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A Monograph:
Facility Disposition Lessons Learned from the Mound Site

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ACRONYMS

AEA	Atomic Energy Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C&D	Construction and Demolition Debris
DOE	Department of Energy
DOE–MEMP	Department of Energy Mound Environmental Management Project
dpm	Disintegrations per Minute
dps	Disintegrations per Second
D&D	Decontamination and Decommissioning
DOT	Department of Transportation
DP	Defense Programs
EM	Environmental Management
ER	Environmental Restoration
FFA	Federal Facility Agreement
LLW	Low Level Waste
MMCIC	Miamisburg Mound Community Improvement Corporation
NPL	National Priority List
NRC	Nuclear Regulatory Commission
OEPA	Ohio Environmental Protection Agency
ODH	Ohio Department of Health
OU	Operable Unit

pCi/g	Picocuries per Gram
PPE	Personnel Protection Equipment
PRS	Potential Release Site
RI/FS	Remedial Investigation /Feasibility Study
USEPA	United States Environmental Protection Agency
WAC	Waste Acceptance Criteria

INTRODUCTION

The Department of Energy's Mound Environmental Management Project (DOE-MEMP) [henceforth referred to as Mound] is working to exit the Mound site by 2005 and transfer the property to Miamisburg Mound Community Improvement Corporation (MMCIC). The City of Miamisburg established this non-profit corporation to coordinate the transfer and economic development of this property. Prior to transferring the Mound site, Mound must fulfill all of its requirements under its Federal Facilities Agreement (FFA). The Mound site was placed on the National Priorities List (NPL) in 1989. As a result, DOE entered into a FFA with the United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA), and is conducting cleanup of this site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Consequently, prior to transferring the property, Mound must obtain approval from its regulators that all environmental media and remaining facilities are protective of human health and the environment. In accordance with guidance issued jointly by DOE and USEPA, Mound is now conducting facility disposition projects as non-time critical removal actions under CERCLA.

Faced with decreased budgets and the pressure to accelerate schedules, Mound has identified a number of approaches to improve its facility disposition program. These approaches are designed to allow Mound to protectively disposition its facilities in a more cost-effective and timely manner. Because other DOE sites are faced with similar challenges, including reduced funding and shortened schedules, DOE's Office of Environmental Policy and Assistance (EH-41) has determined that these lessons learned should be communicated across the complex. Consequently, EH-41 developed this document, and appropriate personnel at the DOE Mound Environmental Management Project have reviewed it to ensure that it accurately represents the facility disposition approaches developed at the Mound site. This document provides general guidelines that a site may follow in applying the five innovative approaches identified by Mound; these approaches are described below:

- ***Core team approach:*** Mound obtains regulator participation beginning at the onset of facility evaluation and continues this involvement through the selection of the disposition approach and verification that protectiveness has been achieved. A core team, which includes all decision-makers (i.e., the DOE program manager and the site's regulators), reaches consensus on all facility disposition decisions requiring concurrence. By gaining regulator agreement on key decisions as they are made, the site reduces the risk that late-stage regulator disapproval will delay specific projects or impede site exit. Because it provides a new approach to communication and decision-making, the core team approach can be effective even if a site and its regulators have had difficulty in the past reaching agreement through conventional mechanisms.

- ***Efficient identification of the appropriate disposition:*** Mound reduces data collection and moves projects more quickly to implementation. Use of existing information as the starting point of evaluation allows the core team to either identify the appropriate disposition or define the range of realistic options. This upfront effort reduces the characterization and evaluation needed to select an appropriate, cost-effective option and allows the site to focus on substantiating and implementing this disposition approach.

- ***Release of facilities with radiological process history:*** To reduce costs and facilitate site exit, Mound has developed a process that will allow it to more effectively pursue release of facilities with radiological process history. As part of this process, Mound is working to reach agreement with its regulators on release criteria for demolition debris. The ability to implement this disposition will help Mound reduce disposal costs. In addition, Mound has contributed to development of a framework that expedites evaluation to determine if a facility can be released intact for reuse. Release of facilities suitable for reuse, when cost-effective, helps Mound to reduce costs and satisfy the interests of its future landlord.

