excavation activities versus the FY 2004 baseline plan.

Table1. OU-7 GEM.

	Cumulative Through September 2002									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
Analysis for Stage I Mods	2,350,706	2,350,706	2,258,048	$92,658	3.94%	$0	0.00%	1.04	1.00	1.04
Total	**$2,350,706**	**$2,350,706**	**$2,258,048**	**$92,658**	**3.94%**	**$0**	**0.00%**	**1.04**	**1.00**	**1.04**
ESH&Q	$1,378,339	$1,378,340	$941,521	$436,819	31.69%	$1	0.00%	1.46	1.00	1.46
Design Engineering	$4,498,233	$4,485,040	$4,874,090	-$389,050	-8.67%	-$13,193	-0.29%	0.92	1.00	0.92
Procurement	$2,333,755	$2,108,976	$2,502,002	-$393,026	-18.64%	-$224,779	-9.63%	0.84	0.90	0.76
Construction	$1,131,116	$1,131,118	$1,239,563	-$108,445	-9.59%	$2	0.00%	0.91	1.00	0.91
Startup and Testing	$35,803	$35,802	$24,943	$10,859	30.33%	-$1	-0.00%	1.44	1.00	1.44
Operations	$2,261,107	$2,214,902	$2,198,480	$16,422	0.74%	-$46,205	-2.04%	1.01	0.98	0.99
Maintenance	$14,935	$14,934	$23,660	-$8,726	-58.43%	-$1	-0.01%	0.63	1.00	0.63
Project Mgmt. and Admin.	$2,298,469	$2,298,469	$2,722,559	-$424,090	-18.45%	$0	0.00%	0.84	1.00	0.84
Total	**$13,951,757**	**$13,667,581**	**$14,526,818**	**-$859,237**	**-6.29%**	**-$284,176**	**-2.04%**	**0.94**	**0.98**	**0.92**
FY 2002 Total	**$16,302,463**	**$16,018,287**	**$16,784,866**	**-$766,579**	**-4.79%**	**-$284,176**	**-1.74%**	**0.95**	**0.98**	**0.94**
	Cumulative Through September 2003									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
ESH&Q	$1,179,235	$1,179,233	$1,177,325	$1,908	0.16%	-$2	-0.00%	1.00	1.00	1.00
Design Engineering	$1,868,718	$1,868,721	$2,678,856	-$810,135	-43.35%	$3	0.00%	0.70	1.00	0.70
Procurement	$4,770,463	$4,770,466	$3,554,431	$1,216,035	25.49%	$3	0.00%	1.34	1.00	1.34
Construction	$3,726,588	$3,726,588	$5,007,564	-$1,280,976	-34.37%	$0	0.00%	0.74	1.00	0.74
DD&D	$1,877,130	$1,440,694	$1,363,037	$77,657	5.39%	-$436,436	-23.25%	1.06	0.77	0.81
Operations	$18,204,532	$12,855,177	$17,793,218	-$4,938,041	-38.41%	-$5,349,355	-29.38%	0.72	0.71	0.51
Project Mgmt. and Admin.	$2,631,919	$2,631,919	$3,054,367	-$422,448	-16.05%	$0	0.00%	0.86	1.00	0.86
FY 2003 Total	**$34,258,585**	**$28,472,798**	**$34,628,798**	**-$6,156,000**	**-21.62%**	**-$5,785,787**	**-16.89%**	**0.82**	**0.83**	**0.68**
	Cumulative Through September 2003 (cont)									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
Alternative Definition and Execution	$2,358,409	$2,233,462	$2,184,715	$48,747	2.18%	-$124,947	-5.30%	1.02	0.95	0.97
ESH&Q Analysis	$363,226	$363,226	$91,322	$271,904	74.86%	$0	0.00%	3.98	1.00	3.98
Requirements Definition	$182,312	$182,311	$274,447	-$92,136	-50.54%	-$1	-0.00%	0.66	1.00	0.66
Project Administration	$796,596	$796,596	$881,289	-$84,693	-10.63%	$0	0.00%	0.90	1.00	0.90
FY 2003 Total	**$3,700,543**	**$3,575,595**	**$3,431,773**	**$143,822**	**4.02%**	**-$124,948**	**-3.38%**	**1.04**	**0.97**	**1.01**
FY 2003 Grand Total	**$37,959,128**	**$32,048,393**	**$38,060,571**	**-$6,012,178**	**-18.76%**	**-$5,910,735**	**-15.57%**	**0.84**	**0.84**	**0.71**
	Cumulative Through March FY 2004									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
Operations	$10,261,295	$7,922,822	$12,944,101	-$5,021,279	-63.38%	-$2,338,473	-22.79%	0.61	0.77	0.47
GEM Safe Shutdown & DD&D	$727,788	$495,287	$515,885	-$20,598	-4.16%	-$232,501	-31.95%	0.96	0.68	0.65
GEM Project Mgmt. Sppt.	$648,849	$656,633	$569,949	$86,684	13.20%	$7,784	1.20%	1.15	1.01	1.17
FY to date 2004 Total	**$11,637,932**	**$9,074,742**	**$14,029,935**	**-$4,955,193**	**-54.60%**	**-$2,563,190**	**-22.02%**	**0.65**	**0.78**	**0.50**

3.3.2.2 ARP IRT Analysis – FY 2004

A review of the FY 2004 (through March) ARP schedule, performance, and actual cost data revels ARP is behind schedule with a variance of $(1,811K) and underrun with a cost variance of $1,627K. (See Table 2, ARP cost, schedule and performance data.) Note: variance dollars in the M&O contractor's explanations may be different than Table 2 as the contractor only identifies major variances. Table 2 reflects total variances.

Again, as previously stated in Section 3.3.2, Cost Estimating above, the GEM Project served in part, as a template for the M&O contractor's ARP BOEs. The following excerpts have been extracted from the M&O contractor's variance explanations (which are included in their entirety below this section), and are intended to demonstrate why the use of the GEM financial data **is not** an appropriate cost model for the ARP.

Schedule Variance $(1,812K)

The AR Project is experiencing a negative schedule variance of ($1,812K) as a result of:

1. Late start of construction and procurement activities due to changes during design execution, which include changes to the building elevation and decision to package waste in drums versus standard waste boxes

2. Additionally, the site preparation schedule has been impacted by the discovery of a waste drum during overburden excavation.

Cost Variance $1,628K

The AR Project cost variance is primarily a result of:

1. A level loaded operations schedule

2. Efficiencies in the ESH&Q account

3. Delays in the site preparations subcontract

4. An under-run in design engineering due to design changes which impacted engineering's ability to work on baseline scope.

Recommendation

Maintain the current contractor ARP cost estimates to minimize additional expenditure of limited funds. Resist the temptation to re-baseline for the purpose of making the project whole or clearing the slate. Re-baselining would only further obscure the true cost of the project. Implement strict change control to the existing baseline. Require disciplined cost, schedule and performance variance reporting by the M&O contractor. Utilize frequent independent reviews and reporting of the project's financial and performance status.

Perform a lessons learned on the M&O contractor's conceptual approach to building BOE assumptions.

Table 2. ARP Performance - Through March 2004.

	Current Period									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
ESH&Q	$494,949	$436,233	$68,956	$367,277	84%	-$58,716	-12%	6.33	0.88	5.58
Design Engineering	$1,210,984	$1,027,768	$323,412	$704,356	69%	-$183,216	-15%	3.18	0.85	2.70
Procurement	$1,534,077	$328,849	$202,211	$126,638	39%	-$1,205,228	-79%	1.63	0.21	0.35
Construction	$447,920	$213,979	$78,418	$135,561	63%	-$233,941	-52%	2.73	0.48	1.30
Operations	$920,288	$934,506	$176,909	$757,597	81%	$14,218	2%	5.28	1.02	5.36
Project Administration	$256,500	$255,140	$175,653	$79,487	31%	-$1,360	-1%	1.45	0.99	1.44
TRU Waste	$379,996	$236,484	$58,137	$178,347	75%	-$143,512	-38%	4.07	0.62	2.53
FY to date 2004 Total	**$5,244,714**	**$3,432,959**	**$1,083,696**	**$2,349,263**	**68%**	**-$1,811,755**	**-35%**	**3.17**	**0.65**	**2.07**

	FY 2004 Cumulative									
	BCWS	**BCWP**	**ACWP**	**CV**	**CV %**	**SV**	**SV%**	**CPI**	**SPI**	**CR**
ESH&Q	$494,949	$436,233	$110,948	$325,285	75%	-$58,716	-12%	3.93	0.88	3.47
Design Engineering	$1,210,984	$1,027,768	$644,967	$382,801	37%	-$183,216	-15%	1.59	0.85	1.35
Procurement	$1,534,077	$328,849	$329,123	-$274	-0%	-$1,205,228	-79%	1.00	0.21	0.21
Construction	$447,920	$213,979	$95,258	$118,721	55%	-$233,941	-52%	2.25	0.48	1.07
Operations	$920,288	$934,506	$206,726	$727,780	78%	$14,218	2%	4.52	1.02	4.59
Project Administration	$256,500	$255,140	$313,868	-$58,728	-23%	-$1,360	-1%	0.81	0.99	0.81
TRU Waste	$379,996	$236,484	$104,094	$132,390	56%	-$143,512	-38%	2.27	0.62	1.41
FY 2004 Total	**$5,244,714**	**$3,432,959**	**$1,804,984**	**$1,627,975**	**47%**	**-$1,811,755**	**-35%**	**1.90**	**0.65**	**1.24**

3.4 ARP Cost Metrics

Figures 3 through 8 depict the Accelerated Cost Metrics broken out by category, draft EE/CA breakdown, total cost by waste type, average per drum cost waste type, drum requirements, and waste/drum percentages.

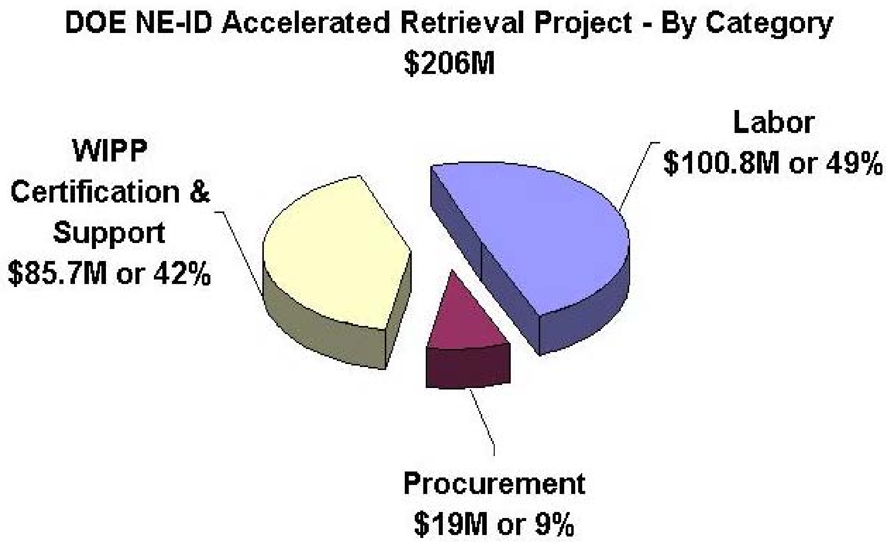

Figure 3. NE-ID ARP by Category. This chart illustrates the primary make-up of the ARP and highlights the labor to total project cost percentage, as well as the low percentage of equipment and material cost.

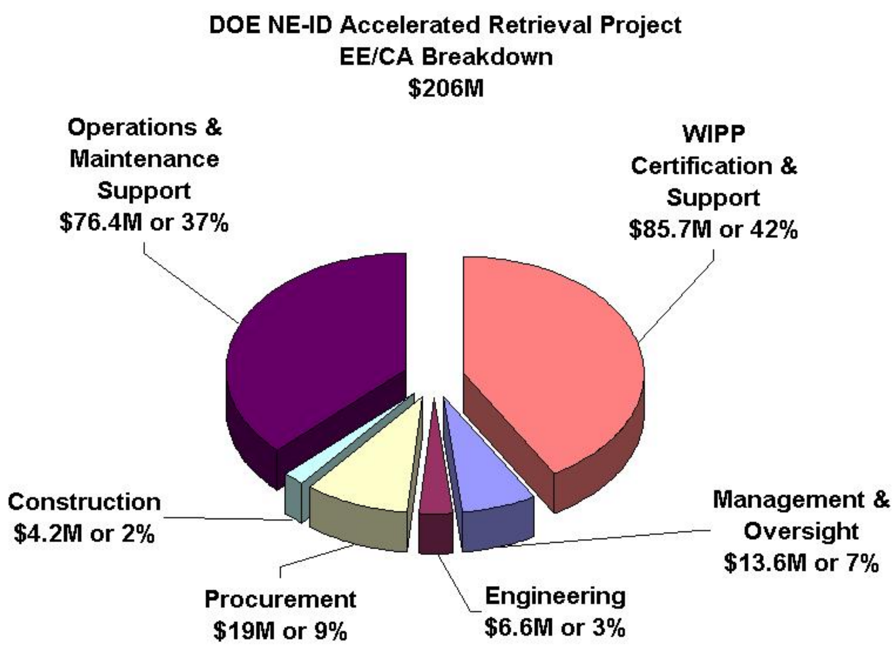

Figure 4. NE-ID ARP by draft EE/CA Breakdown. This illustration reflects the significance of the Operations budget, with respect to the other functional cost areas, and the overall cost of the ARP.

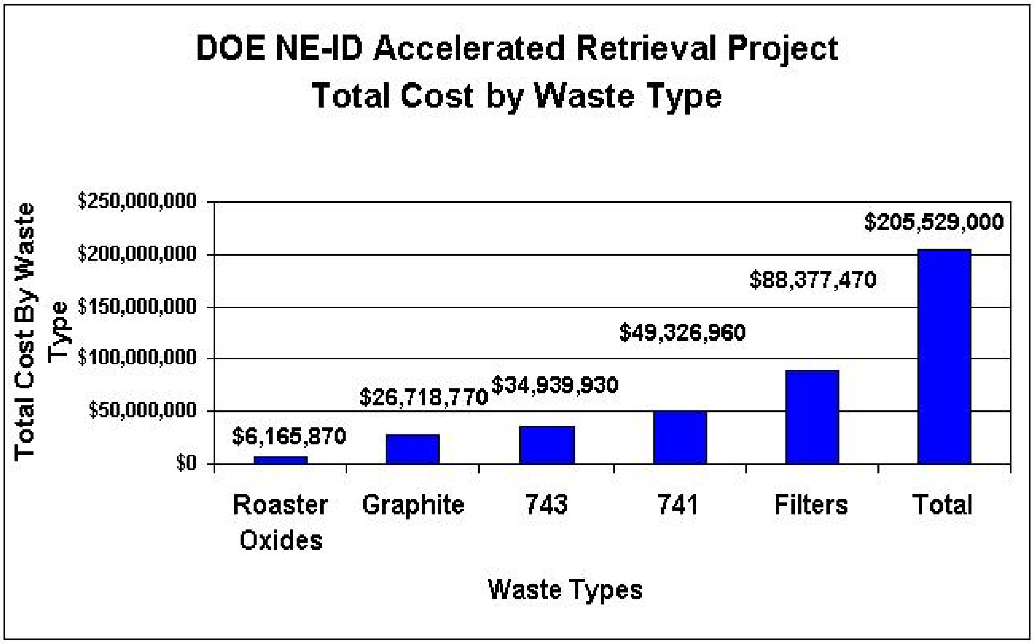

Figure 5. NE-ID ARP Total Cost by Waste Type. Cost by waste type is shown to correlate targeted waste to the overall cost of the project.

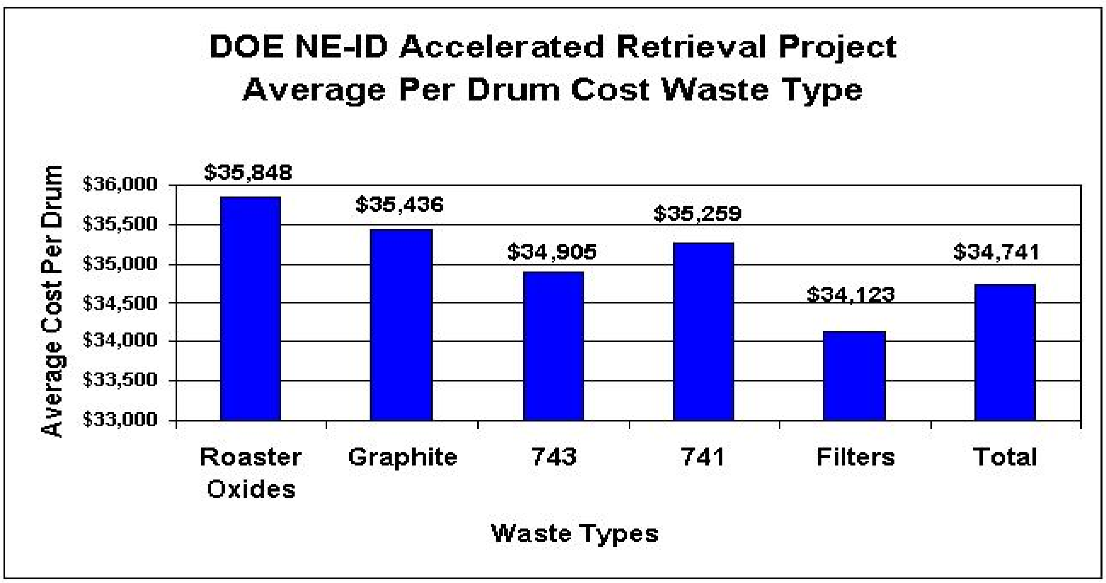

Figure 6. NE-ID ARP Average Per Drum Cost Waste Type. ***Note: Per factual review with the M&O Contractor on 4/28/04, the estimated drum volume base has grown to 12,500, effectively reducing the per drum cost by 50%. However, this is based on the unrealistic assumption that there are no schedule impacts, or additional increased cost.***

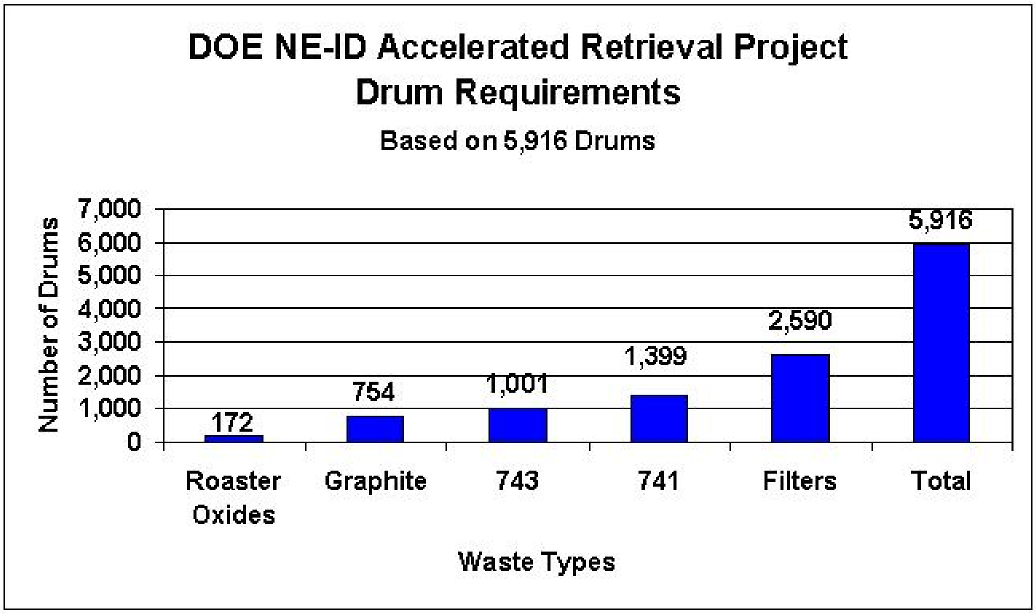

Figure 7. NE-ID ARP – Drum Requirements by Waste Type.

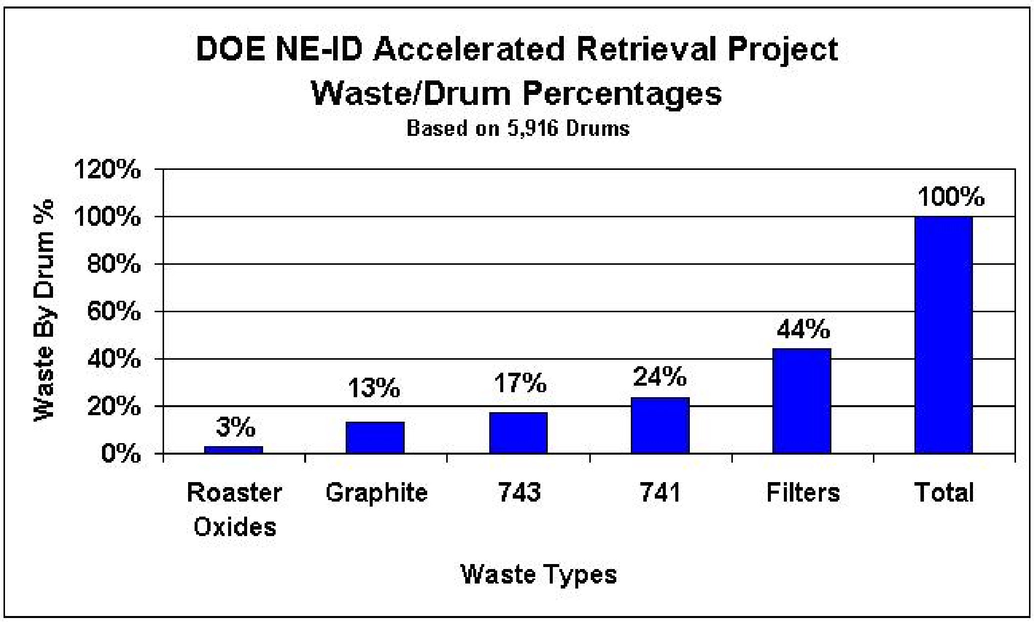

Figure 8. NE-ID ARP by Waste/Drum Percentages.