- ***Facility disposition reengineering:*** Mound recently conducted a reengineering effort to develop a more efficient approach to its facility disposition process. The proposed approach focuses on the decisions that must be made to disposition a facility and conducts activities as efficiently as possible to support these decisions (i.e., only as necessary to support decision-making). By integrating the formerly distinct programs of safe shutdown and decontamination and decommissioning (D&D), Mound has established a single decision-making framework, thereby eliminating redundant and overlapping activities.

In addition to the approaches that Mound has already developed, it is considering applying uncertainty management to facility disposition projects. Mound has reduced data collection and minimized risk posed by project uncertainties by applying this approach to environmental restoration (ER) projects. Given the benefits achievable through this approach, this document provides a description, summarized below, of the applicability of uncertainty management to facility disposition.

- ***Uncertainty management*** allows a site to effectively assess risks to the cost and schedule of individual projects. Through this approach, the site differentiates between those facility conditions that must be fully understood upfront and those that can be managed during implementation through monitoring and contingency planning. Further, the site can identify those factors that have negligible impact on the success of the project and therefore do not need to be further investigated. This approach reduces data collection while minimizing the cost and schedule risk posed by uncertainties.

The approaches presented in this document are consistent with DOE Orders and the CERCLA regulatory framework for facility disposition.

A new context for facility disposition

Mound has identified these approaches to improve its facility disposition projects in response to changes in the context for facility disposition which are impacting sites across the DOE complex. Various parts of the weapons-producing complex have been shut down and many sites are now focused on addressing the environmental problems associated with past DOE activities. DOE is working to transfer much of its property, including land and facilities, for economic redevelopment. Even at sites that are maintaining limited operations, DOE is pursuing the transfer or lease of portions of their property to reduce its overall landlord responsibility and budget. In addition, because DOE's budget has decreased, sites are receiving reduced funding for all environmental restoration work, including facility disposition. As part of the effort to expedite and improve processes for environmental cleanup, DOE and EPA have issued a joint initiative establishing that facility disposition projects be conducted as non-time critical removal actions under CERCLA. DOE sites are in the process of adapting their existing facility disposition programs to respond to these changes. As an example, Mound has been affected in the following ways:

- ***A new site mission:*** In 1989, DOE decided to close the Mound site, changing the site's mission from support of weapons production to environmental restoration in preparation for site exit. In addition, the Mound site was added to the NPL and entered into a FFA with its regulators. This agreement established a set scope of environmental remediation work that the site is legally bound to complete. Because site cleanup activities are being conducted under CERCLA, and in accordance with its FFA, Mound must obtain regulator approval in all phases of the process, including restoration, property transfer and site exit.

- ***Reduced funding:*** As a result of recent, department-wide budgetary cutbacks, Mound is receiving decreased funding for cleanup activities, including facility disposition. Mound determined that the most effective way to achieve its mission given this reduced budget is to accelerate its schedule for completing its set scope of cleanup activities and exiting the site. Facility disposition projects constitute a large portion of the work Mound must complete prior to exit. Therefore reduction of the cost and schedule of these projects is key to accelerating site exit and working under reduced budgets.

- ***DOE's initiative to conduct disposition under CERCLA:*** This policy, coupled with the need for regulator approval in order to exit the site, made Mound realize it needed a more formal approach to regulator involvement. In addition, Mound recognized that there was the opportunity to demonstrate compliance with DOE Orders through the CERCLA process.

The approaches presented in this document were developed by Mound to help successfully disposition facilities within this new context. Similar changes are affecting sites across the DOE complex, both those pursuing exit and those maintaining limited operations. These

sites have a unique opportunity to learn from and adapt the approaches that Mound has identified to improve facility disposition. Because DOE sites follow similar procedures in conducting facility disposition, these approaches are expected to assist most DOE sites in reducing the cost and schedule of facility disposition and conducting these projects appropriately under the CERCLA regulatory framework.

Audience

The lessons learned and implementation guidance provided in this document are primarily intended for:

- DOE personnel with line-management responsibility for conducting facility disposition projects and/or managing facility disposition programs at DOE facilities; these parties comprise the facility disposition core team.

- Those parties with decision-making authority for facility disposition activities at DOE sites (e.g., USEPA, State personnel). In general, decision-makers include regulatory agencies from which the site must obtain concurrence on specific facility disposition decisions (e.g., that the option selected is protective); however, a site may identify additional parties with decision-making authority (e.g., co-owner or potentially responsible party for the site).[1]

This guidance may also be used by DOE contractors responsible for the technical detail involved in conducting facility disposition projects, and by those technical staff, whether DOE employees or contractors, who review facility disposition documents for technical and regulatory adequacy. Stakeholders may find this document useful, as well.

Format

This document describes five approaches designed to improve Mound's facility disposition program. To provide an overview of this document, a summary of each approach is provided upfront. In each summary, the specific issues that Mound was facing, the general approach the site identified/developed to address these issues, and the expected or achieved benefits of applying the approach are described.

Following the summary section, each approach is described in more detail and presented as a module, consisting of two components:

1) ***Implementation:*** This section provides general guidelines that a site may use to adapt, if necessary, and implement the lessons learned by Mound.

[1] These parties comprise the facility disposition core team.

2) ***Notes:*** Linked by references from the implementation section, this section provides additional discussion and examples to further detail the approaches presented in this document. This information is included to supplement the guidelines presented in the implementation section.

Terminology

Because this document is based on work conducted at the Mound site, it is described in terms common to this field site. Specifically:

- ***Safe shutdown*** refers to those activities bringing a facility that no longer has a mission into a stable condition. DOE-Headquarters refers to these activities as deactivation.

- ***Decontamination and decommissioning (D&D)*** refers to any combination of activities that are required to bring a facility to its final end state (e.g., decontamination, demolition). DOE-Headquarters refers to these activities as simply decommissioning.

- ***Disposition*** encompasses any combination of safe shutdown and D&D activities (including decontamination and transfer intact and long term surveillance and maintenance).

SUMMARY OF APPROACHES

CORE TEAM APPROACH

The issue

In order to transfer ownership of the Mound site, the Department of Energy Mound Environmental Management Project (DOE-MEMP) [henceforth referred to as Mound] must obtain approval from the United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA) that the property is protective of human health and the environment for industrial use. USEPA must approve transfer of the site per the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 120(h). OEPA has regulatory authority because it is a party to the site's Federal Facility Agreement (FFA). Consequently, if regulators do not concur at the time of transfer that the property, including environmental media and all facilities, is protective, Mound will be unable to exit prior this site without conducting additional work. Thus, lack of regulator approval that one facility is protective for release for its intended use may delay transfer of the entire site. USEPA must also provide concurrence before Mound can lease facilities for commercial use prior to its site exit. Mound is pursuing this option for a number of its facilities.

For some projects, Mound has to obtain regulator concurrence not only at the time of exit but also before remediation or disposition work for the specific project is implemented. For example, in order to leave any demolition debris onsite as fill, site regulators must concur that the material is clean. If lack of concurrence delays implementation of specific projects and necessitates additional planning and rework to address regulator concerns, Mound's baseline schedule may be prolonged and its budgets exceeded.

In addition to obtaining regulator concurrence that the site is ready for transfer, Mound must secure a future landlord to assume responsibility for the site. The City of Miamisburg is interested in taking over the site for economic redevelopment by local businesses and has formed the Mound Miamisburg Community Involvement Commission (MMCIC), a non-profit organization with the purpose of receiving and developing the Mound site. MMCIC is helping to coordinate site transfer by identifying future tenants. Mound is working, whenever appropriate, to make the site desirable to potential tenants (e.g., by leaving facilities intact for reuse).