3.4.1 Planning Assumptions

Assumptions as stated in the ARP documentation are considered by the IRT to be unrealistically optimistic to a fault. All permitting, waivers, regulator discussions, funding availability, operations, waste retrieval, packaging, sampling, and completion are set to an uninterrupted, delay-free pace. There are no considerations for: equipment failure, safety stop-work or stand-downs, adverse weather, radiological or personnel contamination issues. The history of similar projects supports the effect of some or all of these delay attributes on any given project, at any given time. This was demonstrated (on this project) with the barrel that was contacted unexpectedly at a depth of only two feet on March 20, 2004.

Further evidence of planning weaknesses is demonstrated in Section 3.3.2, Cost Estimates. While GEM costs were used in part as a model for the M&O contractor BOEs, this was accomplished without the benefit of the types of variance explanations provided that cite numerous delays and additional unplanned project expense. In fact the ARP BOEs are void of any of the variance explanation attributes provided to the IRT by the contractor. All BOE assumptions indicate that the ARP project will suffer no delays or experience any unknowns.

Recommendation

Perform a lessons learned from the GEM Project to identify those delay attributes that can reasonably be expected to have a potential to impact the ARP project schedule. Once probable and quantifiable delays are identified, quantify the impacts, and change control these values into the cost and schedule of the appropriate activity, proportionately reducing the contingency.

Identify why the M&O contractor assumed this project would not experience delays or unknowns on the ARP.

3.4.2 Earned Value Performance Measurement

In the April 12, 2004 briefing with the M&O Contractor and NE-ID, discussions of performance measurement indicated that the contractor was intending to claim performance based on the percent of dig-face excavation completed. While this approach represents the least amount of complexity in terms of methodology, it does not relate to the desired project end state, as there are no assurances that waste reduction to the targeted inventory goals will actually be realized. Measuring performance on dig-face completion would be paying the contractor for their methods, not their results. The return to pit (RTP) waste could increase, reducing the effectiveness of the inventory reduction objective. Measuring performance on the number of containers packaged and prepared for shipping to WIPP could also result in difficulties, if for some reason the path to WIPP became unavailable as a result of faulty characterization, or an increased number of containers are generated as a result of blending. Performance measures should be established to quantify progress toward the project objective in order to properly monitor and reward work that is valued by NE-ID.

Recommendation

Negotiate with the M&O contractor, prior to fee determination or project startup, to identify an appropriate earned value approach to ensure the project objectives are met. In addition, to ensure NE-ID understanding of progress on the project, place the earned value method under configuration control, requiring NE-ID approval for any changes. Earned value performance measurement is viewed as key to the success for both contractor and the client. Incorrect earned value measurement is likely to lead to expenditure of cost, while falling short of the project objectives. Since there are several key activities to the ARP (i.e., dig face, targeted waste removal, RTP, sorting, packaging, characterization, storage, certification, and shipping) it is recommended that performance be weighted to each critical activity, with emphasis on project end-state performance measures. The following examples could be used individually, but represent a stronger earned value approach when used concurrently.

Earned Value Performance Method 1 Example.

Figures 9 and 10 are examples of this recommendation. However, the figures depict this recommendation in percentages; it should be noted that in order to measure them for parallel activities, it would be necessary to break the percentage totals out by month.

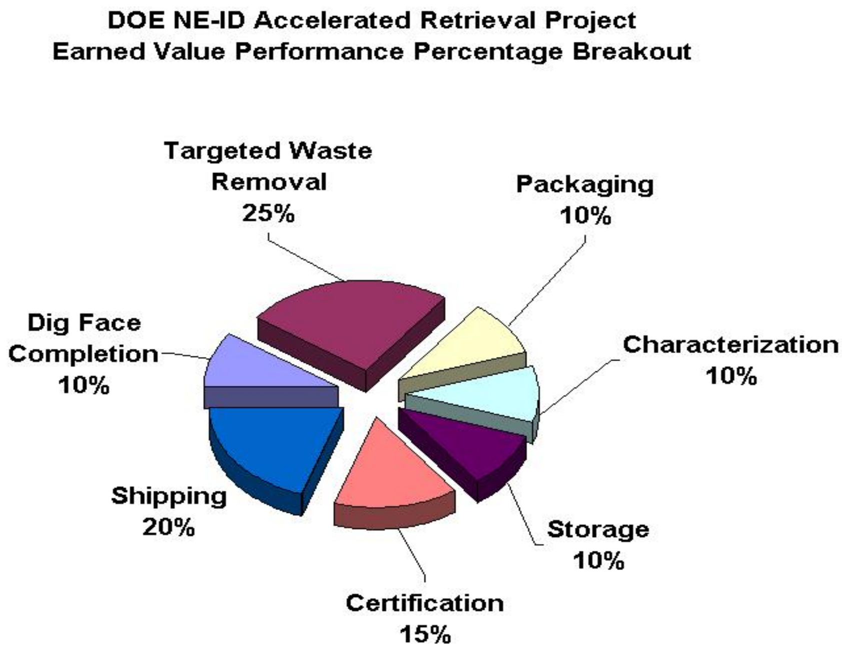

Figure 9. NE-ID ARP Earned Value Performance.

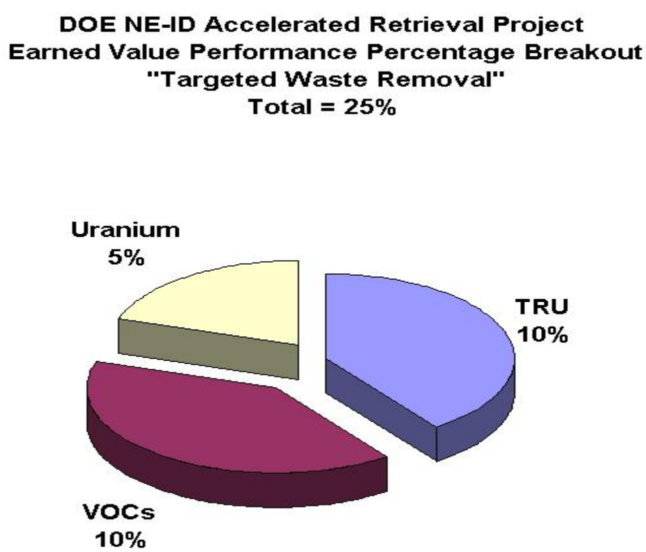

Figure 10. NE-ID ARP Earned Value Performance Breakout by Targeted Waste Removal.

Earned Value Performance Method 2 Example

A second method of earned value performance measurement would be to target reductions to the per-drum cost as shown below in Figure 7. In this example, reductions to the per-drum cost would be assigned percentage values as follows:

1. 50% reduction in per-drum cost would indicate performance at 100%
2. 25% reduction in per-drum cost would indicate performance at 50%
3. 10% reduction in per-drum cost would indicate performance at 25%
4. 5% reduction in per-drum cost would indicate performance at 15%.

Earned Value Performance Method 3 Example

A third method of performance measurement could be measured in a reduction to the contractors ARP staffing plan, supporting the global need to do more with less. For example:

1. 25% reduction in ARP staff would indicate performance at 100%
2. 20% reduction in ARP staff would indicate performance at 50%
3. 15% reduction in ARP staff would indicate performance at 25%
4. 10% reduction in ARP staff would indicate performance at 15%.

This method preserves the core staff resources identified in the staffing analysis, and optimizes the management, administrative, and Hotel resources.

Earned Value Examples 1, 2 and 3 Used in Combination

Figure 11 and Table 3 below represent all three methods with weighted performance percentages and rationale stated for each. The Targeted Waste Removal Method is weighted to reflect the regulatory drivers and site cleanup mission. The ARP Staffing Method is weighted to reflect the significance of immediate cost reductions to the project. The Per-Drum Cost Reduction Method is weighted to reflect the opportunity to demonstrate cost efficiencies for the project through the lifecycle. Each of these methods applied in unison would be calculated on a monthly basis.

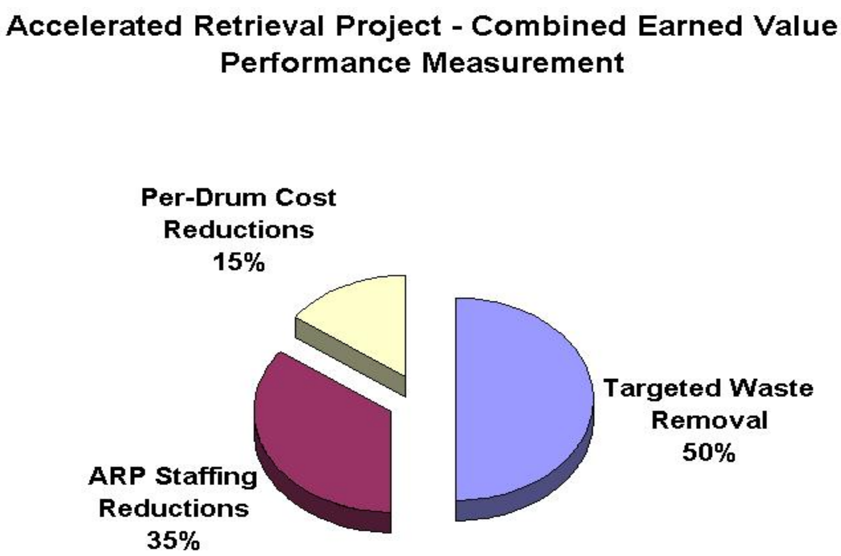

Figure 11. Combined Earned Value Performance Measure.

Table 3. ARP Earned Value Performance Measurement – Examples 1,2 and 3 combined.

Accelerated Retrieval Project Earned Value Performance Measurement Examples 1, 2, and 3 Combined — Proposed Weighted Measurements		
Targeted Waste Removal	**ARP Staffing Reductions**	**Per-Drum Cost Reductions**
Drivers = 50%	**Drivers = 35%**	**Drivers = 15%**
ARP Objective meets Non-Time Critical Removal Action	Consistent with the ever shrinking budgets...creating a "do more with less" environment	Economically advantageous to demonstrate the success of the ARP
Idaho Completion Project Mission - Waste Cleanup	ARP Staffing reductions offer immediate cost reductions to the project	Allows the contractor to capitalize on down stream process, characterization, certification, or shipping efficiencies beyond the current contract period
EPA and Idaho Department of Environmental Quality Regulatory Drivers	Allows M&O Contractor to maximize ARP cost savings	Provides the most probable external opportunities for cost savings, post retrieval, e.g., WIPP
National Oil and hazardous Substances Pollution Contingency Plan (40 CFR300)	Most probable internally influenced cost reduction available to the ARP	Provides ARP Lifecycle incentives
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC 9601et seq., 1980)	Accommodates ARP Earned Value Performance Continuity	Accommodates ARP Earned Value Performance Continuity
Accommodates ARP Earned Value Performance Continuity		

3.5 Soundness of the Technical Basis for the Estimate

3.5.1 Gradall XL5200 Excavator

The estimated cost of the modified excavator is ~$260K.[12] The project is currently set to use a single excavator as part of the waste retrieval project. In discussions with the contractor at the April 12, 2004 briefing, the contractor communicated that the use of two excavators was considered. However, as a result of space constraints and potential related safety issues surrounding movement of multiple machines within the confined space, the decision was made by the contractor to use a single excavator. Their concerns did not consider the need for redundant equipment as a contingency position for equipment failure.

The excavator will be used at the dig face for retrieval, segregation, RTP, and compaction activities, and is considered critical path. Excavator failure will result in critical and expensive delays as all other project operations are dependant upon the raw material supplied by the excavator. If delays occur, the entire operational project cost will continue to be incurred at a rate of ~$112K per day, or ~$3.3 M every 30 days. This calculation is based on the total estimated FY 2005 operating expenses of ~$44.3M divided by the retrieval duration of 395 days. A second excavator (costing ~$260K) could be used for pre-project training, and would be available in the event of failure of the first unit. Scheduling alternating use between the two excavators would allow for concurrent maintenance of the machines ensuring continuity of operations. The purchase of a second excavator is considered a reasonable and prudent investment given that excavator failure causing a three-day delay in schedule would pay for the redundant capacity.

3.5.2 TeleHandler

The Telehandler is also an integral part of the retrieval process used in tray transportation, packaging, and for the RTP area. This equipment has many of the same modifications as the excavator discussed above. As with the excavator, the Telehandler is also planned as a single operating unit. The cost of a used Telehandler is ~$75K.[12] If this equipment fails, the entire retrieval process must be halted. The cost of this operational delay is ~$112K per day, or ~$3.3M every 30 days. The risk associated with the use of a single Telehandler places the complete ARP in jeopardy with negligible cost benefit.

3.5.3 Characterization and Transportation

Complete information regarding the WIPP Central Characterization Project (CCP) characterization and transportation costs was not provided to the IRT. The basis for our review was the $85M estimate provided by the M&O contractor in the BCP.

3.5.3.1 Characterization and Transportation

For the purpose of evaluating the soundness of the WIPP characterization and shipping portion of the BCP, the IRT utilized the limited data provided by the M&O and compared that data against similar cost data from the 3,100 m^3 Project utilizing the following assumptions:

- Characterization and shipment of TRU waste will be performed via CCP at a total estimated cost of ~ $85M, 42% of the total ARP estimated $205M
- Required Agency approvals will be in place to support characterization and shipment of TRU waste to WIPP
- Minimal handling of waste post-retrieval and packaging operations that could inflate the costs
- ARP estimates that 6,046 drums of targeted TRU waste will be retrieved and shipped to WIPP. ***New information received from the M&O contractor during factual review with NE-ID and the M&O contractor (4-28-04) indicates that the targeted TRU waste drum estimate has been changed from 6,046 to ~12,500.***

At ~$85M total characterization and shipping costs and an estimated 6,046 drums, this equates to over $14K per drum unit cost. (See Figure 12 below.) Similar independently derived figures from the 3,100 m^3 Project (averaged over the life of the project) include:

- $6K per drum shipped to WIPP (Tonkay Method)
- $9.5K per drum shipped to WIPP (CABE Method)[13]
- New drum estimates ***(new information referenced above)*** equate cost to ~$6.8K per drum shipped to WIPP.

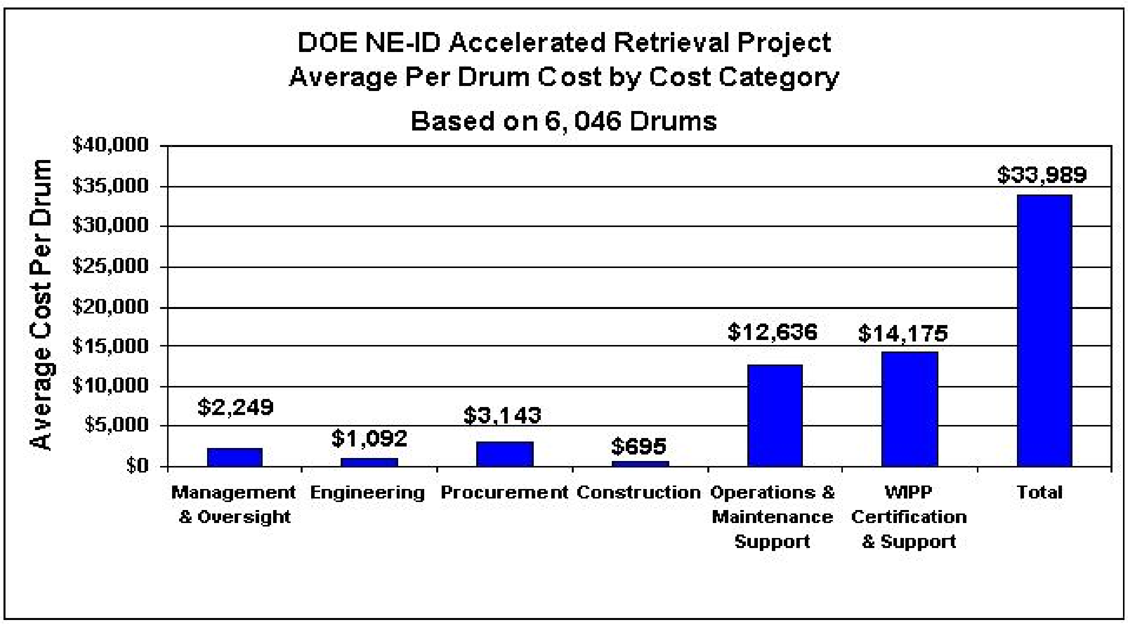

Figure 12. NE-ID ARP Average Per Drum Cost by Cost Category. This chart is intended to provide a per-drum perspective by functional cost area. This graph correlates to and is substantiated by the previously shown Figure 6, "Project Average Per Drum Cost by Cost Category. ***Note: Per factual review with the M&O Contractor on 4/28/04, the estimated drum volume base has grown to 12,500, effectively reducing the per drum cost by 50%.***

The Tonkay and CABE estimates were independently derived estimates of cost/drum that were performed on the 3,100 m^3 Project and other facilities that were shipping TRU waste to WIPP during the same time period. The results of these estimates were reported to the DOE Idaho Operations Office and in the case of the CABE data, the results were also presented to the National Academy of Sciences and DOE-HQ.

The difference between the two methods of analysis was mainly due to the exclusion of costs associated with visual examination, coring, and audits from the Tonkay Method.

Recommendation

The comparisons suggest that the potential exists for significant cost savings to the project through alternative means for characterization and shipping activities, such as utilizing on-site characterization and transportation capabilities. At a minimum, the IRT suggests revisiting the estimates to ensure maximum benefit to the customer for the dollars spent.

4. SCHEDULE

Focusing on the baseline budget and schedule, the IRT examined engineering, procurement, construction, and the generated BCP schedules,[2,5,20-32] comparing them with associated documents to ascertain the status of the project and to identify any potential concerns that could impact successful project completion.

The review of project schedule also considered technical scope, proposed technologies, cost estimates, underlying assumptions and supporting data, as well as the management and contracting strategy for delivering the project. This review took into consideration the limited materials provided by the M&O contractor pertaining to total life cycle costs, (excluding deactivation, decontamination, and decommissioning, which were directed as outside the scope of this review because the equipment, structures, and concept are expected to carry forward with potential applications in other areas of the SDA).

Due to the timing of the project start and the subsequent end of the M&O contract in January 2005, an abbreviated BCP was generated that only covered the scope of work that will be provided by the current M&O contractor. Total project life-cycle costs were thus generated by the M&O contractor through a process of taking the front-end costs and carrying those costs through the end of the project. General schedule assumptions that were made by the IRT but were not identified in detail in the materials provided by the M&O contractor include:

- The retrieval and segregation of targeted waste and non-targeted waste (NTW) from Pit 4 will commence October 1, 2004 and will continue for approximately 13 months with an expected completion date of October 31, 2005. ***New information received from the M&O contractor - during factual review with NE-ID and the M&O contractor on 4-28-04, the M&O contractor indicated that current schedule obligations for retrieval and packaging can not be met. New expectations were stated at ~18 months for retrieval and packaging operations.***

- Packaging of targeted waste will run concurrently with the retrieval and segregation operations with essentially the same start and stop date and duration. ***Based on new (4-28-04) information, can expect a negative but yet undetermined impact to schedule.***

- Characterization and transportation, while outside the scope of the IRT, are expected to start January 2006 with an estimated duration of approximately 171 days.

It appears that the M&O contractor utilized industry-accepted methods and software for the generation of the project schedules. Although the schedules appear to have been generated utilizing industry-accepted methods, there is an overly optimistic reliance on conditions outside the direct control of the project, as documented in the project assumptions. It also appears that while these assumptions may be outside the control of the M&O contractor, sufficient similar work and historical data could have been used and documented that would have provided more justification to the schedule. This same data would also be useful in the justification for contingency throughout the BCP.

The primary focus of the IRT's effort for this area was on the BCP documented assumptions[5] and their potential impacts to schedule. Detailed explanations of the major areas of concern can be found in the following sections, and are summarized in section 4.5. It should also be noted that due to the uncertainty of the project, all concerns listed throughout this report have a potential negative impact on project schedule and therefore all concerns should be evaluated by the M&O contractor for potential impact to schedule and subsequently mitigated to prevent or minimize any impact to the schedule. See Table 4, ARP Activities Schedule for an overview of project activities.

Table 4. ARP Activities Schedule.

Scheduled Activities	**FY04**			**FY05**				**FY06**			
	2nd	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**
Construction											
Retrieval & Storage											
Characterization & Shipment											

The DOE Office of Environmental Policy and Assistance RCRA/CERCLA Division (EH-413) issued a report, "A Monograph: Facility Disposition Lessons Learned from the Mound Site"[27] which summarizes key philosophies/approaches utilized in similar NTCRA work at the Mound Facility. Most notable was their approach for uncertainty management and their core team approach, both of which closely follow corresponding DOE/EPA guidance documents. This report, the methods employed at Mound, and DOE/EPA guidance on uncertainty management and phased response/early actions should be reviewed by the M&O contractor for application to the ARP.

4.1 Retrieval and Segregation

4.1.1 Equipment Redundancy

The need for redundancy of equipment in relation to ARP total costs is highlighted throughout this report. If this concept for retrieval is to become the standard or model for which other SDA wastes will be retrieved, the additional equipment can not only be justified for redundancy in the ARP, but also as an investment in future retrieval actions.