The approach

Mound has determined that by obtaining early and continuous regulator involvement in deciding how environmental media and facilities should be addressed, it can reduce the risk that late-stage regulator disagreement will prevent Mound from achieving its exit deadline. Further, by considering input from MMCIC during decision-making, the site can more effectively respond, as appropriate, to the interests of this stakeholder.

Based on this recognition, Mound now involves regulators in decision-making and obtains input from MMCIC by applying a core team approach to the facility disposition program.

The site obtains appropriate regulator and stakeholder involvement by:

- ***Early establishment of the decision-making framework for facility disposition projects.*** Mound has expedited the decision-making process for facility disposition projects by defining upfront the decisions that must be made and identifying those decisions that regulators must agree with in order to successfully implement projects. Mound also identifies those decisions that will be strengthened by consideration of MMCIC input and actively solicits this input.

- ***Forming a core team of decision-makers.*** Rather than restricting regulator involvement to the traditional, late-stage comment/review period, Mound has formed a core team of decision-makers which includes the DOE decontamination and decommissioning (D&D) program manager, USEPA, and OEPA. Although the Ohio Department of Health (ODH) does not have direct regulatory authority over these projects, this agency provides extensive input to the core team. By reaching consensus on those decisions identified in the decision-making framework that require regulator concurrence (e.g., data required to substantiate protectiveness), the core team works together to select an acceptable disposition approach.

Integral to a successful core team approach is the extended project team. The extended project team comprises all individuals and agencies whose input the core team and/or the site determines is necessary to identify an appropriate approach to a project. To strengthen decision-making, the core team:

- ***Works with the project team.*** The project team consists of Mound and its contractors. The core team works closely with the project team to obtain necessary technical information to make decisions and to ensure that the project team understands why and how these decisions were made so that they are properly implemented.

- ***Involves the future landlord as appropriate***. Because Mound has determined that it needs input from the future landlord to support certain decisions, it involves MMCIC, as appropriate. For example, when determining the most appropriate disposition for a facility, the site considers input from MMCIC on whether future tenants are interested in reusing when determining the most appropriate disposition for the facility.

The benefits

The core team approach is the foundation of Mound's innovative soil remediation strategy, Mound 2000.[2] Because this strategy expedites decision-making and action, Mound estimates that it will save $2 billion and accelerate the site's baseline schedule by approximately 25-30 years. Mound recognized an opportunity to further reduce cost and schedule by applying the core team approach to its facility disposition program. The core team approach provides a framework for gaining regulator concurrence that all facilities have been dispositioned in a manner protective of human health and the environment, which is required before the site can be transferred. Through this approach Mound:

- ***Expedites decision-making and action.*** Because the core team works together, the members develop a level of trust that facilitates decision-making. Once a decision is made, the site need only document the core team consensus, which regulators can quickly review and approve. This reduces the scope of documents that are typically prepared, the time required for review, and allows the site to move more quickly to action.

- ***Reduces the risk that lack of regulator concurrence will impede exit or prolong schedule and increase costs.*** By involving regulators in those specific decisions pertaining to identification and implementation of a protective disposition, Mound ensures that it selects a disposition and implementation approach that regulators agree is protective and sufficiently substantiates this by fulfilling all regulators' data requirements.

- ***Communicates more effectively with MMCIC.*** By obtaining input from the future landlord as decisions are made, Mound now more effectively reflects the interests of potential tenants, when appropriate, in determining the most appropriate disposition. Further, this approach provides an effective forum to obtain input from the general public, as required under CERCLA.

[2] Under Mound 2000, the site and its regulators evaluate individual potential release sites to determine if action is needed. When action is required, the site uses its removal action authority to address the problem. For additional information on Mound 2000, contact Art Kleinrath, CERCLA program manger, at (937) 865-3597.