Recommendations

This focus area is highlighted throughout this report. The potential negative impacts to schedule and costs are tremendous. Lead times for replacement equipment (excavator) with needed modifications can run into the 90-day plus category, which could not only severely impact the schedule, but also cost the project millions of dollars. The IRT recommends:

- M&O contractor thoroughly review all processes and identify potential equipment points of failure
- Quantify the lead times to repair or replace the identified points of failure
- Compare the cost of redundant equipment against the cost of schedule impact
- Determine what constitutes an acceptable impact to the project
- Build a basis for contingency for equipment failure.

4.1.2 Volume Reduction Goals

Waste Treatment Assumption C. of the BCP[5] states, "No volume reduction goals apply to material returned to the pit or for TRU waste disposed at WIPP". This assumption conflicts with the CERCLA policy for non-time critical removal actions and the draft EE/CA.[2] The draft EE/CA Removal Action Objective and Scope states:

- "The focused objectives of the action are as follows: To perform a targeted retrieval of Rocky Flats Plant (RFP) waste streams that are highly contaminated with transuranic radionuclides, volatile organic compounds, and various isotopes of uranium."
- "To reduce the potential for future migration of the associated OU 7-13/14 contaminants of concern (COCs) located within the retrieval area to the subsurface surrounding the SDA and the underlying Snake River Plain Aquifer."
- "To develop and demonstrate an initial method and process for safely and efficiently removing TRU contaminated waste from the SDA and certify and transfer the resulting retrieved TRU waste streams to the Waste Isolation Pilot Plant (WIPP) in New Mexico."

The draft EE/CA goes on to state in section 3.1.2, "Performance of the alternative will, to the extent practical, result in complete removal of the targeted RFP waste streams from the retrieval area. Removal of these waste streams will result in a significant reduction of the curies of transuranic radionuclides and uranium isotopes within the retrieval area".

The inclusion of volume reduction goals would facilitate activity tracking and provide a means to measure overall ARP success. Without measurable volume reduction goals, the project, the M&O contractor, and ultimately NE-ID may come under scrutiny from agencies, DOE, and the public.

Recommendation

Use of volume reduction goals would facilitate activity tracking and provide the M&O contractor and NE-ID a means to track project status and schedule. Volume reduction goals should also tie to the Earned Value Performance Measurement that is detailed in Section 3, Validation of Project Costs and Project Control, and the IRT's recommendations that are also found in that section.

4.1.3 Waste Segregation

Review of the M&O contractor-provided process flow diagrams, BCP documented assumptions, and discussions with M&O contractor personnel showed that the generalized approach to waste segregation (i.e. the method for separating targeted waste from RTP materials) is that it will be performed visually at the point of excavation. In order to do this, an individual identified as the acceptable knowledge (AK) expert will view the excavation on a television screen in one of the pre-staged trailers via closed circuit cameras that are mounted on the excavator and in the retrieval enclosure. As the waste is excavated, the waste expert will make the determination whether or not the waste is targeted waste or RTP material. These decisions are "real-time" decisions and, from our discussions with the M&O contractor, will be made by a single individual at any given time during the process. Initially, the waste determination at the point of excavation was not to be recorded. Following ARP project review, ARP project management determined that recording at segregation will take place.[28]

Reliance on a single individual's determination for waste classification can be a detriment to the ARP as a whole and has the potential to severely impact the retrieval and segregation schedule. Independent calculations from the IRT, (see Appendix B), support our conclusion that the retrieval and segregation operations will be relatively fast-paced, necessitating movement and segregation of a large amount of material in a relatively short time. Our calculations estimate that the excavator will be retrieving a bucket, ~ 5 ft^3 of material, every two to three minutes. This equates roughly one-to-one for the AK expert's need to make waste determinations.

Recommendations

Reliance on a single individual for the dig face determination of waste as either RTP or targeted TRU waste can negatively impact the operations schedule. The IRT recommends:

- M&O contractor utilize multiple AK experts for the segregation activities
- Record all segregation operations and utilize recordings as both training aids for equipment operators and AK experts and maintain recordings as quality assurance records
- Utilize independent real-time verification during segregation (i.e. DEQ, DOE, or EPA oversight).

4.2 Storage Capacity

During discussions with the IRT, M&O contractor personnel stated that the Storage Enclosure, the area where retrieved waste will be stored prior to characterization and shipment to WIPP, will only have enough capacity for approximately 50% of the targeted retrieved waste drums. ***New information was received from the M&O contractor during factual review with NE-ID and the M&O contractor on 4-28-04. The M&O contractor indicated that expected targeted TRU waste volume of ~12,500 drums, storage capacity is now estimated at ~10,000 drums (based on M&O contractor calculations stacking drums five high and obtaining the necessary approvals to stack the drums five high.)***

Using the M&O estimate of the targeted waste drums from retrieval operations (~6,000 drums), this means that the expected storage capacity of the Storage Enclosure is ~ 3,000 drums of targeted waste. Excavation and retrieval operations are expected to start October 1, 2004 (FY05) and be completed by October 31, 2005 or ~ 13 months of excavation and retrieval. ***According to new information (4-28-04), the M&O contractor does not expect to meet the 13-month schedule. The new estimate is ~18 months. Independent estimates in this document were derived from and based on the 13-month retrieval and packaging estimate, therefore schedule and cost impacts of revised estimates are not contained in this report.*** Characterization and Transportation (WIPP CCP operations) are estimated to start January 2006 and last for approximately 171 days. Assuming these figures are accurate, this means that the retrieval operations will be completed prior to the start of characterization and transportation of targeted waste to WIPP. Taking the Storage Enclosure capacity into consideration this equates to ~ 3,000 drums of targeted wastes that will not be stored in the Storage Enclosure.

Additional or alternate storage capacity is not called out or included in the BCP or other review materials provided to the IRT. It appears that the Storage Enclosure capacity may have been adequate when the concept of using standard waste boxes to package targeted wastes was developed by the M&O contractor. Now that the methodology has changed to packaging targeted wastes in drums, the planned storage capacity appears inadequate.

Recommendations

It appears that there is inadequate storage for the estimated retrieved targeted TRU waste. The storage enclosure has an estimated capacity for approximately half of the expected drums of targeted TRU waste. If storage capacity is reached prior to the completion of the retrieval and segregation operations, the potential exists to severely impact scheduled operations. Based on the IRT's findings we suggest:

- M&O contractor determine estimated targeted TRU waste storage requirements for 55-gallon drums.
- Erect additional storage enclosure(s) or make arrangements for total expected targeted TRU waste in 55-gallon drums.
- Arrange with WIPP CCP to accelerate the characterization and shipment of waste to WIPP.
- Explore contingency storage arrangements on site (i.e. British Nuclear Fuels Limited (BNFL) Advanced Mixed Waste Treatment Facility).

4.3 Agency Assumptions

Similar to the M&O treatment of budget uncertainties (see Section 3.3.1), it does not appear that the M&O contractor is following the DOE/EPA guidance document *Uncertainty Management: Expediting Cleanup Through Contingency Planning*[10] regarding uncertainties that could potentially impact schedule. The schedule and ultimate success of the ARP is outside the direct control of the M&O contractor. This is highlighted in several areas throughout the assumptions in the BCP, most notably in the assumptions that deal with CBFO/WIPP and Agency "buy-in" of proposed methodologies and concepts used in the identification and characterization of targeted waste. Some of the assumptions that the IRT questions are:

- "The waste inventory contained within the retrieval area is known based on information gathered from past generator records and disposal record."
- "Sampling will support characterization for acceptance at WIPP. The Field Sampling Plan will be based on the assumption that retrieved targeted waste is WIPP certifiable. If not, additional sampling of repackaged waste will be required."
- "Acceptable waste stream assignment, sampling of homogeneous and soil/gravel wastes, and characterization and certification approaches can be developed and negotiated with WIPP regulators."
- "Evaluation and modification of NEPA documentation will be performed by WIPP to address any potential restrictions to disposal of pre-1970 waste. DOE adequately addresses the Notice of Intent by the New Mexico Environmental Department to restrict WIPP Waste inventory to only those forms addressed in the 1995 Transuranic Waste Baseline Inventory Report. Resolution of this issue by DOE allows for pre-1970 waste to be disposed at WIPP."
- "An area-based sampling program will be implemented to meet WIPP requirements for RCRA sampling. The area-based sampling program will meet EPA SW-846 methodology for sampling landfills and lagoons and WIPP permit requirements. The approach will be approved by WIPP and successfully negotiated with New Mexico Environmental Department by July 1, 2004."

Current M&O, WIPP/CBFO and Agency discussions are underway that should help mitigate the risk in the above highlighted assumptions. There are also other indications, such as the Tom Clements white paper "Action Plan for Reducing Retrieved Buried Transuranic Waste Characterization and Disposal Costs",[29] dated January 8, 2004, that give credence to the M&O contractor addressing the potential issues identified in the above assumptions. Additionally, it should be noted that the BCP does set aside schedule and money for ongoing discussions with the Agencies and regulators. These discussions and the resulting Agency regulatory changes are assumed by the M&O contractor to be completed by July 1, 2004. Any delay in the discussions and resulting required Agency changes may critically impact and delay the schedule.

Historical data from the 3,100 m^3 Project and the Remote-Handled Transuranic Waste Disposition Project do not necessarily confirm the allotted schedule for these discussions and changes required from the Agencies involved.

Recommendations

There appears to be an optimistic reliance on timely Agency "buy-in" of M&O contractor-proposed methodologies and technical concepts that historical data does not support. Operations (retrieval and segregation) are set to start October 1, 2004 and will be fully staffed in August 2004. Delays for Agency approvals have the potential to impact schedule on a day-for-day basis and can cost the project in excess of $100K per day of delay in operations alone. The IRT recommends:

- Implement the DOE/EPA guidance document *Uncertainty Management: Expediting Cleanup Through Contingency Planning*[10] in the planning process
- M&O contractor utilize similar experiences and available data (i.e. 3,100 m^3 Project) to quantify realistic expectations for Agency approvals
- Consistent with DOE/EPA guidance for uncertainty management, develop contingency plan(s) for viable alternatives should the Agency approvals be delayed
- Perform a risk analysis to determine what the acceptable cost of failure is should Agency approvals be denied
- Develop a basis of estimate for contingency due to Agency delays that is defensible and incorporate this into the BCP and schedules
- Utilize the "Core Team Approach" specified in DOE/EPA guidance for Phased Response/Early Actions under CERCLA[10] to access project needs and establish/facilitate approvals.

4.4 Transportation

Characterization and Transportation are a function of the CCP and were only reviewed in the context of potential impacts and delays to schedule and cost. Transportation of WIPP-certifiable waste is projected to start in January 2006 and continue for approximately 171 days. The M&O contractor estimates total volume of targeted waste at 6,046 drums of waste. ***New information was received from the M&O contractor during factual review with NE-ID and the M&O contractor on 4-28-04. The M&O contractor revised the estimate on targeted TRU waste to ~12,500 drums. Retrieval and packaging schedule changed from 13 months to 18 months with potential impact on characterization and shipping activities (CCP).*** Assuming that none of the waste is remote-handled and therefore can be shipped in a standard TRUPACT-II shipping container configuration (14 55-gallon drums), this equates to approximately 893 TRUPACT-II containers or ~ 5 containers per day. These assumptions do not take into consideration weight of the payloads, WIPP shipping/receiving schedules or any other anomalies that may be experienced with the waste.

In comparison, the 3,100 m^3 Project processed an average of three TRUPACT-II shipping containers per 12-hr shift. Correlating these numbers shows that there may not be adequate schedule considerations given for transportation of waste to WIPP.

Additional transportation considerations:

- Availability of TRUPACT-II shipping containers
- Availability of transport tractor-trailers
- Competing agendas, needs, and priorities from competing TRU waste sites already shipping or planning on shipping waste to WIPP (i.e. BNFL).

Recommendations

Characterization and transportation are a function of CCP and were reviewed for potential impacts to scheduled activities. Based on the IRT's findings we suggest:

- M&O contractor arrange with WIPP CCP to accelerate the characterization and shipment of waste to WIPP
- Utilize historical data (3,100 m^3 Project transportation information) to verify reasonableness of transportation projections
- Evaluate additional transportation considerations (i.e. availability of containers, trucks, and competing agendas).

4.5 Summary of Schedule Review

Table 5 summarizes the findings of the schedule review.

Table 5. Summary of Schedule Review

Activity/Task	M&O Contractor	Independent IRT	Comment and/or Recommendation
Retrieval & Segregation	SSCs shall have a design life and throughput capacity consistent with 50% of the WAG 7 buried TRU waste.	Redundancy of key equipment would help ensure throughput and capacity.	Review processes for point(s)-of-failure. Quantify lead times and fixes. Determination of cost vs. schedule impacts. Build basis for contingency to account for redundancy Follow DOE/EPA uncertainty management guidance.
Waste Treatment Assumptions	No volume reduction goals apply to material returned to pit or for TRU waste disposed at WIPP.	Conflicting statement with what is stated and implied throughout the draft EE/CA and CERCLA NTCRA.	Utilize volume reduction goals. Tie goals to earned value performance measurement. Utilize to track status of project.
Operations & Maintenance Assumptions	Waste will be visually segregated at the point of excavation.	Appears that most of the responsibility and liability is placed on the knowledge and judgment of a single individual.	Utilize multiple “AK experts” for waste determination concurrence. Recommend the use of an “independent” verifier (i.e. EPA, DEQ, or DOE) for “real-time” concurrence of waste determination. Recommend waste retrieval and segregation operations are recorded as a means to mitigate issues and also for training new individuals. Initially, the waste determination at the point of excavation was not to be recorded. Following ARP project review, project management determined that recording at segregation will take place. (Ref 63).
Waste Storage Enclosure	Early discussions with M&O revealed that the waste storage enclosure would provide storage capacity for 50% of the expected retrieved targeted waste. New data still shows inadequate storage capacity for expected targeted waste in drums	Current schedule and BCP does not support this. Retrieval schedule shows that the waste will be retrieved prior to the start of the characterization. This leaves approximately 2,500 drums of targeted waste with no identified storage.	Explore/identify additional storage. Accelerate characterization & shipping schedule (CCP). Erect additional storage enclosure(s).
Scope Assumptions	Many critical assumptions relying on Agency “buy-in” to concepts and methodologies.	Historical review and perspectives from past projects (i.e. 3,100 m3 Project, etc.) show that this is arduous, costly, and time consuming.	Quantify realistic expectations for approvals Utilize “Core Team Approach” as specified in DOE guidance for Phased Response/Early Actions (DOE/EH/-0506).10 Utilize actual past experience and lessons learned information to mitigate risk of starting work “at risk”. Develop BOEs for contingency due to Agency delays.
Transportation	Function of CCP at ~$85M and estimated duration of 171 days.	The estimated amount of containers conflicts with historical data on the viability of completing this task in the allotted time frame without significant impact to cost/schedule.	Arrange with CCP to accelerate schedule. Utilize historical data to verify reasonableness of projections/schedule/cost. Evaluate additional transportation considerations. Evaluate on-site characterization & transportation options.

5. TECHNICAL APPROACH

Each major task of the ARP was analyzed by the IRT in order to ascertain whether the proposed project fits certain criteria, including whether the process is cost-effective, safe, and a technically defensible way to accomplish the handling and removal of buried waste, specifically retrieval and segregation, packaging, characterization, and transportation for ultimate disposal at the WIPP.

Information reviewed included weekly reports from the week of January 5, 2004 through the week of April 12, 2004,[30] the Baseline Change Proposal, BCP/FCN No. RWMC-04-021, dated April, 5, 2004,[5] A-E Specifications for the Storage Enclosure, SPC-521,[16] A-E Specifications for the Retrieval and Airlock Tents, SPC-518,[14] Construction Specification for the Retrieval Enclosure Installation Package, SPC-540,[20] GEM Project Operating Procedures TPR-1793, 1794, 1795, 1796, and 1799,[31-35] and the Statement of Work (SOW) for the DPS, SOW-1804.[24] M&O contractor e-mail responses to IRT questions have been timely and invaluable.

5.1 Retrieval and Segregation

During discussions with M&O contractor personnel and a review of the GEM project procedure for retrieval,[31] the IRT found very little similarity between retrieval equipment and techniques used on the GEM project and those proposed for the ARP.

5.1.1 Excavation

The overall technique for excavation appears to be a sound approach, with an Initial Trench planned to open up the pit to or near the basalt and then a stepped progression to the end of the designated area. The excavator will be positioned in the pit until reaching the end of the designated area, at which time it will work from above grade. The Initial Trench is also the starting point for placing non targeted waste and potentially contaminated soil (PCS) back into the pit. It appears that the M&O contractor put considerable thought into the excavation technique.

Segregating waste and soil with the excavator bucket and assorted excavator tools will be difficult and time consuming. The large buried items such as the support structures associated with the refueling machine from Test Area North (TAN) and the reactor skid and shielding will not be moved, but digging around these structures without causing damage to the excavator bucket will be slow and require significant operator skill. It is assumed the excavator buckets will be blade buckets and not toothed digging buckets. The toothed buckets tend to cause more damage during excavation activities.

There is some question on whether the grid markings painted on the side and end of the retrieval enclosure are adequate for an excavator operator to return to the previous stopping point or pinpoint the location of the large items left behind as required by the regulators. A more positive locator system is discussed in detail in Section 6.1.8 of Industry Practices.

It is assumed some of the NTW soft-sided boxes (SSBs) need to be staged in the retrieval enclosure prior to starting the excavation and periodically during the excavation. It is also assumed that NTW boxes will be placed in the Retrieval Enclosure as needed through Airlock #1.

Recommendation

From a technical approach the planned pit initial trench and stepped progression excavation method are good. However, there are industry practice recommendations that should be addressed. These recommendations are provided in Section 6.1.1 of Industry Practices.

5.1.2 Non-Targeted Waste Soft Boxes

The durability of the NTW boxes is questionable. The boxes will have inserts to make them rigid, but they will be handled with a Telehandler and excavator. The boxes will also be stacked in the pit and, according to information contained in the BCP,[5] the material returned to the pit ". . . will be compacted to prevent future subsidence". The IRT has a concern as to whether the bottom boxes will withstand the weight of the stacked boxes plus the backfill PCS without collapsing. The M&O contractor has considered several sizes of boxes. It is unclear whether a final decision on the size of the box has been made.

5.1.3 Lighting for the Retrieval Enclosure

The Excavator operator(s) will have limited visibility due to the wearing of full respirators. The portable lights coupled with an assumed existing 24 Volt light mounted on the excavator boom should provide adequate lighting for the excavator operator. However, the Telehandler operator will need good lighting at the front of the enclosure for moving targeted waste trays into the airlock and at the back of the enclosure for placing/ retrieving the filled NTW boxes into/from the staging area. The AK experts must also have good lighting for the closed circuit television (CCTV) to observe the various waste forms and make technical decisions on the waste disposition. It is unknown at this time where the portable lighting stands will be placed, how often they will need to be moved for excavation and segregation purposes, and/or how they will be moved. The M&O contractor is in the process of evaluating different styles of portable lighting and is testing their effectiveness at the Cold Test Pit. Overhead lighting had previously been considered by the M&O contractor, however the question of maintenance became an issue. ***During a factual review with the M&O contractor, NE-ID, and the IRT on April 28, 2004, the M&O contractor stated that lighting will be increased for better visibility throughout the enclosure and six high-powered Halogen lamps will be installed on both the excavator and Telehandler for increased visibility at the dig face. The IRT supports the planned lighting changes for the retrieval enclosure and the dig face.***

Recommendation

The IRT recommends that in addition to the portable lighting currently planned and the front lighting on the excavator boom, overhead or tracked lighting be installed throughout the retrieval enclosure. This would enhance the visibility in the dig face area for increased visibility for the AK expert to make waste form decisions, and increase visibility for the Telehandler operator to place/retrieve the NTW into/from the staging area.

5.1.4 Training

Limited personnel training information was provided by the M&O contractor. Trained and qualified personnel are one of the keys to a successful campaign. The training should simulate as closely as possible the conditions the workers will encounter during excavation/packaging activities. Training should be performed on the actual procedures that will be used in the retrieval/ packaging activities. This is the opportunity to make corrections in the procedures before work activities begin. It is possible that some of the GEM project personnel will work the DPS for this project. Those personnel will have gained valuable experience working in a glovebox environment.

Recommendation

The IRT recommends a mockup facility in an uncontaminated area to simulate working conditions as much as possible during training. Training should be done to the actual procedures that will be used for the retrieval, segregation, drum packaging, drum assay, and temporary storage activities. The IRT recommends the use of a mockup to increase operator efficiency and identify problems with operational procedures before retrieval activities begin. The IRT also recommends a certification program for the AK experts similar to the certification for the real time radiographers on the 3100 m^3 Program.

5.1.5 Gamma Detection

According to the information provided to the IRT, there are no gamma detection devices in the retrieval enclosure that can be used to alert operations personnel that high gamma sources have been uncovered in the dig face or have been placed on a targeted waste tray for transfer into the DPS. There are sources in the pit that could trigger unsafe conditions primarily for the personnel working on the DPS. A high radiation source on a waste tray transferred into the DPS could cause a delay in drum loading. A gamma detection device was considered earlier in the project design. No information has been provided on why the device was later dropped from the design.

An email from the M&O contractor in response to IRT questions stated, “Each operator, in the retrieval enclosure, will be required by the RWP to wear two types of Electronic Dosimetry (ED). The RCIMS one will have two radiation alarms, one for dose and one for dose rate. The other electronic dosimetry will be telemetry out to the RCT work station where the exposure fields will be monitored by the RCTs. The employees in the clean air lock will only wear the RCMIS ED.”[36]

Recommendation

Based on the possible gamma exposures at one meter discussed in SAR-215, for a “typical americium drum,” detailed calculations are recommended for the Final SAR (FSAR). (Refer to section 5.3.4 of this report for gamma exposure calculation recommendations.) It is assumed an engineering design file (EDF) is being prepared on the gamma exposure calculations for the FSAR and will be included in the safety documentation. Depending on the results of these calculations, inexpensive gamma detection devices (such as DC operated ion chambers) on the excavator boom and the front of the Telehandler may be wise to alert operators of high gamma fields. As discussed in section 5.3.4, DPS personnel then could erect temporary shielding before the tray arrives.

5.2 Packaging

During discussions with M&O contractor personnel and a review of the GEM project procedure for waste handling and packaging,[32] the IRT found very little similarity between those activities on the GEM project and those proposed for the ARP. The only similarities are the use of a liner in the targeted waste transfer cart that becomes the waste bag that is loaded into a 55-gallon drum and the standard bag-in/bag-out methods as discussed in section 5.2.2 below.

5.2.1 Tray Loading

Depending on how full the targeted waste transfer tray is, there is a potential problem in closing the bag and lowering it into the drum. A full tray has a greater volume (11 cu.ft) than the 55 gallon drum (7.4 cu.ft.). Some volume capacity should also be allowed for the tray liner (bag). During the GEM project a line was marked on the excavator bucket to guide the operator to avoid overfilling the tray liner. The ARP is a much larger project with less visibility for the excavator operator. The IRT is concerned with the possibility of overfilling the tray liner, as a drum load would be approximately half of the planned ½ cubic yard bucket. For more information on bucket sizes refer to Section 6.1.13 of Industry Practices. Detailed information has not been provided on the tray liner as changes to the liner design and evaluations are still in progress.

There is a possibility that a tray of waste in a packaging station will be determined to be NTW. If that does happen, the current plan (as of 4/15/2004) is to gather the bag straps together and secure them in the packaging station. The Telehandler will remove the tray and transport it back to the excavation area where the excavator will return the bag to the pit using the bucket or other tools as necessary.

There is also a possibility that WIPP-prohibited items could be placed on a tray and enter a packaging station. Those items will have to be removed from the tray and set aside somewhere in the glovebox. It is assumed that after loading the targeted waste liner in the drum the prohibited items will be placed back on the tray and returned to the retrieval enclosure for final disposition.

Recommendation

Refer to Section 6.1.13 of Industry Practices for tray loading recommendations.

5.2.2 Drum Loading

Discussions with M&O project personnel and a review of GEM project procedures[33-35] indicate that the planned DPS drum-in/drum change-out operations, bag-in/bag-out methods and glove change-out operations are fairly standard. The use of zip ties to secure the twisted bag before wrapping duct tape around the twist, appears to be effective and will hold the twist securely in place. The IRT is aware that the DPS is considerably different than the drum packaging enclosure used for the GEM project, but the techniques are similar. The M&O contractor is still in the process of solving issues with the handling of the tray liner/bag as a result of difficulties encountered during the GEM project.

After the targeted waste liner/bag is loaded into a drum and the drum liner is sealed and cut, the drum lid and locking ring are placed on the drum before moving the drum to the loaded drum staging area. The M&O contractor plans to move the loaded drums to the staging area using a small fork lift. These fork lifts have been in use for many years and are designed for these applications. The fork lift should present no problems to the operation. The IRT does have a concern on how remote handled (RH) drums will be handled. An M&O contractor email responding to a question on how the RH drums will be handled, stated that “radiological surveys at the packaging stations will limit the level of radiation allowed in the area and an external shielding fixture will be placed around the loaded drum.”[37] It is the IRT contention that placing shielding around the RH drum after it is loaded is too late. The packaging station worker has been handling the material in a glovebox, possibly receiving unnecessary extremity and whole body exposure. DPS personnel gamma exposure rates and the possible use of shielding are discussed further in Sections 5.3.3, paragraph 3, and the recommendations under section 5.3.4.

In addition, the BCP states ". . . waste stream confirmation will occur at the time of packaging based upon a visual inspection of the waste. Hazardous waste codes will be determined for the as disposed waste forms based on acceptable knowledge."[5] In order to perform this determination and assign correct hazard codes, the IRT assumes that DPS personnel are trained as AK experts.

Finally, the DPS has been divided into two sections of three gloveboxes each. A section can be isolated if a glovebox(es) become contaminated. Individual gloveboxes will be shutdown for glove change outs, decontamination, and other maintenance items. Without detailed information, the IRT assumed routine maintenance, decontamination, and repair times have been factored into the planned production rates.

Recommendation

The IRT evaluated the drum loading activities based on discussions with M&O project personnel. The IRT has no specific recommendations for routine drum loading activities. See Section 5.3.4, paragraphs 2 and 3, for RH drum handling recommendations.

5.2.3 Drum Assay

Drums will be assayed for criticality safety using the existing Drum Assay System (DAS) manufactured by Eberline. Personnel successfully used the planned assay system on the GEM Project. Loaded targeted waste drums waiting assay for criticality safety will be staged at the front of Airlock 2 and transferred to the DAS when scheduled. The IRT concurs with the use of the existing DAS for criticality safety assay activities.

5.2.4 Drum Storage

Drums assayed for criticality safety will be stored in the CERCLA Temporary Storage Enclosure. Pallets and stacking spacers will be used to stack the waste-containing drums on the floor of the Storage Enclosure. The IRT had some initial concerns regarding the stacking of drums on the floor of the enclosure, which was originally planned to be gravel. However, at a review briefing on April 12, 2004, as well as in the April 5, 2004 weekly report, the M&O contractor stated that the temporary storage enclosure will now have a concrete floor. It is assumed CERCLA drum storage requirements have been incorporated into the planned temporary drum storage or have been waived. Requirement discussions with the Regulators appear to still be in progress.

According to the General Process Flow diagram, if a drum fails the criticality assay it will be placed in Special Case Storage. A Special Case Storage area is not identified nor are there details for eventual treatment of the drum or drums or returning them to the pit.

5.3 Health and Safety

The IRT has considered health and safety aspects of the ARP as part of the technical approach. ARP will minimize use of automation and rely primarily on human operations, which have a corresponding influence on worker health and safety. For the sake of efficiency, worker training and conformance to procedures also are emphasized over built-in safety features. As stated in SAR-215, "When the analysis identifies the need for Technical Safety Requirement (TSR)-level controls to protect the facility worker, institutional safety programs and administrative controls (ACs) are chosen over safety-significant structures, systems, and components (SSCs). This does not imply that a defense-in-depth approach is not required or that engineered SSCs will not be used to protect the worker. Rather, TSR-level controls for facility worker protection will consist of institutional safety programs and ACs. SSCs will be relied upon to provide defense-in-depth protection, but will not necessarily be designated safety significant. This approach results in greater, albeit acceptable, risk to the worker."[4]

Along with examining the underlying ARP strategy in this context, the IRT investigated several specific topics:

- Identification of COCs at Area 1 of Pit 4 and selection of targeted buried wastes for extraction.
- Consistency of ARP documents with major health and safety implications, including the draft EE/CA,[2] the Health and Safety Plan,[3] the Preliminary SAR,[4] the Ancillary Basis for Risk Analysis,[38] and key supporting EDFs-3543, 4428, 4434, 4478, and 4491).[39-43]
- Consequences of potential accidents to ARP personnel, co-located workers, and the off-site public.
- Proposed ARP TSRs and SSCs.

5.3.1 Contaminants of Concern and Targeted Wastes

The Draft EE/CA[2] identifies 16 human health COCs at the SDA, along with three plutonium isotopes as special-case COCs. Specific radionuclide COCs identified are Am-241, C-14, I-129, Nb-94, Np-237, Sr-90, Tc-99, U-233, U-234, U-235, U-236, U-238, Pu-238, Pu-239, and Pu-240. Volatile organic compounds (VOCs) specified as COCs are carbon tetrachloride, methylene chloride, tetrachloroethylene, and nitrates. These COCs were recommended in the Ancillary Basis for Risk Analysis[38] based on estimates of carcinogenic risks and hazard indices to hypothetical current and future occupational and residential receptors. This list of COCs was logically and defensibly shortened in the draft EE/CA for Area 1 in Pit 4 by examining shipment records for RFP wastes, plus other buried waste streams, and estimating inventories (as summarized in EDF-4478).[42] The resulting COC "short list" consists of uranium and plutonium isotopes, Am-241, Np-237, and the VOCs.

Besides providing a basis for targeting certain types of buried waste for extraction, the "short list" also can be used to provide approximate source terms for ARP workers. Thus, the IRT focused its attention on these COCs.

As stated in the draft EE/CA, "The general objective of the proposed NTCRA is to reduce the threat to human health and the environment posed by the RFP waste streams in the designated retrieval area…In order to achieve the targeted retrieval objective listed above, the NTCRA would primarily focus on removal of…Series 741 and 743 sludge, graphite, filters, and roaster oxide waste." The IRT examined this choice by reviewing EDF-4478[42] for waste volumes in the designated retrieval area, EDF-3543[39] for average COC inventories per drum in the SDA, EDF-4491[43] for conversion of Area 1 waste volumes into estimated radionuclide inventories, and the Health and Safety Plan[3] for conversion of waste volumes into estimated VOC inventories. The IRT found the choice of targeted waste streams to be both logical and technically defensible and, thus, validated this aspect of ARP with respect to satisfying the stated primary objective.

5.3.2 Consistency of ARP Health and Safety Documents

The ARP is in an active state of development, with numerous details under internal consideration at the M&O contractor and subject to revision. Accordingly, the IRT had a concern that different assumptions might have been used in preparing ARP documents with health and safety implications. However, after reviewing the documents listed in the Introduction to this section, the IRT found a remarkably high degree of internal consistency. The flow of calculations is straightforward, supporting documents are clearly identified, and assumptions are clearly stated. Accordingly, key assumptions and methodologies were relatively easy to validate for consistency.

Part of the high consistency is attributed to the fact that all of the documents reviewed presumed that targeted wastes would be loaded into standard waste boxes after extraction, so none of the reviewed versions of these documents address the DPS or Telehandler operations inside the Retrieval Enclosure. Many of the documents are being revised to adjust to this major change in the process flow. But, because updated documents are not yet available for external review, the IRT can draw no conclusions as to the consistency of the forthcoming versions.

One inconsistency was observed regarding potential gamma exposure to ARP workers. Page 3-32 of SAR-215 states, “Additionally, some TRU waste disposed in the pits contains high Am-241 intrinsic to certain waste streams. The typical americium drum is estimated to contain an average of 0.74 Ci of Am-241…The estimated exposure rates, at one meter, affiliated with an average americium drum would yield exposure rates ranging from 0.07 to 0.22 R/hr…The ranges of the estimated exposure rates are related to the condition of the drum and/or its contents (i.e., source, geometry). Exposure to a high radiation source is considered anticipated to conservatively account for uncertainties in the materials buried in the SDA. Considering reasonable exposure times, radioactive decay, and a reduction in the exposure rate as the distance from the source increases (i.e., inverse square law), the consequence to the facility worker from this event would be low…”[4] Uncharacteristically, the quoted material is unsupported by an EDF, thus the IRT was unable to validate the conclusion. In contrast, analyses of other hazards are thoroughly supported down to the level of safety code input values.

5.3.3 Safety of ARP Personnel, Co-located Workers, and the Off-Site Public

SAR-215[4] addresses hazards to ARP personnel, other nearby workers at the RWMC, and the off-site public at the closest receptor location. The IRT confirmed that the methodology followed in this document conforms to DOE orders and standards. Hazards associated with excavation, loading of standard waste boxes (SWBs), and subsequent handling of SWBs are comprehensively evaluated. Design basis accidents are chosen defensibly, consequences are calculated appropriately, and consequences are found to be well within DOE thresholds of concern. Analyses of design basis accidents are thoroughly supported by EDFs.

SAR-215 predates the process change from loading SWBs to loading drums. Accordingly, hazards are not addressed in the reviewed version of SAR-215 for

Telehandler operations in the Retrieval Enclosure or for personnel working in the DPS, so the IRT could not formally consider those issues. Nevertheless, because the material at risk for SWB accidents would be at least as large as for comparable drum accidents, SAR-215 consequence conclusions for SWB accidents appear to bound those for similar drum accident scenarios. Thus, consequences to co-located workers and the off-site public are not expected to change in later SAR versions.

Hazard significance to ARP workers may change once Telehandler and DPS operations are considered. In particular, the closer proximity of DPS personnel and the Telehandler operator to gamma sources (relative to the excavator operator) may change the consequence category for the ionizing radiation hazard from "low" to "medium." Relative to the gamma exposure rates of 0.07 to 0.22 R/hr at 1 meter quoted above from a typical americium drum with 0.74 Ci of Am-241, the IRT noted that (per EDF-4491[43]) an average drum of Series 741 sludge will contain 5.61 Ci of Am-241. Gamma exposure rates would then approach those anticipated from remote-handled material. If so, appropriate measures such as gamma shielding might be dictated to mitigate worker risk from this source term.

5.3.4 Proposed ARP TSRs and SSCs

As mentioned previously, the ARP approach relies heavily on ACs, such as the Radiation Safety Program and Industrial Hygiene Program, to prevent excessive risk to ARP workers. That is, the proposed TSR-level controls emphasize ACs over safety-significant SSCs. In particular, the use of PPE is the primary defense against inhalation or ingestion of airborne COCs, with additional mitigation from dust suppression, Retrieval Enclosure ventilation, and filtered ventilation on the excavator cab. (Apparently the Telehandler cab also will be ventilated.) This basic approach is documented adequately in SAR-215,[4] with extensive support in EDF-4428[40] and EDF-4434.[41] The IRT found this treatment of airborne hazards to be conservative, and therefore technically sound and defensible. Although the amount of conservatism is difficult to determine within assumption uncertainties, minimum PPE protection factors of 10,000 are clearly warranted for Derived Air Concentration values up to 6,600.

The IRT noted that, although no credit was taken for features such as dust suppression in analyzing design basis accidents, associated ACs are still required to mitigate worker hazards. The ARP position that associated equipment does not constitute safety-significant SSCs can be viewed as somewhat controversial. Relying on institutional and procedural controls is a valid point of view, but attention should not be diverted from specific means to achieve compliance with these controls. Aspects such as performance of associated equipment (required for safety-significant SSCs) are difficult to separate from properly maintaining an institutional program. The IRT believes this subtlety will receive more attention as ARP evolves and related nuances will be resolved on a case-by-case basis without compromising worker safety.

Similarly, the Radiation Protection Program is evoked frequently to mitigate worker risks from radioactive material. Whether an AC is fully sufficient in this regard without support from safety-significant SSCs likely will receive detailed scrutiny in connection with Telehandler and DPS operations.

The proposed TSRs include no limiting conditions for operation (LCOs). However, during the IRT briefing by the M&O contractor on April 6, 2004, the IRT was informed that high winds might compromise performance of the

Retrieval Enclosure ventilation system to the extent that Retrieval Enclosure activities might need to be suspended. If this IRT impression is accurate, wind velocity or a corresponding aspect of ventilation system performance perhaps should be considered as an LCO.

Recommendation

The IRT recommends that the issue of worker exposure to gamma source terms receive explicit attention in the FSAR, commensurate with the commendable treatment given to airborne alpha-emitters in SAR-215. Besides anticipated accidents from exposing an unusually high gamma source, the hazard to equipment operators inside the Retrieval Enclosure and to DPS personnel from excavating 886 drums of Series 741 sludge appears to be an issue for routine operations. Atypically high gamma sources in other buried waste streams may also pose a significant occasional concern.

Based upon the limited information currently available, the IRT suspects that potentially remote-handled material (>200mR on drum contact) may be excavated with more than an occasional frequency. Depending on results of the gamma exposure calculations recommended above, it may be advisable to install permanent shielding in the DPS gloves, panels, and windows and perhaps also on the cabs for the excavator and Telehandler. The shielding need not be thick, because the overwhelming gamma photon from Am-241 has a relatively small energy (~60 keV).

Temporary shielding is another option for reducing gamma exposure, despite the practical difficulty and labor-intensive nature of its installation. If this approach is ultimately taken, corresponding consideration also should be given to a gross gamma detector at the dig face. This detector would provide an early warning that material with a high gamma source was being loaded into the tray, such that temporary shields could be put up in DPS and perhaps on the Telehandler cab.

5.4 Sampling

Sampling of the retrieval area as part of waste characterization will occur prior to packaging and will be limited to less than 60 samples per half-acre. A Field Sampling Plan is being prepared by the M&O contractor. The sampling program approach is still being negotiated with WIPP and the New Mexico Environmental Department. There is also the possibility that the Idaho Department of Environmental Quality may impose additional requirements for materials to be returned to the pit.

5.5 Transportation

Transportation issues were not considered in this study.

5.6 Summary of Technical Approach Review

Table 6 summarizes the results of the technical approach review.

Table 6. Summary of technical approach review.

Activity/Task	M&O Contractor	Independent IRT	Comments and Recommendations
Waste Retrieval			
Excavation	Initial trench and then stepped progression.	Concurs with excavation method.	M&O contractor has a viable excavation approach and has put considerable thought into the method.
Non target soil sacks (soft sided boxes)	Soft sided boxes with inserts to maintain rigidity.	Questionable durability to withstand handling and stacking.	Need load testing to ensure NWT boxes will not collapse upon stacking in the pit.
Lighting for Retrieval Enclosure	2 Portable lighting stands with 2 1000W lamps each stand (TBD). A design change has been made to include fixed lighting for the background lighting in the Retrieval Enclosure and six high-powered Halogen lights mounted on both the excavator and the Telehandler.	Inadequate to see entire enclosure and the dig face. Could have safety and production implications.	Good lighting is a must to perform excavation in a safe and productive manner for both the excavator operator and the AK expert. Telehandler operator also needs adequate lighting for tray and NTW box transport. Recommend adding overhead lighting or track lighting throughout the retrieval enclosure.
Training	Details were not provided for evaluation.	Well trained and qualified personnel are a key to the successful completion of this activity.	The IRT recommends an ARP mockup in an uncontaminated area to increase operator efficiency and identify problems with operational procedures before retrieval activities begin. The IRT also recommends a certification program for the AK experts that is similar to that used for the real time radiographers on the 3100 m^3 project.
Gamma Detection	No gamma field detectors in Retrieval Enclosure. Relying on personal dosimeters. Gamma detection had been considered earlier in the project design.	An advanced warning of high gamma fields would minimize the potential of loading material on a transfer tray that could not be accepted in the DPS.	The IRT recommends placing gamma detectors on both the excavator boom and the front of the Telehandler. High radiation fields in the DPS could stop production.
Tray Loading	GEM Operator experience. Marking excavator bucket.	Not the same working conditions as GEM.	GEM was performed on a much smaller scale and with different equipment. Visibility for operators within the retrieval enclosure will be less than those observed on GEM.

Activity/Task	M&O Contractor	Independent IRT	Comments and Recommendations
Waste Packaging			
Drum Loading	Recent change from SWB. Bagout of drummed waste is similar to GEM project.	Discussions with M&O project personnel and review of GEM project procedures.	The planned targeted waste bagout method is fairly standard for removing materials from a contaminated area. The IRT has a concern on how remote-handled (RH) drums will be handled. The M&O contractor suggests using shielding for a loaded drum but that would be of little value to the packaging station worker.
General Health and Safety	Safety documents being updated to include DPS and Telehandler.	Reviewed PSAR, ARP H&S Plan, and supporting documents (all predate DPS and Telehandler.)	Validated selection of COCs and targeted wastes. Safety documents reviewed are internally consistent. Validated safety of co-located RWMC workers, and off-site public. Validated evaluation of hazards, design basis accidents and accident consequences.
Airborne hazards to ARP workers	Reliance on PPE, dust suppression, and ACs.	Concurs with M&O contractor approach.	Validated DAC basis
Gamma exposure hazard to ARP workers	Reliance on Radiation Protection Program (monitoring, dosimetry, training, etc.)	Worker dose rates for normal operations and anticipated accidents were not provided in documents.	The IRT recommends calculating gamma dose rates for personnel in the Retrieval Enclosure and the DPS and documenting in the FSAR. The M&O contractor should also consider permanent shielding on the excavator and Telehandler cabs and in gloves, panels, and windows in the DPS.
Drum Assay			
Drum Assay	Use existing Eberline system. Currently negotiating a new contract with Eberline.	Concurs with the use of this Drum Assay System.	Personnel used this system on the GEM Project.
Temporary Drum Storage			
Drum Storage	Pallets and stacking spacers will be used. The revised Storage Enclosure will have a concrete floor.	CERCLA drum storage criteria.	It is assumed CERCLA drum storage requirements have been incorporated into the planned drum storage or have been waived.
Characterization			
Sampling	Preparing Sampling Plan and Strategies.	Sampling strategy appears to be viable.	The sampling approach is being negotiated with WIPP and the Regulators. Idaho DEQ may place additional requirements on the material that is returned to the pit.

6. INDUSTRY PRACTICES

As discussed in Technical Approach, Section 5.0, the IRT was tasked with reviewing whether the ARP process was efficient, safe, and technically defensible and to evaluate the ARP with regard to industry practices. Historically, private industry was involved in TRU processing, characterization, and shipping; however, private industry does not process or manage TRU waste today. Therefore, this section will focus on comparisons between the mineral industry and TRU ARP at Pit 4, with the caveat being that staffing and costs are quite a bit higher due to the Integrated Safety Management System (ISMS) and the conduct of operations (COO) requirements surrounding TRU materials handling.

During the review and evaluation of the ARP project approach, each major task, was compared to current industry practices regarding the retrieval and segregation of the TRU waste from Pit 4. This comparison was based primarily on the experience gained by team members working in the mineral and environmental industries, both private and government sponsored. Because of the immense variability between the two industries, the following section does not discuss all the tasks and undertakings of each industry.