EFFICIENT IDENTIFICATION OF AN APPROPRIATE DISPOSITION

The issue

In Mound's effort to meet its exit deadline, the site is working to move more quickly from characterization and evaluation to implementation in facility disposition projects. The site recognized that one way to expedite implementation was to address inefficiencies in the characterization efforts conducted to support disposition. Mound determined that the inefficiency of data collection was the product of the following factors:

1) ***Mound was not making use of the existing information available for its facilities.*** For each facility, the site has several existing sources of information that may provide data on the nature and extent of contamination and the facility's physical condition (e.g., process history, inspection records, spill records). Because the site was not reviewing this information prior initiating data collection, the site often collected data that was already available.

2) ***In conducting its first disposition projects, Mound collected more information than required to support facility disposition decisions (i.e., decisions related to engineering, health and safety, and waste management approaches).*** Mound generally conducted a full characterization of the facility prior to selecting the disposition approach. This detailed information is not generally necessary to determine and implement the appropriate disposition for a facility. Because the site was not identifying the specific information required to make disposition decisions, in some cases its data collection efforts were excessive.

3) ***Separate data collection efforts were conducted to identify the disposition and to support implementation [e.g., data to support demolition, to determine personnel protection equipment (PPE), define waste type].*** Mound recognized that there was often overlap between the data collected to support selection of the appropriate disposition and that collected to support implementation. The site realized that action would be expedited if it could begin to fill implementation data needs as early as possible.

The approach

Mound realized that it could streamline data collection by: (1) evaluating all of the existing information for a facility at the beginning of a project; and (2) focusing evaluation and decision-making on identifying the appropriate disposition as early as possible. Based on this recognition, Mound identifies the appropriate disposition through the following steps:

1) ***Evaluate existing information.*** The site works with its regulators to evaluate

existing information in an effort to determine the nature and extent of contamination and the physical conditions of the facility.[3]

2) ***Identify the appropriate disposition or define the range of realistic options.*** Based on its understanding of the conditions of the facility, the site attempts to identify the appropriate disposition. If the site and its regulators agree on an appropriate disposition, the site can proceed with implementation.[4] If the disposition is not obvious, the range of feasible options is defined based on expectations about the facility's conditions.

3) ***Focus any necessary, additional evaluation.*** If existing information is not sufficient to make a disposition decision, the site collects only those data that are needed to make that decision. For example, if more information is needed to substantiate that a disposition is protective, the site works with its regulators to identify the specific data required (e.g., contaminant concentration). If the most cost-effective approach within the range of realistic options is not evident, Mound conducts an order of magnitude cost-benefit evaluation to quickly compare the relative costs of protective disposition options.

Based on the range of realistic disposition options, the site begins, to the extent possible, to fill any implementation data needs during these early data collection efforts.

The benefits

By evaluating existing information as the first step in decision-making and working to identify the appropriate disposition as early as possible, Mound has reduced the scope of necessary data collection and expedited implementation of facility disposition projects. Specifically, this approach has allowed Mound to:

- Reduce characterization and evaluation activities by using existing information to make decisions about how a facility should be dispositioned;

- Focus any additional, necessary data collection by identifying the specific information required to select the most appropriate disposition from a range of realistic options;

[3] In order to achieve all of the benefits of this approach, Mound obtains regulator participation and approval throughout the process of identifying the appropriate disposition. Because regulators must concur that the disposition chosen is protective of human health and the environment, the core team reaches consensus on all decisions related to protectiveness (e.g., nature and extent of contamination in the facility). (*See Module 1 for a discussion on involving regulators through a core team approach.*)

[4] Additional design data may be needed to implement the appropriate disposition.

Efficient Identification of an Appropriate Disposition

- Minimize the number of characterization efforts necessary by obtaining, whenever possible, data that may be needed for implementation during early data collection efforts. (*Module 5, Facility Disposition Reengineering, provides additional information on coordination of overlapping disposition activities.*)

RELEASE OF FACILITIES WITH RADIOLOGICAL PROCESS HISTORY

The issue

Some of the facilities at the Mound site have radiological process history; however, based on existing information most of these facilities are expected to contain only limited or no residual radiological contamination. Further, many of the facilities that are known to have radiological contamination are expected to contain portions that are clean. Mound realized that, contrary to its original plan, it may not be necessary to demolish and dispose of all of its facilities with radiological process history as LLW. Rather, release[5] of many of these facilities would not only be protective of human health and the environment, but also less costly than demolition and disposal as LLW. In addition to the potential cost savings, release of facilities intact will help Mound in responding to the requests of future tenants, a key stakeholder.

Despite the potential benefits of these dispositions, Mound was initially hesitant to pursue release of its facilities with radiological process history for the following reasons:

1) Because of a lack of generic release criteria for ***demolition debris***, the site did not know the levels at which disposal of this material as non-radiological waste would be acceptable to regulators.

2) Although generic release criteria *do* exist for the unconditional release of an ***intact facility*** with surface contamination, Mound was unsure what the regulators would require to substantiate that a facility meets these criteria.

The risk that the site would not obtain regulator approval for release and would therefore have to spend additional time and money selecting and implementing an alternate disposition outweighed the potential benefits provided by this disposition option.

The approach

Mound recognized that releasing facilities whenever protective is a key step in meeting its decreasing budgets. Therefore, Mound has made an upfront investment of time and effort to overcome the barriers to implementing this option. In collaboration with its regulators, the site has developed a process designed to facilitate efficient, cost-effective release of facilities with radiological process history. This process incorporates (1) generic release criteria, established in DOE Order 5400.5, for the release of an intact facility with surface contamination; and (2) draft criteria for the release of debris with residual radiological

[5] In this document the term “release” refers to one of several dispositions: 1) unconditional release of an intact facility, 2) conditional release of an intact facility (e.g., with deed restrictions), 3) demolition and disposal of debris as non-radiological waste, or 4) recycling of facility materials.

contamination, derived based on a dose limit by the Nuclear Regulatory Commission (NRC) in Draft NUREG 1500. This process incorporates elements of Mound's basic approach to facility disposition, including:

- ***Core team.*** Regulator involvement is initiated early so that Mound can identify upfront if regulators will approve release of a facility in its current state or if decontamination is needed to reach protective levels.

- ***Efficient identification of an appropriate disposition.*** By beginning with an evaluation of existing information, Mound forms expectations about the conditions of a facility and determines if release may be cost-effective. If existing information is not sufficient to substantiate release, the core team identifies the additional information that is required to determine if a release disposition is appropriate.

The benefits

By using this process, Mound is now able to efficiently pursue release of its facilities and demolition debris. Further, the site is able to identify and dispose of clean *portions* of a contaminated facility as non-radiological waste. By implementing this disposition whenever cost-effective and protective, Mound will be able to: (1) reduce disposal costs; and (2) satisfy the requests of its stakeholders, as appropriate, by leaving facilities intact to be reused for economic development.

Note to readers:

As participants in its development, regulators concurred that Mound's release process effectively identifies facilities that can be released intact and demolition debris that can be disposed of in a conventional construction and demolition debris (C&D) landfill without posing a risk to human health and the environment. Upon subsequent review, however, the state regulators (i.e., Ohio EPA and Ohio Department of Health) determined that certain applications of this process would violate the Ohio Revised Code. Based on their interpretation of these state-specific regulations, Mound's regulators determined that disposal of the debris in a state landfill is not allowed if any residual radiological contamination exists above background. Therefore, although regulators agree that the process described in this document ensures protectiveness and is technically sound, DOE MEMP cannot legally dispose of debris with any residual radiological contamination in a state landfill. State regulators have indicated, however, that Mound may be able to use this release process to identify debris that may be placed onsite as clean fill.