For the mining and materials industries, production rates and low operating costs are the main factors that contribute to a successful business. For the ARP, these same factors will be focused on, while keeping in mind that the factor of safety controls production and cost to a greater degree on government-sponsored operations than it does in industry. Nevertheless, comparisons between industry and the ARP were performed where possible and the following observations and recommendations are provided.

Information reviewed included weekly reports from the week of January 5, 2004 through the week of April 12, 2004,[30] the Baseline Change Proposal, BCP/FCN No. RWMC-04-021, dated 04/05/2004,[5] A-E Specifications for the Storage Enclosure, SPC-521,[16] A-E Specifications for the Retrieval and Airlock Tents, SPC-518,[14] Construction Specification for the Retrieval Enclosure Installation Package, SPC-540,[20] the Statement of Work for the DPS, SOW-1804,[24] and other resources listed in the References in Section 8.

6.1 Retrieval and Segregation

6.1.1 Excavation Methodology

Waste retrieval for the ARP at Pit 4 appears to be well thought out. The method for extracting waste from Pit 4 is very similar to, and may well be patterned after, strip mining for coal. This is a very efficient method for extracting bedded mineral deposits covered by thin overburden, and seems appropriate for the ARP.

In strip mining, a strip of overburden is first removed, exposing the coal seam, and set aside. Mining commences exposing and excavating the strip of coal. As coal is removed, more overburden is removed ahead of the coal and used to backfill the void left by mining, as depicted in Figure 13. Mining progresses with overburden removal, coal extraction, and emplacement of overburden as backfill until the design extent of operations is reached.

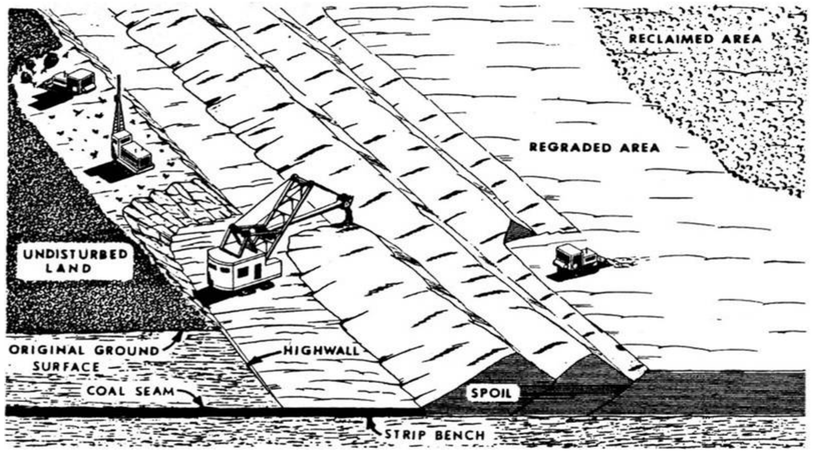

Figure 13. Typical Coal Strip Mining Operation depicting overburden stripping and layback prior to coal extraction.

Other industry methods that could potentially be used to excavate waste from Pit 4 include a more selective method such as pick and shovel, or a more productive method such as track loader and haul truck. Neither of these options would be acceptable in this high radiation, mixed waste environment.

Recommendation

With regard to the excavation method, the ARP proposed method is similar to the standard strip mining methods used in the coal mining industry. This is an industry proven mining method that uses efficient equipment utilization and maximizes productivity.

6.1.2 GRADALL XL5200

To maintain the production schedule and thus the ARP success, the IRT determined that continuous utilization of the single Gradall XL5200 excavator was a critical issue.

Review of the M&O contractor's excavation plan, weekly reports, and the BCP indicated that only one modified Gradall XL5200 excavator was planned and available to excavate waste within the Pit 4 Retrieval Enclosure, although apparently at one time two excavators were recommended.

While it is recognized that the Gradall XL5200 excavator is an appropriate selection for the ARP excavation, (it is used in the construction industry to perform precise grading of fill and for excavating intricate foundations and piping) the Gradall XL5200 is not normally used for mineral excavation, because its small size limits production. The Gradall XL5200 has been fitted with high-pressure hydraulics which deliver higher digging forces and faster cycle times than its predecessor, important considerations for excavating waste in Pit 4. Additionally, the implementation of the superboom yielding a reach of 50 ft, which will be needed in laying back the excavated PCS behind the dig face, was an important modification which will improve the production and capabilities of the excavator. According to the previously cited documents, the Gradall XL5200 excavator will be used to perform the following tasks:

- Excavation of all PCS, non-targeted and targeted wastes, and interstitial soils (30%), see Appendix D.
- Placing of the waste into trays (not to exceed 5 cu.ft.) or into waste boxes, after visual examination.
- Return, as backfill to Pit 4, all PCS, NTW and an assumed 60% of all interstitial soils. SSBs will be placed in bottom of pit, with remaining interstitial soils and NTW placed loosely on the boxes.
- Compaction of RTP material, as necessary.
- Dust suppression.

Calculations derived from information provided in the references cited (see Appendix D) indicate that excavation will need to maintain an overall rate of one scoop every 2.4 minutes to meet project completion on October 31, 2005. Considering all the activities listed above that are required to be performed by the excavator, the production schedule seems quite aggressive, with little, if any, room for error. To maintain the ARP schedule, the average excavation cycle time in good conditions is approximately 15 seconds,[12] for the Pit 4 operations. However, it is conceivable that the average cycle time could extend upwards of two minutes or more, because operators will be guided by outside personnel using the CCTV system, and then required to carefully place excavated waste on liners in waste trays, all the while in full PPE including a full-face supplied-air respirator. Operating under the conditions listed above, the IRT determined that using one excavator could hinder or bottleneck production.

Additionally, the M&O contractor plans to rent an additional Gradall XL5200 excavator for two months for operator training as stated at the independent IRTs “mid-review” Issues meeting on April 12, 2004 and the weekly for March 15, 2004. However, apparently there are no plans to purchase an additional, identical, excavator as backup for the Pit 4 TRU waste retrieval. The IRT considers the excavator a critical item, one that will stop production should a mechanical failure occur.

Recommendations

The IRT recommends that an additional Gradall XL5200 should be purchased and modified for excavation in the Retrieval Enclosure. Reasons to support this recommendation are as follows:

- If there was only one excavator and it was down for mechanical reasons, the estimated operational cost of one down day has been estimated to be approximately $112,000 (Section 3.5). The cost of loss of production for three days could potentially pay for the excavator and the modification to the excavator.
- After the first lateral strip is completed in Pit 4, the excavator could proceed longitudinally. This would allow additional room for a second excavator working laterally so that production could be increased to some degree.
- Either excavator could become the main production unit should one of these units experience mechanical problems.
- A second excavator could be used to train additional personnel prior to using the second unit in the enclosure.

- An additional excavator may eliminate considerations for using a conveyor system to backfill the pit as stated in the weekly for March 29, 2004.
- Both excavators could be used for excavation and retrieval of waste from other pits at a future date.

Industry constantly strives to maximize production and increase efficiency because it decreases the overall cost. The recommendation to acquire an additional Gradall XL5200 excavator is viewed as very important by the IRT for maintaining the waste retrieval schedule and also possibly reducing the overall cost of the project.

Because the Gradall XL5200 excavator is the key piece of equipment in the Pit 4 excavation plan, the IRT also recommends that management give consideration to purchasing new equipment rather than used. New price for the XL5200 is approximately $260,000.[12]

6.1.3 TH103 Telehandler Forklift

The TH103 Telehandler forklift also appears well chosen for moving waste boxes and other chores inside the Retrieval Enclosure. Review of the M&O contractor's excavation plan, weekly reports, and the BCP, indicate that only one modified TH103 Telehandler forklift will be available to transfer and manipulate the waste trays and NWT boxes within the Pit 4 Retrieval Enclosure.

Tasks identified for the TH103 Telehandler forklift inside the Retrieval Enclosure include:

- Transfer empty waste trays to the excavation area for loading of more targeted waste.
- Transfer full waste trays to the processing area for retrieval of some non-targeted and targeted waste.
- Move some of the backfill SSB's containing NTW back to the trench/pit.
- Move the portable light plants as needed.

The IRT considers the time available to complete the foregoing tasks to be sufficient. However, the IRT considers the Telehandler a critical item which will also stop production should a mechanical failure occur.

Information to consider:

The modified Gradall XL5200 and TH103 Telehandler forklift are vital to the continued waste retrieval and segregation schedule for the ARP. From the excavation plan and other detail provided, volumes and cycle times were calculated for the pit 4 excavation (see Appendix D).

Overall, the IRT finds that one Telehandler in the work zone will be able to sufficiently maintain the production schedule, if the forklift does not breakdown. Consequently, a single excavator may be hard pressed to maintain an overall production schedule of one scoop every 2.4 minutes. It is apparent that the M&O contractor also is concerned with this problem and has undertaken model simulations to study it. The IRT is not familiar with this computer modeling software and thus cannot speak to it. However, it was noted in the weekly reports for March 15, 2004, that two identical excavators were considered at one time to ensure no lost time due to equipment malfunctions.

The IRT also noted that used equipment was purchased, and apparently at good value. This practice is also pursued in industry for normal operations, but, it is with the recognition that the history of the equipment may remain unknown and thus the reliability of the equipment will remain at risk. Management may want to revisit the option of using two identical sets of equipment, especially in light that the original equipment is used.

Recommendations

The modified TH103 Telehandler forklift is another critical piece of equipment for the ARP because if it becomes non-operational then the project production would be halted, thus negatively impacting the project. The IRT recommends an additional modified TH103 Telehandler forklift should be purchased so that production can be maintained and to support the additional Gradall XL5200. Reasons to support this recommendation are as follows:

- To support the second excavator used to backfill the pit.
- The second Telehandler could replace the main Telehandler if it had mechanical problems. In the present excavation plan, if the Telehandler forklift is down for one day and the project is halted, the estimated operational cost for one down day is estimated to be approximately $112,000 which would cover the cost of an additional used TH103 Telehandler forklift and some of the modifications.
- The second Telehandler could be used to train personnel.
- If there was only one Telehandler and it was down for mechanical reasons, the cost of each down day will increase the end cost of the project.

The second TH103 Telehandler would need to be modified for utilization in the Retrieval Enclosure. As in industry, to maintain maximum production and increase efficiency, use of a second modified Telehandler forklift would decrease the overall and contingency cost for the ARP. The recommendation to acquire an additional TH103 Telehandler forklift is extremely important in maintaining the waste retrieval schedule and reducing the cost of the project.

6.1.4 Modification of Work Shifts

Reportedly, excavation and packaging of waste from Pit 4 will occur during a single 12-hour shift per day, with the work schedule rotating two crews on a 4-day-on, 4-day-off schedule, for 396 days to project completion. This was confirmed in the literature (draft EE/CA,[2] BCP,[5] etc.), and at the Independent IRT “Mid-Review” Issues meeting with the M&O contractor and the DOE on April 12, 2004. This may be justified if the work site is remote, causing significant travel time to and from the job site, but it also means that 30% of the hours will be overtime hours. Also, four 12-hour shifts back-to-back per week can be quite tiring and productivity might suffer, or the incident/accident rates may increase. Management may want to consider other options.

Recommendation

To maximize production and minimize overtime costs, it is quite common in the mineral industry to operate using two eight-hour production shifts and one four to eight-hour maintenance shift per day. However, shift hours are also dependent on the cost of overtime, worker travel time, safety requirements, and the equipment preventive maintenance schedule. The IRT recommends management examine the industry alternative presented in Appendix D for consideration on how additional shifts of shorter duration impact production and costs.

6.1.5 Staffing

Staffing for the Pit 4 operations is markedly higher than would be encountered in industry (private) operations. This may well be driven by the ISMS and the COO requirements under which this type of remediation needs to be completed on a government site. However, there do appear to be areas where more efficient use of personnel could be realized, and management may want to revisit staffing requirements for the ARP.

Recommendations

The IRT was tasked with reviewing the estimated costs for removing TRU waste from Pit 4. As identified in Section 3.0, the dominant cost is labor (the proposed staffing) for the removal effort. Thus, this discussion will focus on the proposed staffing, and areas where staffing requirements may be made more efficient, from an industry point of view.

First, some brief thoughts on objectives need to be given. The objective of any mineral extraction or any waste remediation project in private industry is to complete the project successfully and efficiently, thus maximizing profit. However, because government operations often operate “in a fish bowl”, meaning they are very transparent to public scrutiny, have a higher level of staffing of public projects may be used to ensure the project is completed on time and to minimize the risk that the project will fail or become a focus of public scrutiny. Another observation is that private industry relies on personal competence and personal responsibility to ensure proper project completion, whereas government operations often rely on rules, regulations, procedures, and multiple layers of management to reach this goal (i.e., ISMS and COO).

The IRT focused on the Accelerated Remediation Concept (AR) Project ROM Estimate – Operations document[44] that was proposed for TRU removal from Pit 4 during a 6-month time period because it appeared to be a good summary document that dealt just with Pit 4 Operations staffing. Job functions identified in this document were re-organized by the team into upper-level, mid-level, professional, shop (the core group) and Hotel (support) groups to better analyze the various job functions and time allocations to the ARP.

There are four main areas where efficiencies of staffing may be modified: decreasing upper-level management load, reducing multiple tiers of management, combining worker responsibilities, and support staffing.

The IRT noticed that a few positions, such as a Nuclear facilities manager, a shift operations manager, and an operations ESH&Q manager were assigned full time; and a Radcon manager and a Hotel Site Area manager were assigned half time (on a six month basis) to the Pit 4 project (see Appendix D, Study for Excavating Pit 4 Waste in Private Industry). In the private side, these positions would be considered upper level, possibly at the Vice President or Manager level. At the upper level, the people often oversee 10 to 20 projects, and their time is pro-rated accordingly.

Regarding multiple tiers of management, in the ROM document it was noticed that the project plans to have a Shift Operations manager, an Operations Director, an Operations foreman, and a shift foreman. In private side operations, the chain of command for these functions might simply pass from the shift foreman to the Project Engineer to the V.P of Operations, with the Project Engineer fulfilling the responsibilities of the Shift Operations Manager, the Operations Director, and the Operations Foreman (see Appendix D).

An example of combining responsibilities is seen in the areas of health, safety, and radiation control. In industry, the Safety Engineer may well be assigned all of the listed responsibilities, whereas in the ROM they are separate functions, each requiring separate staffing. In industry, reporting to the Safety Engineer would be the Safety technicians, one for each shift, whose responsibility would be to monitor and report on health, safety, and radiation concerns during the shift. The safety techs would also have the authority for stopping work if they felt conditions warranted.

Staffing loads in general. As mentioned previously, one goal in the private side is to make project staffing as efficient as possible (and as represented in Appendix D, Study for Excavating Pit 4 Waste in Private Industry). However, this does not necessarily imply supporting only minimal staffing, but one that can be shown warranted, considering both the goals of the project and the risks inherent in that project. Support staff (those not listed as core personnel in Appendix D) would be kept to a minimum as they add no value to the project other than administrative and janitorial needs. Additionally, in industry, if a project is scheduled to be shut down for more than a few days, the whole team may be reallocated to other projects until work on this project can continue. Temporary layoffs may be necessary. Finally, workers missing a shift because of illness or vacation would either be replaced by another worker from another project or the project would proceed at reduced staff (five workers packaging the waste in the glove boxes versus six workers for example).

By staffing a project with these concepts in mind, those funding a project in industry or in the government sector can feel more comfortable that they are "getting the most bang for their buck".

The IRT recommends that the M&O contractor review and re-evaluate staffing loads for the ARP, with due consideration given to the staffing requirements mandated by DOE directives or other regulations the M&O contractor must operate under. The intent of this review would be to delineate areas where staffing loads may be reduced without degrading the overall successful completion of the ARP project and reduce the budget while remaining on schedule. This may well require that DOE issue waivers in order to effect some of the staffing reductions recommended by the M&O contractor.

6.1.6 Excavation Cost Comparison

Per the ARP draft EE/CA^2 Life Cycle Cost RWMC Estimate Number 5984-G, operational costs, and thus excavation, costs will be approximately $60,000,000. These costs are quite a bit higher than would be encountered in industry (private side) operations. For the 396-day excavation period, this equates to $4,000 per cubic yard of pit material excavated (not including excavation of the overburden).

In industry, excavation costs vary from $1 to $8 per yard ($5 per ton) for small open pit mining operations and may reach $150 per yard ($100 per ton), for small underground operations.[45] Cameco Corp., a Canadian uranium producer extracting uranium ore from underground operations of such high grade that shielding is required on equipment, probably has a underground mining cost of no more than $750 per cu yard ($500 per ton.[46]

In RS Means documentation,[47] the estimates in the cost assemblies for excavator cut and fill operations for performing work in safety Level A was estimated to be $222 per hour for excavation only. Safety Level A is the highest level of protection, where labor productivity varies from 10% – 40% and equipment productivity may average 50%. This equates to approximately $50 per yard, using an extracting rate of 4.6 cubic yards per hour.

Thus, from an industry standpoint, excavation costs for Pit 4 are quite high. Furthermore, labor is the dominant cost item in the operational costs, this renders further impetus for management to re-evaluate staffing loads for the ARP at Pit 4.

Recommendation

The IRT considers that significant cost savings will be recognized if the M&O contractor re-evaluates staffing for the ARP and reductions are imposed, as discussed above.

6.1.7 Theoretical Performance and Cost Industry Evaluation

The IRT decided it might be a worthwhile exercise to do a brief "paper" study on how TRU removal from Pit 4 might be undertaken in private industry. However, it is with the recognition that, to the best of the team's knowledge, there has never been a TRU remediation project completed in private industry.

The details of this study are in Appendix D. The excavation volumes and processes are identical to that planned for Pit 4. However, the industry work schedule has been altered to two eight-hour shifts with an eight hour maintenance shift per 24 hour day, five days per week, with standard holidays taken. Also, in the industry section, staffing has been significantly reduced, with many of the functions considered in the Accelerated Remediation Concept (AR) Project ROM Estimate – Operations document[44] combined under one person or eliminated altogether to reduce personnel redundancy, and multiple layers of management. Additionally, in the industry section of Appendix D, two excavators are used in the enclosure, reducing the average cycle time from 2.4 minutes to 2.0 minutes (at 80% productivity).

As can be seen from the study detailed in Appendix D, by operating with two eight-hour shifts, operating days are shortened from 396 to 304 days (including 30 contingency days). Staffing unit costs are reduced from $1,000 per cu. yd to $220 per cu. yd, or roughly a 4:1 reduction in unit staffing cost.

Recommendation

The IRT recommends that some of the industry options presented be considered to optimize the project; understanding however, that an intermediate ground must be attained to maintain safety and production when excavating TRU wastes.

6.1.8 GPS/Laser Mine Management System for Waste Retrieval

In the mining industry, an integrated, real-time Mine Management System utilizing GPS and/or laser tracking, data radio-links, and on-board computers with visual CAD design file is being used to increase productivity, efficiency, and equipment performance. Other industries such as manufacturing, construction, and agriculture have similar systems.[48]

The Excavation Plan and Process Narrative for the ARP provided an overview of the retrieval process plan for the project. The overall process for the ARP utilizes a bucket position monitor in concert with visual marks along the perimeter of the excavation site to determine the location of the RCRA samples. The process also utilizes a two-way radio link and a camera for visual examination of the waste. However, information on a plan to integrate the waste identification and the waste retrieval processes to maximize waste production was not found in the material presented to the team for review.

As per the February 9, 2004 weekly report, a need for accurate x, y, and z coordinates of the retrieved waste for WIPP inventory and certification was recognized by the WIPP disposition team and it was proposed that the excavator use a GPS system to provide accurate x, y, z coordinates for the waste. The decision on whether the grid markings painted on the side and end of the retrieval enclosure and the level provide adequate coordinate accuracy apparently has not yet been made. However, the time required for the operator to perform the task to provide the coordinates for the inventory personnel, determine bucket volumes, and visually examine the waste will slow retrieval production rate, will slow operations and use up more of the 2.4 minutes of average scoop time available.

From the Excavation Plan, it is apparent that the operator and the AK personnel will be able to visibly examine and discuss the waste content in each bucket via a two-way radio link. However, it is not apparent whether the waste inventory and the potential contaminate excavated will be continuously communicated to the operator. In the mining industry, a continuous flow of high-level information and data transfer in real-time between the operation and planning is communicated. This is achieved using an integrated mining system that uses GPS, wireless radio link, and visual monitor connecting both the mining engineer and the operator.[48]

For the ARP, each shift operator will be required to relocate the excavator using the painted grid on the retrieval enclosure, which may present a problem depending upon how accurate the relocation needs to be, and the visibility within the retrieval enclosure. However, as discussed in the April 15th presentation to DOE, the required accuracy of RCRA samples and excavator relocation has yet to be determined. Considering the cost of a GPS system when compared to staffing costs, management may want to re-consider this option.

Recommendation

The IRT recommends management reconsider the use of an integrated GPS/data management system for use during Pit 4 excavation.

The present standard of practice in the mineral industry is the incorporation of an integrated, real-time Mine Management System utilizing GPS, data radio-links, and on-board computers with a visual CAD design file.[49]

This type of system can provide increased production and efficiency by linking operations and design data together. The system allows for the wireless transmission of excavation plans to an on-board computer, visually displays operator bucket location to all, identifies waste type, allows easy relocation, provides x, y, and z coordinates for waste inventory, and improves safety by warning of upcoming hazards.[50] These systems allow the engineers and the operators to operate and communicate in real-time.

For the ARP, use of an integrated, real-time Management System utilizing GPS, data radio-links, and on-board computer with a visual CAD design file would allow:

- The excavator to use a GPS system to provide accurate x, y, and z coordinates for the waste as proposed by the disposition team that evaluated WIPP certification. A laser tracking system using a permanent base station could also be used instead of a GPS system.
- New operators upon shift change to re-position the bucket over the same location.
- A wireless radio network for required personnel (operator, AK expert, design engineer, waste handlers)
- The operator to have an onboard real-time display of position, heading and inclination of the bucket with the ability to track the waste using the visual 3D waste profile.[51]
- The AK expert, design engineer, and operator to have a waste tracking and volume calculation/control which allows the waste and waste locations to be tracked and displayed.
- For the information and the information monitored to be interfaced with others at different locations (Idaho Falls, etc).

The costs for the systems vary depending on the precision of the system required (i.e. accurate vertically within 1 inch or 1 foot), the number of stations and receivers used, and the type of software required. Some systems utilize an drafting (AUTOCad) system while others utilize powerful mine business/operational software systems. Cost estimates for a dual excavator system with the GPS, radio links, integrated on-board machines, support, and software ranges at $150K to $300K.[49] This is a very conservative estimate and depends on the software and hardware needs for the ARP project. For example, if a system acquired that uses the AUTOCad software and the M&O contractor uses the same system then that will lower the cost of the system. If this option is considered, several costs and systems can be evaluated in further detail.

6.1.9 ARP Mockup (Cold Pit) Testing and Training

An ARP mockup test was considered by the M&O contractor for worker training purposes; however, the scope for the ARP Mockup was removed, as per Feb. 23, 2004 weekly. The reason is unknown. Performing a pre-test or mockup test to train workers to work in high-risk environments is a requirement from the industry and the worker, Safety Standards (U.S. Department of Labor, Mine Safety and Health Administration [MSHA] & Occupational Safety and Heath Act [OSHA]) point of view. The mockup testing allows workers to practice operating and using the equipment at a simulated waste excavation prior to entering the retrieval enclosure.

An ARP mockup test may help increase productivity by testing excavation, waste transfer, and packaging procedures and identifying problems with the retrieval methods prior to entering high-risk areas. It also allows the equipment operators to gain familiarity with the equipment without the encumbrance of PPE and full face respirators. During the testing, safety procedures and waste segregation tasks can be observed, assessed, and refined to allow the ARP to be completed successfully. The excavator can be evaluated for bucket load capacities with the boom extended, maneuverability, and production rate. This is another issue management may need to revisit.

Recommendation

With new equipment and processes, industry usually provides a training period for operators and others involved in excavation activities. Often this is simple on the job training (OJT) with experienced operators or waste handlers, but OJT may well not be feasible in the retrieval enclosure or in the equipment cabs at Pit 4, which would be considered a high-risk area.

After review of the tasks that will need to be performed by the heavy equipment operators, AK experts, waste segregation and packaging personnel, the IRT believes it would be beneficial to set up an ARP mockup testing area for training and retrieval procedure testing. During the Mockup, the retrieval procedures can be reviewed and modified and personnel assigned to the Pit 4 TRU remediation can be trained in a low-risk environment. Management should give this option more consideration.

6.1.10 Backup Generator

The option of having a generator available as a back-up power source when the electrical service at the RWMC facility is not functioning was reviewed for safety purposes and concluded by the M&O contractor to be unnecessary, as per briefing for IRT, April 6th, 2004. Although not critical to operations, power outages will cause lost production and thus, in view of the minimal cost involved, management may want to reconsider this option, which will help ensure production will remain on schedule.

Recommendation

The IRT recommends that a back-up diesel-powered generator of sufficient size to operate the lighting, HVAC, and other systems necessary for continued operations in the retrieval enclosure be obtained for this project. It appears that saving just one day of down time due to electrical failure will pay for the entire cost of having the generator during the project period.

6.1.11 Video Camera

For the ARP, video cameras will be used extensively for the visual examination of the waste being excavated from the pit. The April 12th, 2004 weekly report states that lighting will consist of east-west indirect lighting and spot specific lighting mounted on a motorized monorail. The IRT supports this additional lighting consideration, because adequate lighting is a prerequisite for good video images.

According to the April 6th, 2004 briefing, a video camera will be mounted near the end of the excavator boom for close-up video of the waste being excavated. This location presents a problem because the boom will also be used for dust suppression via spraying and misting. Management might want to consider other video camera locations that will not degrade the image quality because of dust suppression activities.

Recommendation

The IRT is concerned about mounting the video camera on the excavator boom because the camera in this location may become inoperable due to spraying and other dust suppression activities. The April 12th, 2004 weekly report mentions that some lighting may be placed on a moveable monorail system. The IRT recommends that consideration be given to mounting the dig face video camera on this or a similar monorail, and that the camera have zoom capability for close up examination of the dig face. Lighting could either operate in tandem with the camera or independently.

6.1.12 Limiting Operator Production Capability

(Excavator Certification – Requirements Unknown)

Another key issue for maintaining production pertains to equipment operator safety and comfort. The HE operators for the ARP project are required to be in PPE and self-contained breathing apparatus (SCBA) respirator protection for the full duration of the shift when working in the retrieval enclosure. In industry, modifications to the equipment are sometimes made so that operators only need minimal PPE and respiratory protection. For example, when working in high radiation environments, Cameco weld-seals seams, shields equipment cabs, and has increased the cleaning frequency to reduce operator exposure. Management may want to consider these and other engineering control options which would maintain production levels by having the heavy equipment operating inside the retrieval enclosure certified for use with supplied air.

Recommendation

The IRT considers it a preferable option to have the heavy equipment working inside the Retrieval Enclosure certified for use with supplied air, if this appears feasible in this mixed waste environment. The purpose of the recommendation is to alleviate operators from wearing full-face masks, which should increase productivity by making a better working environment. Possibly low air pressure can be supplied to the cab interior via either high pressure air cylinders attached to the equipment or an airline reel system attached to the ceiling frame system of the enclosure.

6.1.13 Bucket Size and Tray Loading

As discussed in Section 5.2.1, the limiting factor on filling the trays is not exceeding the 5 cu.ft.maximum per drum. According to material reviewed by the team, the nominal bucket size for excavating Pit 4 will be ½ cubic yard. Simple calculations show that the half yard bucket will only be approximately 1/3 full per scoop, which may be hard for the operator to visually confirm. Also, preventing spillage around the tray during tray loading may be harder to achieve using a larger bucket. Additionally, material remaining in an overfilled bucket will have to be returned to pit, resulting in increased excavation times.

The April 12th, 2004 weekly report states that a 15-inch bucket is now being considered for the ARP excavation. As will be discussed in the Recommendations section, special consideration should be given to the merits of using a smaller bucket for excavating Pit 4 waste.

Recommendation

A smaller excavator bucket, ¼ yard or equivalent is being considered for waste extraction in Pit 4. The IRT recommends management support this option. The IRT also recommends that 1 inch or similar sections of angle iron be welded to the insides of the bucket to delineate the 5.0 cu.ft. level for the operator.

6.1.14 Additional Airlock for Excavator Effector Change-out

The IRT had concerns regarding the original excavation plan which used airlock #1 for both personnel change out and equipment maintenance, including Effector change-out. However, at the April 12th meeting with the M&O contractor, it was explained that Airlock #1 will now be divided into three bays, one for the excavator, one for the Telehandler, and one for personnel change out, with the effectors being placed in containers to reduce worker exposure to contamination.

Recommendation

The M&O contractor is presently planning to divide Airlock #1 into three bays, one each for the excavator and the Telehandler and the third for personnel change out. The IRT recommends that management keep the option open for having another airlock attached to the Retrieval Enclosure. This would be a contingency option should either of the airlocks become unusable over time because of increasing contamination levels.

6.1.15 Waste Delineation

Prior to commencing any mining or remediation operation, drill sampling is conducted to provide sufficient detail to delineate and define the extent of mineralization/contamination so that volumes can be estimated and excavation plans can be formulated. Drill hole grid spacing is dependent upon the variability of the ore/contamination. Uniformly deposited coal may only require drilling on ½ mile centers whereas a highly variable gold deposit may require drill sampling on 50 foot centers or less.

Pit 4 excavation and waste removal will be based on historical shipment data and reported disposal locations of waste material placed in the pit. Some localized testing via emplacement of probes has been completed in a small portion of the pit but not in a grid-like manner over the entire pit. There apparently is sufficient historical data of waste disposed of in Pit 4 to anticipate where contaminated waste material will be encountered. It is not apparent from the provided information; however, that drill sampling for this waste must have been deemed unnecessary.

A reasonable concern is that drill sampling of the pit may induce additional pathways for contamination to spread. Also, conducting sampling operations of mixed wastes imposes a whole new set of contamination and waste generation issues. Thus, it may have been decided that burdening the project with the costs necessary to deal with these issues in order to delineate the nature and extent of waste discharge and contamination in Pit 4 was not justified in light of the historical shipping data available.

However, one problem encountered by the IRT was verifying depths to the different units in the pit such as overburden, PCS waste, and underburden in Pit 4. This lack of accurate depth data directly impacts volumes of each unit, thus anticipated production and scheduling. In future remedial operations, management might want to re-consider the use of drill sampling to assist in volume estimates.

Recommendation

Drill Sampling. One problem encountered in reviewing data is determining actual depths to the different units such as overburden, PCS, and underburden. This lack of accurate depth data directly impacts volumes of each unit; thus directly impacting the anticipated production and scheduling. Assuming all units are relatively flat lying, simple probing using, for example, a Geoprobe™, could have been done on a 40 foot or 50 foot grid to better delineate the extent of these units. Probably no more than 40 drill holes or less might have been sufficient. One manner of proceeding with is a drill program is using a methodology such as "SmartSampling" devised at Sandia National Labs, which matches the variability of the parameter sought with the degree of precision necessary to yield the appropriate sample spacing.

6.2 Packaging

The DPS and other issues surrounding packaging were evaluated by the IRT and discussions are presented in Section 5.0. However, from an industry perspective, if the DPS does not function as designed it can cause production delays and impact costs due to downtime just as well as the failure of the single excavator planned for the ARP. Consideration should be taken to simulate the ARP excavation and packaging activities during a Mockup testing to determine how effectively the DPS and all system operate before working with the targeted waste.

6.3 Characterization

Characterization issues were not evaluated or considered in this independent review.

6.4 Transportation

Transportation issues were not evaluated or considered in this independent review.

6.5 General Recommendation

The only similar high-radiation environment of a private side (industrial) nature identified by the IRT is located at the McArthur River Operation, owned by Cameco, a Canadian company that is one of the largest uranium producers in the world. Average ore grade at McArthur River is 23% naturally occurring uranium. This ore grade is so high that special equipment and safety procedures are required. The IRT recommends management contact Cameco[46] for a tour of their operations, including discussions on their ore handling methods and their safety procedures to better understand how high-radiation working environments are dealt with in industry and in a foreign country. They may not be willing to discuss costs but they certainly should be willing to freely exchange information on the safety and operating methods.

As a result, when considering staff re-evaluation, an intermediate staffing level should be attained between the wide-range of staffing levels presented in Table D4, therefore achieving a reduction in the present ARP staff and project costs while preserving core resources and optimizing ARP production.

To maintain ARP production and schedule, the other listed recommendations should be considered for implementation into the ARP, such as two excavators and Telehandlers, and the addition of a back-up generator, which can be used for future retrieval projects.

6.6 Summary of Industry Practices Review

Table 7 summarizes the results of the industry practices review.

Table 7. Summary of industry practices review.

Activity/Task	M&O Contractor	Independent IRT	Comment and Recommendations
Waste Retrieval			
Gradall XL5200 Excavator	1 modified excavator per the ARP.	Redundancy Needed – 2 excavators per project.	Industry considers excavator downtime as a negative impact for productivity.
TH103 Telehandler/Forklift	1 modified forklift per the ARP.	Redundancy Needed – 2 forklifts per project.	Industry considers forklift downtime as a negative impact for productivity.
Modification of Shift Work Schedule	One 12-hour production shift per day.	As per industry, additional shift(s) would be utilized to maintain the project schedule and replace non-targeted and PCS waste.	Industry typically utilizes multiple shifts to maximize production and maintain efficiency. Industry usually plans for two-production and one-maintenance shift per day.
Staffing Re-evaluation	The contractor provided the estimated staff loading documentation.	Optimize staffing requirements for the ARP to reduce personnel redundancy and multiple management.	Find an intermediate ground between the government contractor and industry when re-evaluating staff loading.
Operational Cost Comparison	Operational and excavation cost estimated to be $57M, equating to $4000/cu yd excavated.	Industry operational and excavation costs range between $8 to $750/cu yd.	Re-evaluate staffing loads because labor is a dominate cost item.
For Excavation, use an integrated, real-time Mine Management System utilizing GPS, data radio-links, and on-board computer with visual CAD design file.	The disposition team that evaluated WIPP certification, proposed that the excavator use a GPS system to provide accurate x, y, z coordinates for the waste, as per the Feb. 9, 2004 weekly. Unknown status of the proposal.	Excavator and team use of an integrated, real-time Mine Management System utilizing GPS, data radio-links, and on board computer with visual CAD design file.	This system will provide increased production and efficiency by linking operation, maintenance, and design data together. System allows wireless transmit of excavation plan to on-board computer, visually displays operator bucket location to all, identifies waste type, allows easy relocation, provides x, y, and z coordinates for waste inventory, improves safety (marks hazards). This system allows the engineers and the operator to operate in real-time.
ARP Mockup (Cold Pit) Testing, Training, and System Validation	Option considered, Scope for the Mockup was removed as per Feb. 23, 2004 weekly. Reason unknown.	Increase productivity of operators and identify problems with retrieval operation before initial hot tasks are performed.	An ARP mockup testing will increase productivity by identifying problems with the retrieval method before working in contamination and it allows training on the HE with and without respiratory PPE. Safety factors and waste segregation tasks can be observed, assessed, and refined.
Backup Generator	Option Reviewed for safety purposes and determined to be unnecessary.	Generator option revisited as a consideration for continuous, non-stop productivity.	Industry considers downtime due to power outages as a negative impact for project productivity and efficiency.

Activity/Task	M&O Contractor	Independent IRT	Comment and Recommendations
Video Camera System	Video cameras will be used for the visual examination. Some cameras are from GEM will be used at ARP, from the weeklies.	Redundancy needed, and stationary cameras with telephoto capability. Additional information needed.	Increasing clarity and the number of camera views during waste visual examination will decrease the decision period for the HE operators and AK personnel. Labeling and inventory for WIPP will also be expedited.
Limiting Operator Production Capability Certification of Gradall XL5200 Excavator Certification of the TH103 Telehandler		Modify cab so HE operator only has to wear less respiratory and PPE.	An increase in productivity would be recognized even if the operator were able to work in a half-faced respirator rather than a full SCBA. Excavator certification requirements unknown.
Quarter Cubic Yard Bucket for Excavator	The size of the buckets procured hold approximately a third to a half, cubic yard heaped capacity.	Use a quarter cubic yard bucket heaped capacity for retrieval, allowing each bucket volume to be nearly equivalent to the drum capacity.	Removing excess waste from trays would be counterproductive and cause delay. Maintain the waste handling process using an excavator bucket sized similar in volume to the preferred drum storage volume. The volume of a larger bucket could allow overfilling of the waste trays.
Additional Airlock for Excavator Effector Change-out	As per the meeting with the M&O on 4/13/04, the designed airlock will be divided to accommodate effecter change out and maintenance.	Add an additional airlock for machine maintenance and effector change out.	To maintain production, an additional Airlock area for Excavator Bucket Change-out would allow contaminated attachments to be placed on storage racks outside other higher traffic areas and allow easier change-out.
Waste Delineation	Information unavailable.	Use direct-push drilling program to improve waste characterize in Pit 4.	Drilling to characterize the ore grade is standard procedure in the mining industry. It allows for a more refined estimate of ore grade that can be used for mine planning and design; thus reducing the contingency pertaining to the project or ore extraction design.
Waste handling systemWaste Segregation	The waste handling system is presently under construction.	For more information refer to Section 5.0.	An efficient waste handling system is needed to provide adequate production to achieve the project schedule. If the waste and drum handling system is interrupted then the ARP shuts down. This system should be tested prior to installation in a contaminated zone to allow for system modification before equipment is contaminated.
Handling/removal of Classified Waste from Glove Box	Refer to Section 5.0 for information.	Prior to project startup, make sure there is a plan to handle classified waste or waste that is required to be sent back the retrieval pit.	If the waste is classified or exceeds the exposure limit for humans, a plan to handle this waste remotely needs to be available to allow immediate removal back to the pit or a control area for burial at a later time. An effective removal and handling method needs to be available to allow production continue without interruption.

7. SUMMARY

7.1 Cost

The IRT recommends that the following cost considerations be included in the M&O contractor's approach to the ARP.

1. Contingency/Planning Assumptions – Consistent with DOE/EPA guidance on managing uncertainties, re-examine the project assumptions to determine if they are realistic, identify cost impacts and earmark against contingency to reduce the current 28% level.
2. Earned Value Performance Measurement – Assign an appropriate earned value approach to ensure the project objectives are met.
3. Gradall XL5200 Excavator – Cost of backup excavator (~$260K) is less than 1% of the total project cost, but could cost the project ~$112K per day if inoperable.

7.2 Schedule

The conceptual changes to the ARP coupled with the compression of the review have presented many unique challenges. The IRT has identified multiple concerns; all of which have the potential to impact schedule. The dynamics of the ARP and rapidly changing conditions (i.e. the change from boxes to drums) appear to have caused the M&O contractor to overlook the effect of these dynamics on the ARP as a whole. The potential exists for all concerns identified by the IRT to have a negative impact on schedule and cost and as such, the concerns should be reviewed and addressed accordingly.

The planning and scheduling approach used by the M&O contractor has the appearance of not considering and exacting the intent of the DOE/EPA guidance "*Uncertainty Management: Expediting Cleanup Through Contingency Planning*."[10] Instead, the planning methodology appears to be "business as usual," with no significant reduction in costs/schedule and an over-reliance on optimistic assumptions.

7.3 Technical Approach

The IRT recommends that the following be included in the M&O contractor's technical approach to the ARP.

1. Calculate gamma dose rates for personnel in the retrieval enclosure and DPS and provide in FSAR.

2. Address improved lighting/visibility for retrieval enclosure operators.

3. Include a mockup for training in an uncontaminated testing area.

7.4 Industry Practices

The IRT recommends that the following industry practices be included in the M&O contractor's approach to the ARP.

1. Consider redundancy of equipment (excavator, forklift, etc.)

2. Re-evaluate staffing needs to reduce costs.

3. Consider modifying planned work shifts from one to two production shifts.

4. Consider real-time, Integrated Retrieval Management System utilizing GPS, data radiolinks, and on-board computer CAD design.

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9. APPENDICES

Appendix A: Independent Review Team Biographies

Appendix B: Drum/Box Estimates

Appendix C. M&O Contractor Variance Explanations for GEM and ARP

Appendix D: Study for Excavating Pit 4 Waste in Private Industry

APPENDIX A

Independent Review Team Biographies

The IRT consisted of individuals ranging from cost/schedule and technical experts skilled in the nuclear storage and disposal industry to individuals experienced in industrial practices such as strip mining and disposal. The experience of the IRT members ranged from between 18 to 40 years in their particular areas of expertise. This appendix contains a brief biography for each member of the IRT.

James Cook

Mr. Cook has over 40 years of experience working with various contractors at Hanford, Vallecitos Nuclear Center, and the INEEL. He has served as chemist/supervisor at the Purex Processing Facility, hot cell engineer at Vallecitos for nuclear materials evaluation and medical isotope production, and project engineer for various work for other programs, including the National Spent Nuclear Fuel Program at the INEEL, and other projects dealing within the inspection, storage, and transport of radioactive waste. Most recently, Mr. Cook has worked as a consultant for GTI providing intermittent management assessment support to various GTI customers. He is a certified quality assurance lead auditor for commercial, government, and nuclear industries. His consulting support consists of all phases of the management and readiness assessment for packaging, shipment, and disposal of Spent Nuclear Fuel.

In addition, Mr. Cook has served as work package manager for the CLWR Production of Tritium project. In this position he was responsible for the receipt and storage of the tritium-producing burnable absorber rods.

Education:

BS Chemistry, University of Great Falls, Great Falls, MT in 1962
Advanced education classes from General Electric Company and EG&G, Idaho and Lead Auditor Quality Assurance Training and Certification

Joseph Gordon

Mr. Gordon has over 17 years of experience in the nuclear power field. He currently serves as Chief Production Officer for GTI, providing day-to-day production department guidance and long-term strategic planning. Mr. Gordon is responsible for new product development and production schedules. Trained in the operation and safeguards of nuclear power plants by the United States Naval Nuclear Power Program, he has four years of intensive training in mechanical repairs of nuclear power plant components and is experienced in the proper characterization, handling, packaging and shipping of hazardous and mixed hazardous wastes. He successfully streamlined the process of receipt and disposition of Government Furnished Equipment associated with defueling and inactivation of Naval Nuclear Power Plants. He has a diverse mechanical, production, technical and environmental background.

Most recently, Mr. Gordon has been responsible for the development of the US Army (TACOM) Battery Assembly Test (BAT), which resulted in a five-year contract for delivery of an estimated 8,500 units. He has provided task management (project oversight) for the development of remote-handled Transuranic Waste Disposition Program (RH-TWDP) upper-tier and implementing procedures. Mr. Gordon, specifically developed: the Quality Program Plan (QPP), the program procedure matrix, quality assurance records procedure, document preparation and control procedure, qualification and training procedure, management of deficiencies procedure, and the audits procedure. He ensured strict compliance with the CBFO/WIPP requirements documents as well as to the 3,100 m^3 Project in the areas of document consolidation and procedure review/revision. Mr. Gordon documented, analyzed, and captured the lessons learned from a $240M eight-year project. He has consulted on and developed various high-dollar project budgets and detailed work plans, and assisted in numerous audits and surveillances.

Education:

B.S., Business/Management, University of Phoenix, Phoenix, AZ, 2003

Craig Hewitt

Mr. Hewitt provides direct support to the Department of Energy, Office of River Protection (ORP) out of the GTI Richland, Washington office. His primary responsibility includes representing ORP in the analysis and negotiation of the Hanford Site Services. Mr. Hewitt coordinated and facilitated Site Service Board meetings to resolve site service issues resulting from prime contractor proposals and/or DOE direction. He is responsible for maintaining the Site Service Manual and controlling changes to the manual. Mr. Hewitt participated in the Site finance board meetings and provided financial analysis to support decisions/initiatives made by the board. He participated on Site finance board sub-teams on issues requiring in-depth analysis. He has supported ORP site service self-perform initiatives. Mr. Hewitt performed an analysis to determine which Hanford prime contractor is best suited to perform required site services and identified financial outcome that is in the best interest of the government. Mr. Hewitt has participated in discussions and analysis to determine the best methodology to distribute cost equitably to all Hanford prime contractors. He has provided recommendations to the SSB, SFB and HMBT for each analysis performed; developed and maintained the financial reporting tools to track execution year funding and cost; provided financial projections and analysis for all activities under ORP; and prepared the monthly executive level reports for the Director of Business Administration.

Education:

Columbia Basin College, General Education/Computer Science Degree, 1999
Ft. Knox School of Armor, Ft. Knox, Kentucky; 1977

Mr. Jerald Barbre

Mr. Barbre has over 30 years experience in project management and control in both the private and Federal sectors. His experience is primarily in the area of cost analysis related to operating projects and includes project scheduling as well as budget analysis. Mr. Barbre is currently the Program Analyst for the Department of Energy –Idaho Operations Office where he is responsible for assessing and reporting on cost and performance data for major projects within the Environmental Management Program. Programs for which he is responsible are the RWMC Closure projects, Balance of INEEL Cleanup Projects, Mixed Low Level Waste Projects and the Advanced Mixed Waste Treatment Project contract. He has served as the Financial Advisor to two major Source Evaluation Boards. Mr. Barbre was employed by the Defense Contract Audit Agency (DCAA) where he was Auditor in Charge over major contractors at Vandenburg Air Force Base. In this capacity he actively examined contractor cost and price proposals and developed reports utilized in negotiations of both major and minor government contracts. Auditing experience with DCAA included Operational Audits that focused on efficiency of existing operations. In 1989 Mr. Barbre was employed by Delco Systems Operations of Goleta, California, where he was in charge of development of Indirect Rate Proposals used in pricing all government contracts and was appointed the official company point of contract all interface with the DCAA regarding audit-related matters related to contracts including negotiations. Mr. Barbre currently oversees the financial portions of the Advanced Mixed Waste Treatment Project contract.

Education

B.S. Accounting Information Systems, Idaho State University.
Member of Beta Alpha Psi – National Honors Fraternity of Accountancy.

E. A. (Andy) Johnson

Mr. Johnson has over 20 years in mining working as both mining project engineer and geologist. In remediation activities, Mr. Johnson has over 10 years serving in the fields of onsite and technical cost analysis duties. Other responsibilities have included evaluating cost and cost-effectiveness of environmental remedial technologies, which included the evaluation of markets for recovered resources. He served as Project Engineer for the Berkley Pit water remediation technology demonstration. Other specific assignments that Mr. Johnson has been responsible for include supervising surface and underground drilling programs; ore reserve calculations; haulage road design and construction; emergency escape system design; supervising integrated surface and underground evaluation of uranium mining district; evaluation of uranium potential of the Northwestern United States; and supervision of all exploration activities in Washington, Idaho, Oregon, and Montana for Western Nuclear, Inc. Mr. Johnson serves as a consultant for GTI providing intermittent cost and management assessment support to various GTI customers.

Education:

M.S. Geological Engineering, Montana College of Mineral Science and Technology, Butte, Montana, 1973
B.S. Geological Engineering, Montana College of Mineral Science and Technology, Butte, Montana, 1968

Thomas Lewallen

Mr. Lewallen is currently the Chief Regulatory Compliance Officer for GTI. He has over 35 years experience in the areas of management reviews, surveillances, and audit activities. Recent activities have involved developing and managing QA programs for the DOE National Spent Fuel Program; developing and managing QA programs for the manufacturing of armor for the Army M1A1 Battle Tank; and developing and managing Quality Assurance programs for the chemical processing of Spent Nuclear Fuel. Mr. Lewallen has extensive experience serving such customers as DOE, DOE contractors, Bureau of Engraving and Printing, Commercial Nuclear Utilities, EPA, the Federal Emergency Management Agency (FEMA), and the Department of the Air Force. Mr. Lewallen recently performed an audit of the RWMC TRU Waste Program to determine compliance with the WIPP QA Program and the New Mexico Part B permit QA and technical requirements. He has provided consulting services to Fluor Hanford on Spent Nuclear fuel packaging and intra-site shipment and storage. He provided consulting services to Bechtel SAIC during contract transition at the Yucca Mountain Project. Mr. Lewallen provided consulting services to the DOE at Idaho and DOE-HQ on the QA Program for the National Spent Nuclear Fuel Program. His involvement ensured strict compliance with the CBFO/WIPP requirements documents as well as to the 3,100 m^3 Project in the areas of document consolidation and procedure review/revision.

Education:

San Diego City College, Quality Control and Reliability, 1967 to 1973
Various College and technical courses (undergraduate studies)

A. Lynn McCloskey

Ms. McCloskey has over 20 years of experience in the mining engineering field. Responsibilities have included designing remedial technology applications for mining and mining-associated wastes of bench- and pilot-scale demonstration levels; design, emplacement, verification of subsurface contamination for structures for hydraulic control; installing monitoring wells, production wells, and unsaturated zone deep sampling Lysimeters; water and soil sampling; conducting environmental site assessments for real estate transactions; performing project planning; writing health and safety plans; preparing NEPA documentation and writing project reports; developing mining reclamation techniques such as grouting, stabilization, and bioremediation pursuant to CERCLA, NEPA, and Surface Mine Control and Reclamation Act; providing environmental compliance support for federal, state, and DOE regulations including RCRA, CERCLA, NEPA and the Clean Water Act, and the Toxic Substance Control Act. Ms. McCloskey serves as a consultant for GTI providing support to various GTI customers.

Education:

MS, Geologic Engineering, Montana College of Mineral Science and Technology, Butte Montana, 1991
BS, Mining Engineering; Montana College of Mineral Science and Technology, Butte Montana, 1988

Scott Ploger

Mr. Ploger has worked for 29 years as a physicist and materials scientist in the nuclear industry, mainly at the INEEL. He has extensive experience with spent nuclear fuel, radioactive material characterization, high-temperature metal/ceramic interactions, safety evaluations of nuclear facilities, waste management technologies, and project management/engineering techniques. Mr. Ploger has reviewed numerous DOE and contractor documents for compliance to DOE Orders, Federal laws, and state permitting regulations. Mr. Ploger co-discovered the Controlled Aspiration Process for spray-forming high-performance metals and plastics, helped file four DOE patent applications, and co-owned an INEEL "spin-off" company. Mr. Ploger is a Principal Investigator on several GTI research and development projects, including a patent-pending direct energy conversion concept for the Defense Advanced Research Projects Agency.

Education:

BS 1972 Physics/Mathematics, University of Wisconsin-Madison
MS 1974 Materials Science, University of Wisconsin-Madison

APPENDIX B
Drum/Box Estimates (Operations)

Acronyms:

RTP	Return to pit	ML-1	Reactor vessel
NTW	Non-targeted waste box	RFM	Refueling machine
PCS	Potentially contaminated soils	SSB	Soft-sided boxes

Assumptions:

1 13 months of excavation at Pit 4 (October 1, 2004 through October 31, 2005) or 396 days of operation. New information received during factual review with DOE and M&O 4-28-04, M&O now estimates retrieval operations at ~18 months.

2 7 day per week operations working a single 12-hour shift per day

3 M&O estimated ~6000 drums of waste to be excavated during operations. New information received during factual review with DOE and M&O 4-28-04, M&O now estimates ~12,500 drums of targeted waste to be excavated.

4 Standard 55 gallon drums used for packaging. Drums filled with approximately 5 cubic feet of targeted waste

5 An additional 30% of surrounding materials will be processed/loaded into drums to ensure adequate capture of targeted wastes. In addition, a 1.25 swell factor will be used to account for the compaction of the waste (soils) as the waste is excavated and packaged or RTP.

6 Estimated waste volumes (cubic feet):

	Waste	Volume	Drum Fill w/30%	Swell	Drums	Drums/Day
a	Roaster Oxides	780	1,014	1,268	254	
	Graphite	3,410	4,433	5,541	1,108	
	743	4,530	5,889	7,361	1,472	
	741	6,330	8,229	10,286	2,057	
	Filters	11,720	15,236	19,045	3,809	
	Totals	26,770	34,801	43,501	8,700	22
b	M&O Estimate				12,500	32

7 Total volume of pit/materials (cubic feet) is based on pit dimensions of approximately 243 feet x 126 feet x 16 feet. The measurements are topside measurements and the volume calculations include the 1:1 repose and the 2 foot of PCS with the following large object exclusions:

a

Waste	Volume		
Overburden	122,472	4ft	Removed prior to enclosure erection, not calculated in total
PCS	61,236	2ft	
ML-1	800		New information received during factual review with DOE and M&O 4-28-04, M&O now questions if reactor vessel (ML-1) is located in retrieval area and whether or not the 20 dumpsters were included in waste retrieval area or just the material in the dumpsters were placed in the retrieval area.
RFM	5,750		
RFM	5,750		
Tank	15		
20 Dumpsters	3,000	5ft x 5ft x 6ft	
Underburden	35,448	2ft	Left in place, not calculated in total
Total	15,315		

b Pit 4 Area — Volume 403,616 — hx[(A1 + A2)/2] assuming overlap of repose is insignificant and lends to conservatism of estimate

c Excavation Area - Large Objects
Volume
388,301

d RTP materials = (excavation area - large objects - targeted waste)
Volume
353,500 — Neglecting swell but accounting for 30% interstitial additional materials in targeted waste

8 Assume that the bulk of the RTP material will come directly from excavation operations as material is segregated and put into NTW SSBs. The remaining quantities of RTP materials will come via the drum loading station in NTWs or other alternate method and the quantity of these materials is considered insignificant in the context of this review. Initially, all excavated materials will be segregated as either targeted waste and placed in trays or RTP and placed in NTWs. As the excavation progresses, less waste will be put into NTWs and will be returned directly to the pit instead. For the purpose of this estimate, we assumed that a total of 10% of the RTP will be placed in NTWs. Initial trench campaign will account for bulk of RTP in NTW boxes; initial campaign is assumed to last approximately 40 days.

RTP	Swell	10%	NTW's	NTW's/day	NTW Size	Weight/NTW
353,500	441,875	44,188	1,637	41	3x3x3	2,268
353,500	441,875	44,188	1,637	41	4x4x3	2,268
353,500	441,875	44,188	1,637	41	3x5x3	2,268
				First 40 days		

Assuming no more than one cubic yard of RTP per box and density of material of 120lb/ft3 reduced to 84lb/ft3 to adjust for swell

9 Trays used to transport target waste to drum station are 3ft x 5ft x 8in with a usable volume of approximately 5 cubic feet due to the usable volume of the 55 gallon drums and the need of a one to one transfer of targeted wastes in the trays to the drums at the drum station. Therefore we can assume that the same number of trays will be processed per day as drums in number six above. This also assumes no rejected drums and minimal prohibited wastes found at drum station.

10 This estimate does not take into consideration inventory of the waste, both targeted and RTP materials, that may be required by the regulatory agencies.

11 All assumptions are based on level loading from start to finish of the project (exception of RTP in NTW boxes); realizing that initially the majority of the materials excavated will be RTP and as the project progresses and targeted wastes are excavated, less waste will be RTP.

APPENDIX C
M&O Contractor GEM and ARP Variance Explanations

The following is excerpted from the M&O contractor's variance explanations for the GEM and ARP projects.

GEM Through September, FY 2002

Schedule Variance $(284K)

The OU 7-10 Glovebox Excavator Method Project negative schedule variance ($284k) resulted from the delay in procurement activities for the WES, delays in fabrication and installation of mock-up facilities, and delays in the Fissile Material Monitor (FMM) fabrication.

Cost Variance $(859K)

The OU 7-10 Glovebox Excavator Method Project work package negative cost variance of ($859k) resulted from the following:

Negative cost variances of ($424) for Project Management and ($389) for Design engineering. Project Management costs were higher than planned in response to increased resource needs to resolve CD-2/3 external independent review comments, addition of a second deputy project manager, additional projects records costs to meet document throughput and requests, costs to complete the Project Execution Plans, and additional cost for emerging issues such as waste handling. The engineering overrun was the result of resolving more design issues/ comments than anticipated, additional resources required to prepare GFE purchases previously planned to be purchased by subcontractors, additional time for vendor data review and response and underestimate of the volume of technical editing required.

A negative cost variance of ($393k) in Procurement due to earlier than plan progress payments for glovebox and retrieval confinement structure required to maintain schedule.

Negative cost variance of ($108k) in Construction due to exclusion of Construction management pool account adder excluded from baseline.

GEM through September, FY 2003

Schedule Variance $(5,786K)

The OU 7-10 GEM Project schedule variance is a result of performing specific activities in a different sequence than originally planned. Additionally, the current early-start schedule for the start of excavation activities on September 16, 2003, has been extended because of delays in integrated system testing, operator qualification and integrated training, development of maintenance procedures, delays evolving from training and readiness preparation, and the re-performance of the contractor operations Management Self Assessment (MSA). Although the September 2003 baseline start of excavation is 6 months ahead of the enforceable milestone, the early-start schedule for excavation activities will be delayed until December, 2003. In addition, the early start date for performance of the MSA was based on an aggressive plan that recognized risk in early completion, but would have resulted in additional schedule float relative to the enforceable milestone date.

Cost Variance $(6,158K)

The OU 7-10 GEM Project negative cost variance due to (1) additional construction costs for design changes, overtime required to maintain schedule, subcontractor change orders and incentive payments, additional tent vestibules, and repair of cracked PGS glass; (2)

increase in operation costs due to additional radiological control technician requirements, growth in mockup facility requirements, and an underestimated cost of materials, assembly, and management for the mockup facility, and schedule cost impacts due to the re-performance of the contractor MSA; (3) additional engineering costs due to design changes resulting from operations mockup experience, field design changes, PGS window glass replacement, and additional engineering to support turnover and warranty items and (4) growth in project management and administration as a result of additional resources required to support emerging waste handling issues, response to agency comments, actual labor costs higher than planned, and addition of testing and turnover supervisor and personnel.

GEM through March, FY 2004

Schedule Variance $(633K)

The OU 7-10 GEM Project schedule variance ($633K) is a result of delays and re-scoping of the facility shutdown activities. The GEM facility will be placed in a warm shutdown condition to allow for future utilization versus readiness for demolition.

Cost Variance $(3,197K)

The OU 7-10 GEM Project negative cost variance of ($3,658K) is due to addition of the management self-assessment (MSA) recovery team that was not included in the FY 2004 baseline plan, purchase of additional operational materials and spares, and a 20-day slip in start of excavation activities versus the FY 2004 baseline plan.

ARP through March, 2004

Schedule Variance Explanation $(1,812K)

The AR Project is experiencing a negative schedule variance of ($1,812K) as a result of the late start of construction and procurement activities due to changes during design execution, which include changes to the building elevation and decision to package waste in drums versus standard waste boxes. Additionally, the site preparation schedule has been impacted by the discovery of a waste drum during overburden excavation.

Cost Variance $1,628K

The AR Project cost variance is primarily a result of a level loaded operations schedule, efficiencies in the ESH&Q account, delays in the site preparations subcontract, and an under-run in design engineering due to design changes which impacted engineering's ability to work on baseline scope.

APPENDIX D

Study For Excavating Pit 4 Waste in Private Industry

For this study of the ARP, information was provided by the M&O contractor so a private industry perspective could be performed and evaluated for cost analysis. The main areas addressed in this study include 1) excavation volume, production and costs calculations using the listed project assumptions, and 2) the summary of the ARP staffing cost review. The assumptions, volumes, production, and unit cost for the ARP used in this study are given in Table D1.

The primary limiting factors for the ARP excavation appear to be the 5.0 cu.ft. of waste per tray and the cycle time for excavating one scoop of targeted waste and dumping it into one tray. For the industry operation section, it was decided that two excavators and two Telehandlers be used for the calculations and be considered for use in the ARP (See Table D2). Once used in the contamination zone, they will not leave until retrieval is complete. However, after the pit is opened up and the first lateral strip is completed, it will be assumed that the second excavator can be used on an infrequent basis to assist in returning waste to the pit and with backfilling and smoothing operations. Thus overall cycle time will be reduced to 2.0 minutes and the productivity factor will be 80% (see Table D3).

Using the above discussed criteria, including those given in Table D1, calculations indicate that 14,652 yards will be excavated in 274 working days, or approximately 12.5 months. Contingency will be added on a per day basis. From reviewing and experience from past projects, it was found that five days may be lost to weather, five days might be lost to safety related stoppages, 10 days might be lost to radiation concerns, and another 10 days might be lost for a variety of miscellaneous reasons, for a total of 30 non-productive delay days. Thus, the project may reasonably be expected to be completed in 304 working days, or 14 months.

Table D1. Assumptions, Volumes, Production, and Unit Cost.

Assumptions	
Soils and waste density	120 lbs. Per cu.ft. in-place 52 100 lbs. Per cu.ft. loose
Swell	25%
Interstitial soils blended to targeted waste	30% of drum waste
Thickness of overburden	3 ft. to 9 ft.
Thickness of PCS	2 ft.
Thickness of Waste	14 ft. 2
Thickness of Underburden (UB)	2 ft.
(Depth to basalt)	(21 ft. to 27 ft.)
Dimensions of Pit at top of PCS	243 ft. x 126 ft.
Dimensions of Pit at top of UB	211 ft. x 94 ft.
Offset at slope of 1 : 1 to top of UB	16 ft.
Excavation Days	396 days
Excavation hours per day	8 hours
Tray / drum capacity	5.0 cu.ft.
Excavator Bucket size	¼ yd. (6.75 cu.ft., 3/4 full)
Cost (excavation)	$60,000,000
Volumes	
Total excavation	15,350 cu yds – PCS + total waste in zone
Targeted waste	1,010 cu yds.
NTW	3,250 cu yds.
Large Objects	570 cu yds.
PCS	2,270 cu yds. (simple lay back)
Interstitial Soils (IS)	8,250 cu yds.
IS used for blending in drums	300 cu yds.
RTP	14,370 cu yds (not counting PCS)
Drums required	9,000 drums
Production minimums	
Total yards per day	37 cu yds
Bucket loads per hour	25 Buckets
Cycle	1 Bucket every 2.4 minutes
PCS setback	5.7 yds per day
Targeted waste	23 drums per day
RTP	36 yds per day
Unit Cost	$4,000 per cu yard

1. 3 ft. were added to adjust for drum encountered during overburden excavation.
2. Based on $60,000,000 ops cost and 15,000 total excavation.

Table D2. Volume Calculations (Based on and reported in Table D1.)

Total waste zone, (not counting PCS, overburden or underburden) (211 x 94 x 14) + (243 x 126 – 211 x 94) x 14 / 2	353,164 cu.ft. (13,080 cu. yds.)
PCS volume 243 x 126 x 2	61,236 cu.ft, (2,268 cu. yds)
Waste zone contents Targeted waste (given) NTW (given) Large objects (given) Interstitial soils 13,080 – 1,013 – 3,250 – 568 Soils lost to drums 1,013 x 0.3	 27,351 cu.ft. (1,013 cu. yds) 87,750 cu.ft. (3,250 cu. yds) 15,336 cu.ft. (568 cu. yds) 222,723 cu ft. (8,249 cu. yds) 8,205 cu ft. (304 cu. yds)
Drums required (1,013 x 1.3 x 1.25) x 27 / 5.0	8,889 drums
RTP (3,250 + 8,249 – 304) x 1.25	377,811 cu ft. (13,993 cu. yds)
ARP estimated production Total Excavated from Pit 4 13,080 + 2,268 – 568 Per day 14,780 / 396 Scoops per hour 1,008 / 5.0 / 8 Minutes per scoop 60 / 25.2 RTP 13,993 / 396 days	 399,060 cu ft. (14,780 cu. yds) 1,008 cu ft. (37.32 cu. yds/day) 25.2 scoops/hour 2.38 minutes per scoop 35.34 cu. yds per day

Table D3. Industry Production Calculation

Givens Production shifts Schedule Actual "in zone" working time	 2 - 8 hr. shifts per day 5 days per week, 22 days per month Actual working time, 6 hours per shift, 3 hours morning 3 hours afternoon
Productivity Productivity in zone Excavated per scoop Average cycle time Total material to be excavated	 80% 5.0 cu.ft. (Bank measure) 2.0 minute per cycle 14,652 cu.yds. Large objects will remain in trench Includes PCS which will be simple layback
Production 5.0 cu ft x 60min/2.0 cpm x 6hrs x 80% Days required 14,652 yds. x 27 / 1,440 cuft/day TRU waste packaged 1,010 yds x 27 x 1.3 (blending) / 275 days / 5.0 cu ft./drum	 720 cu.ft. total excavation per shift 1,440 cu.ft. per day 275 days 12.5 months 26 drums per day, if blended

Staffing

It should be understood that there is a substantial difference in philosophy and requirements when comparing and evaluating private industry and government-directed projects. Note that the unit cost for the ARP is quite high, mainly a function of the high degree of staffing assigned to this project. In industry, staffing levels would be much lower, resulting in unit cost more typical of industry operations. The staffing level proposed in *the* *Accelerated Remediation Concept (AR) Project ROM Estimate – Operations*[44] is compared to one that might be used in private industry in Table D4. ***While reviewing the staffing section of Appendix D, it should be understood that as per the M&O contractor's factual review comments provided on April 28, 2004, one of the reasons that the staffing costs are higher than industry costs is due to the ISMS and COO requirements.*** For this study of the ARP, the following private industry considerations were established:

1. The ARP excavation is not the only work being performed at this site. It is only a small portion of the work being performed by personnel at the site. At a mine, the ARP would be considered a remediation project and not included in the production side of the operation (i.e. coal extraction); and as a result, only limited resources would be directed towards the project and those resources would have multiple projects. An example would be, the facility manager (or mine manager for industry) would only be concerned about the project issues addressed in meetings and would not be full time on the project management because of numerous other responsibilities. This philosophy is apparent in Table D4 where the Nuclear Facility Manager has 1,089 hour/6 month period and only 100 hours/6 month period for industry. Industry management and engineers manage multiple projects and tasks and the most important tasks are production-oriented.

2. Excavation of approximately 15,000 cubic yards is not a substantial issue in industry. However, excavating mixed waste containing TRU waste is, (and thus the potential for occasional high radiation working levels), and, as far as the IRT knows, has not been attempted in industry.

3. Three eight-hour shifts were proposed: two production shifts and one equipment maintenance and cleaning shift. The M&O contractor used one 12-hour shift; however, consideration to the schedule should be taken and, to allow the project to be successfully complete on schedule, shift work must be considered. Note that both estimates consider that a subcontractor will excavate the overburden.

4. The core operations personnel required to complete the ARP will remain in the estimates; however, the Hotel and middle- to upper-management positions will be decreased because redundancy of decision makers/management are not always required. Workers tasks are integrated as much as possible in industry.

As discussed previously, staffing costs are the dominant costs for the ARP project. Equipment, planning, engineering, and permitting costs will not be included in this staffing cost analysis. As indicated in the Staffing Analysis in Table D4, staffing costs for a six-month period will be approximately $1,400,000, or $235,000 per month. Total costs for 14 months will be $3,300,000, including contingency.

On the same basis, again using the Staffing Analysis in Table D4, the ROM M&O contractor staffing costs are $6,900,000 for the six-month period, or $1,150,000 per month, 10% of which are overtime dollars. Using 396 days at 30 days per month, the estimated total staffing cost becomes $15,000,000. Excavation unit costs are usually expressed as per cubic yard. The unit staffing cost, based on 15,000 cu yds of excavated waste, becomes $1,000 per cu yd. For the industry approach, the unit staffing cost becomes $220 per cu yd. From an industry standpoint, this unit cost is quite high and reflects the very low production level (5 cu ft. per scoop) and the high level of staffing required to complete the required project goals of excavating, separating, and packaging the TRU waste for shipment off site.

Detailed Narrative for Table D4 – Summary of Project Cost Review

The summary of project cost review illustrates two extremes with respect to project staffing, one high and one low estimate. An intermediate staffing load should be considered and achieved for the ARP project. Redundancy in personnel, integration of programs to develop a efficient decision-making team, and effectively evaluating the risk to optimize the workers, needs to be considered for the ARP project. "*A Monograph: Facility Disposition Lessons Learned From the Mound Site*"[27] could provide the initial guidance during review of staffing.

General information for the reviewers include: industry proposed using three eight-hour shifts: two production shifts and one, equipment maintenance and cleaning shift. The M&O contractor proposes using one 12- hour shift per day with two crews.

The core group for industry will consist of 12 waste operators (six per shift), two safety/rad techs (one per shift), eight equipment operators (four per shift), two laborers (one per shift), two mechanics (one per shift), two instrument techs (one per shift), two data recorders (one per shift), and two janitorial/laborers (one per shift).

For the equipment operators, there will be two teams. Each team will be in the zone for one three-hour period and outside the zone for the other three-hour period. For the team outside the zone, one will be moving drums to storage or other miscellaneous equipment-related activities and the other will be on the CCTV monitor assisting the excavator operator in the zone in discriminating between soils and waste. The safety/rad techs will perform all safety, hygiene, and rad control functions, will report to the project engineer and the safety/rad engineer, and will have the authority to stop work. The rest of the crew will report to the shift supervisors who will report to the project engineer.

The project engineer will have overall responsibility for the day-to-day operations of the project and will report to the VP of operations (or a project manager depending on how the company is organized). The environmental engineer and the safety/rad engineer would coordinate with the project engineer and report to the VP/Manager. (These positions are shown in the upper level category on the Staffing Analysis chart to indicate their counterparts on the ROM document, but they really are mid-level positions). Housekeeping supplies to these types of operations are normally brought to the site by anyone heading that way, be it the VP or the janitor.

Table D4. Summary of Project Cost Review

Staffing Review -
M&O contractor BOE = 6 - 7 Months, 30-Days per month, 1 - 12 Hour Shift with 2 – Crews and overburden removal by subcontract…Data as of 3/30/04
Private Industry BOE = 6 Months, 22 Days per month, 2- 8 Hour shifts and 1 - 8 hour maintenance shift (1,056 hrs), camp setup and overburden removal by subcontract
Hourly costs to the penny are from the ICP Burdened Rates.
Cost in whole dollars are from the ARP ROM Estimate, Operations.
Note: ARP ROM Costs are usually higher than the ICP Rates.
*Position added to table for Industry purposes, not part of M&O contractor staffing estimate.

Level/ code	Function	How Many?	Status	FTE %	M&O Contr. Regular Hours	Private Industry Recomm. Hours	Rate	Regular Cost	OT Hrs	OT Rate	OT Cost	Total Cost	Private Industry	Private Industry Total Cost	Function	How Many?	Status	Regular	OT Hrs	Rate
Upper																				
Z03	Nuc. Facil. Mngr.	1	Full time	58%	1,089	100	$83.42	$90,844	0	$125.13	$0.00	$90,844.38	Typically, in private industry a VP of Operations may manage 10 projects of this size for this duration	$8,342	V.P. Ops	1	1/10	100	0	$83.24
Z03	Shift Ops. Mngr.	1	Full time	58%	1,089	0	$83.42	$90,844	0	$125.13	$0.00	$90,844.38	This position would be a function of the Project Engineer	$0						
Z03	Ops. Director	1	Full time	58%	1,089	250	$83.42	$90,844	0	$125.13	$0.00	$90,844.38	This position would be a staffed by the Project Engineer	$20,855	Project Engineer	1	1/4	250		$83.42
Z04	Ops ESH&Q Mngr.	1	½ time	29%	544	250	$94.72	$51,528	0	$142.08	$0.00	$51,527.68	Environmental Engineer	$23,680	Enviro. Engineer	1	1/4	250		$83.42
Z03	Rad. Con. Mngr.	1	½ time	29%	544	0	$83.42	$45,380	0	$125.13	$0.00	$45,380.48	See Safety/Rad Con, Engineer below	$0						
Z04	Hotel Site Area Mngr.	1	½ time	29%	544	0	$94.72	$51,528	0	$142.08	$0.00	$51,527.68	This position would be a staffed by the Project Engineer	$0						
				Subtotal	4,899	600		$420,969	0		$0.00	$420,968.98		$52,877			Subtotal	600		
Mid.																				
Z10	Ops Forman	2	Full time	116%	2,178	0	$85.00	$185,130	192	$127.50	$24,480.00	$209,610.00	This would be a function of the Ops. Shift Supervisor	$0						
F05	Shift Super.	1-2.2	Full time	108%	2,022	2,122	$38.07	$76,978	211	$57.11	$12,049.16	$89,026.70	Ops. Shift Supervisor	$80,785	Ops. Shift Super.	2	Full	2,122		$38.07
E54	Prod. Coordinator	1-2.5	Full time	103%	1,944	0	$60.22	$117,068	0	$90.33	$0.00	$117,067.68	This position would be a function of the Project Engineer	$0						

Table D4. Summary of Project Cost Review

Staffing Review -
M&O contractor BOE = 6 - 7 Months, 30-Days per month, 1 - 12 Hour Shift with 2 – Crews and overburden removal by subcontract…Data as of 3/30/04
Private Industry BOE = 6 Months, 22 Days per month, 2- 8 Hour shifts and 1 - 8 hour maintenance shift (1,056 hrs), camp setup and overburden removal by subcontract
Hourly costs to the penny are from the ICP Burdened Rates.
Cost in whole dollars are from the ARP ROM Estimate, Operations.
Note: ARP ROM Costs are usually higher than the ICP Rates.
*Position added to table for Industry purposes, not part of M&O contractor staffing estimate.

Level/ code	Function	How Many?	Status	FTE %	M&O Contr. Regular Hours	Private Industry Recomm. Hours	Rate	Regular Cost	OT Hrs	OT Rate	OT Cost	Total Cost	Private Industry	Private Industry Total Cost	Function	How Many?	Status	Regular	OT Hrs	Rate
Z10	Rad. Con. Forman	1-2	Full time	101%	1,867	0	$75.00	$140,025	192	$112.50	$21,600.00	$161,625.00	This would be a function of the Safety/Rad Engineer	$0	Mech. Super.	1	1/4	250		$75.00
E18	Rad. Con. Super.	.5 - 1	Full time	54%	1,011	0	$60.34	$61,004	0	$90.51	$0.00	$61,003.74	This would be a function of the Rad. Con. Engineer	$0						
P23	Hotel Training Lead	1	Full time	50%	933	0	$85.00	$79,305		$127.50	$0.00	$79,305.00	This function would be coordinated/performed by the Project/Safety/Rad Engineer	$0						
Z11	Hotel Mntc. Forman	1	.1 - .25	11%	210	0	$65.00	$13,650		$97.50	$0.00	$13,650.00	This function would be coordinated/performed by the Project/Safety/Rad Engineer	$0						
Z07	Hotel Planning Super.	1	.1	5%	93	0	$85.00	$7,905		$127.50	$0.00	$7,905.00	This function would be coordinated/performed by the Project/Safety/Rad Engineer	$0						
				Subtotal	10,258	2,122		$681,064	595		$58,129.16	$739,193.12		$80,785			Subtotal	2,372		
Prof.																				
E54	Hotel Syst. Engineer	5 - 6.5	Full time	336%	6,315	0	$107.00	$675,705		$160.50	$0.00	$675,705.00	This position would be a function of the Project Engineer	$0						
P23	Hotel Trainers	1	4-5-2	232%	4,355	0	$75.00	$326,625		$112.50	$0.00	$326,625.00	This position would be a function of the Project Engineer	$0						

Table D4. Summary of Project Cost Review

Staffing Review -
M&O contractor BOE = 6 - 7 Months, 30-Days per month, 1 - 12 Hour Shift with 2 – Crews and overburden removal by subcontract…Data as of 3/30/04
Private Industry BOE = 6 Months, 22 Days per month, 2- 8 Hour shifts and 1 - 8 hour maintenance shift (1,056 hrs), camp setup and overburden removal by subcontract
Hourly costs to the penny are from the ICP Burdened Rates.
Cost in whole dollars are from the ARP ROM Estimate, Operations.
Note: ARP ROM Costs are usually higher than the ICP Rates.
*Position added to table for Industry purposes, not part of M&O contractor staffing estimate.

Level/ code	Function	How Many?	Status	FTE %	M&O Contr. Regular Hours	Private Industry Recomm. Hours	Rate	Regular Cost	OT Hrs	OT Rate	OT Cost	Total Cost	Private Industry	Private Industry Total Cost	Function	How Many?	Status	Regular	OT Hrs	Rate
E18	Rad. Con. Engineer	1-2-3	Full time	149%	2,800	250	$60.64	$169,792	0	$90.96	$0.00	$169,792.00	This would be staffed by the Rad. Con. Engineer	$15,160	Safety/Rad. Engineer	1	1/4	250		$60.64
E17	Quality Engineer	1-2	Full time	74%	1,400	0	$59.18	$82,852	0	$88.77	$0.00	$82,852.00	This position would be a function of the Project Engineer	$0						
X16	WG8 Personnel	.5-1-2	Full time	74%	1,400	0	$49.34	$69,076		$74.01	$0.00	$69,076.00	This position would be a function of the Project Engineer	$0						
P37	Hotel Training Technol.	1	½ time	29%	544	0	$75.00	$40,800		$112.50	$0.00	$40,800.00	This position would be a function of the Project Engineer	$0						
E17	Quality Inspector	1	1/3 time	21%	389	0	$59.18	$23,021	0	$88.77	$0.00	$23,021.02	This position would be a function of the Project Engineer	$0						
E40	Hotel Eng. Com. Mgmt.	1	0.4	20%	373	0	$44.18	$16,479		$66.27	$0.00	$16,479.14	This position would be a function of the Project Engineer	$0						
E05	Hotel Eng. & Design	1	0.2	12%	218	0	$62.93	$13,719		$94.40	$0.00	$13,718.74	This position would be a function of the Project Engineer	$0						
				Subtotal	17,794	250		$1,418,069	0		$0.00	$1,418,068.90		$15,160			Subtotal	250		
Shop	(CORE)														(CORE)					
U73	Waste Operator	2-34	Full time	Full	27,066	6,366	$32.53	$880,457	3,264	$48.80	$159,266.88	$1,039,723.86	Waste Operator	$207,086	Waste Operators	12	Full	6,366		$32.53
U60	Rad. Con. Tech.	2-25-30	Full time	Full	21,621	2,122	$51.00	$1,102,671	2,880	$76.50	$220,320.00	$1,322,991.00	Safety and /Rad. Techs. combined	$108,222	Safety/Rad. Techs.	3	Full	2,122		$51.00
U12	Equip. Operator	2-11-22	Full time	Full	16,022	8,448	$51.00	$817,122	2,122	$76.50	$162,333.00	$979,455.00	Equip. Operators	$430,848	Equip. Operators	8	Full	8,448		$51.00
U21	Laborer	4	3/4	3/4	3,733	2,122	$20.00	$74,660	384	$30.00	$11,520.00	$86,180.00	Laborer	$42,440	Laborer	2	Full	2,122		$20.00

Table D4. Summary of Project Cost Review

Staffing Review -
M&O contractor BOE = 6 - 7 Months, 30-Days per month, 1 - 12 Hour Shift with 2 – Crews and overburden removal by subcontract…Data as of 3/30/04
Private Industry BOE = 6 Months, 22 Days per month, 2- 8 Hour shifts and 1 - 8 hour maintenance shift (1,056 hrs), camp setup and overburden removal by subcontract
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Cost in whole dollars are from the ARP ROM Estimate, Operations.
Note: ARP ROM Costs are usually higher than the ICP Rates.
*Position added to table for Industry purposes, not part of M&O contractor staffing estimate.

Level/ code	Function	How Many?	Status	FTE %	M&O Contr. Regular Hours	Private Industry Recomm. Hours	Rate	Regular Cost	OT Hrs	OT Rate	OT Cost	Total Cost	Private Industry	Private Industry Total Cost	Function	How Many?	Status	Regular	OT Hrs	Rate
U29	System Mechanic	1-2	2/3	2/3	1,400	2,122	$51.00	$71,400	192	$76.50	$14,688.00	$86,088.00	Mechanics	$108,222	Mechanics	2	Full	2,122		$51.00
S08	Indust. Hygiene	1-2	Full time	Full	1,400	0	$48.47	$67,858	0	$72.71	$0.00	$67,858.00	Performed by the Safety and /Rad. Techs.	$0						
E19	Indust. Safety	1-2	Full time	Full	1,400	0	$58.42	$81,788	0	$87.63	$0.00	$81,788.00	Performed by the Safety and /Rad. Techs.	$0						
S21	Enviro. Tech.	1	Full time	Full	1,089	0	$59.54	$64,839	0	$89.31	$0.00	$64,839.06	Performed by the Safety and /Rad. Techs.	$0						
T25	Computer Support Tech.	1	½ time	1/2	544	2,122		$0	0	$0.00	$0.00	$0.00	Instru. Tech.	$0	Instru. Tech.	2	Full	2,122		$37.00
P19	Records	0*	0*		0	2,122	$30.75			$46.13	$0.00	$0.00	Data Recorder	$65,252	Data Recorder	2	Full	2,122		$30.75
U84	Laborer	0*	0*			2,122	$29.78			$44.67	$0.00	$0.00	Janitor would also act as laborer	$63,193	Janitor/Laborer	2	Full	2,122		$29.78
E41	Fireman	1	½ time	1/2	544	2,122	$59.27	$32,243	0	$88.91	$0.00	$32,242.88	Not required in private industry	$125,771						
				Subtotal	74,819	29,668		$3,193,038	8,842		$568,127.88	$3,761,165.80		$1,151,034			Subtotal	27,546		
Hotel																				
E24	Ops. Integration	4	Full time	Full	4,355	0	$20.00	$87,100	0	$30.00	$0.00	$87,100.00	Not required in private industry	$0						
P22	Procedure Writer	3-2-1	Full time	Full	2,489	0	$39.62	$98,614	0	$59.43	$0.00	$98,614.18	Not required in private industry	$0						
U19	Instrument Tech.	1	1-2	1 - 2	1,244	0	$51.00	$63,444	0	$76.50	$0.00	$63,444.00	Not required in private industry	$0						
U06	Carpenter	1	2-5	2 - .5	1,167	0	$51.00	$59,517	0	$76.50	$0.00	$59,517.00	Not required in private industry	$0						
A14	Admin Support	1	Full time	Full	1,089	250	$23.05	$25,101	0	$34.58	$0.00	$25,101.45	Purchasing	$5,763	Purchasing	1	1/4	250		$23.05
P33	Train. Admin.	1	Full time	Full	975	500	$36.91	$35,987	0	$55.37	$0.00	$35,987.25	Payroll will track training records	$18,455	Payroll	1	1/2	500		$36.91
P19	Records	1	2/3	2/3	653	2,122	$30.75	$20,080	0	$46.13	$0.00	$20,079.75	Will be performed by payroll	$65,252						

Table D4. Summary of Project Cost Review

Staffing Review -
M&O contractor BOE = 6 - 7 Months, 30-Days per month, 1 - 12 Hour Shift with 2 – Crews and overburden removal by subcontract…Data as of 3/30/04
Private Industry BOE = 6 Months, 22 Days per month, 2- 8 Hour shifts and 1 - 8 hour maintenance shift (1,056 hrs), camp setup and overburden removal by subcontract
Hourly costs to the penny are from the ICP Burdened Rates.
Cost in whole dollars are from the ARP ROM Estimate, Operations.
Note: ARP ROM Costs are usually higher than the ICP Rates.
*Position added to table for Industry purposes, not part of M&O contractor staffing estimate.

Level/ code	Function	How Many?	Status	FTE %	M&O Contr. Regular Hours	Private Industry Recomm. Hours	Rate	Regular Cost	OT Hrs	OT Rate	OT Cost	Total Cost	Private Industry	Private Industry Total Cost	Function	How Many?	Status	Regular	OT Hrs	Rate
U35	Painter	1	1 - .5	1 - .5	622	0		$0	0	$0.00	$0.00	$0.00	Not required in private industry	$0						
P19	Records	1	½ time	1/2	544	0	$30.75	$16,728	0	$46.13	$0.00	$16,728.00	Not required in private industry	$0						
U21	Laborer	1	.5	.5	467	0	$20.00	$9,340	0	$30.00	$0.00	$9,340.00	Not required in private industry	$0						
U29	Mechanic	1	.5	.5	467	0	$51.00	$23,817	0	$76.50	$0.00	$23,817.00	Not required in private industry	$0						
U16	Pipefitter	1	1 - .25	1 - .25	389	0	$51.00	$19,839	0	$76.50	$0.00	$19,839.00	Only as required	$0						
U11	Electrician.	1	.5 - .25	.5 - .25	311	100	$51.00	$15,861	0	$76.50	$0.00	$15,861.00	Electrician	$5,100	Electrician	1	4 hr/wk	100		$76.50
Z04	Manager ???	1	1/3	1/3	311	0	$20.00	$6,220	0	$30.00	$0.00	$6,220.00	Not required in private industry	$0						
T03	Drafting	1	¼	1/4	272	100	$35.20	$9,574	0	$52.80	$0.00	$9,574.40	Drafting	$3,520	Drafting	1	4 hr/wk	100		$52.80
F10	Work Planners	1	¼	1/4	233	0	$65.00	$15,145	0	$97.50	$0.00	$15,145.00	Would be a function Ops. Shift Supervisor	$0						
A25	Office Admin.	1	0.2	0	218	416	$23.10	$5,036	0	$34.65	$0.00	$5,035.80	Office Admin.	$9,610	Office Admin.	1	16 hr/wk	416		$34.65
F10	Work control	1	1/5	1/5	187	0	$65.00	$12,155	0	$97.50	$0.00	$12,155.00	Not required in private industry	$0						
F10	Mat'l. Spec.	1	1/5	1/5	187	0	$65.00	$12,155	0	$97.50	$0.00	$12,155.00	Not required in private industry	$0						
F07	WCAC	1	1/5	1/5	187	0	$42.63	$7,972	0	$63.95	$0.00	$7,971.81	Not required in private industry	$0						
U01	Equip. Mech.	1	1/5	1/5	109	0	$51.00	$5,559	0	$76.50	$0.00	$5,559.00	See above	$0						
P21	Subcontract Admin.	1	.02	.02	22	0	$74.34	$1,635	0	$111.51	$0.00	$1,635.48	Not required in private industry	$0						
				Total	16,498	3,488		$550,880	0		$0.00	$550,880		$107,699			Subtotal	1,366		
							Total	$6,264,020		Total	$626,257	$6,890,277	Total	$1,407,554						