Although Mound may not apply this process to dispose of demolition debris with residual radiological contamination in a state C&D landfill, EH-41 feels that the approach should be communicated to other DOE sites. Other sites may not have similar regulatory constraints, and consequently, may be able to use this process for the offsite disposal of debris, in addition to releasing intact facilities and placing debris onsite as clean fill.

FACILITY DISPOSITION REENGINEERING

The issue

Mound recognized that its existing facility disposition process was not well aligned with its mission to exit the site as efficiently and cost-effectively as possible. In an assessment of risks to its exit deadline, Mound identified several facility disposition projects that had a high probability of prolonging its baseline schedule. The approaches described in previous modules have improved its facility disposition process thereby reducing this risk as well as the cost of facility disposition. In addition to these improvements, Mound has determined that the site could improve the overall efficiency of its facility disposition process by integrating safe shutdown and D&D. DOE established these programs when Environmental Management (EM) and Defense Programs (DP) each had separate facility disposition responsibilities. Through its safe shutdown program, DP conducted those activities necessary to stabilize a facility following the end of its mission. Stable facilities were then transferred to EM where the final disposition for the facility was selected, planned, and implemented through the D&D program.

Although EM has now assumed total responsibility for the site, including the stabilization of facilities, until recently, safe shutdown and D&D were operated independently of each other. The activities conducted under these programs were not well coordinated and there was limited communication between parties responsible for these two phases of facility disposition. Consequently, these programs included several overlapping or redundant activities (e.g., characterization, risk/hazard identification, closeout). Further, the site was continuing to conduct activities that were no longer necessary because EM now has full responsibility for the site (i.e., activities conducted to facilitate transfer of facilities from DP to EM).

In addition to the inefficiencies resulting from the separation of safe shutdown and D&D, Mound recognized that it was not working under the CERCLA framework as efficiently as possible.

The approach

Mound has developed an approach for reengineering its facility disposition process that is designed to reduce costs and minimize the risk that facility disposition projects pose to achieving its exit deadline. The site determined that it could improve its process by (1) integrating safe shutdown and D&D so that all facility disposition activities are conducted as a single process; (2) focusing the process on those decisions that must be made to disposition a facility; (3) organizing disposition activities so that they support these key decisions as efficiently as possible; and (4) eliminating unnecessary documentation. In order to develop this approach, Mound:

1) ***Defined the mission/objectives of facility disposition.*** Mound began its reengineering effort by defining specific ways that it could improve its facility disposition process to more effectively fulfill its mission (i.e., objectives of reengineering). Achievement of these objectives served as the focus of the reengineering effort.

2) ***Defined the existing facility disposition processes.*** Mound determined that its process would be more efficient and flexible by focusing the process on making key disposition decisions rather than conducting a set series of activities. In order to pinpoint these key decisions, Mound identified all of the activities conducted under both safe shutdown and D&D, and defined the purpose and intent (i.e., objective) of each activity. Based on this evaluation, Mound defined two separate decision-making frameworks for safe shutdown and D&D (i.e., the series of decisions made in each process and the activities that support each decision). These frameworks served as the basis for identifying opportunities for improvement.

3) ***Identified opportunities for improvement.*** Mound identified all areas where activities did not efficiently support facility disposition decisions. By comparing the decision-making frameworks for safe shutdown and D&D, Mound identified overlap and redundancy in the decisions and activities conducted under these programs. The site also identified activities that are not needed to support facility disposition decisions. Having identified those inefficiencies, Mound eliminated redundant decisions and activities, organized key decisions in a logical, streamlined framework consistent with its mission, and then determined how the necessary activities should be conducted to support these decisions. Mound also incorporated the core team approach and early identification of an appropriate disposition into its revised approach. Finally, Mound determined how it could demonstrate compliance with DOE orders through the CERCLA process and thereby eliminate redundant efforts.

The benefits

Through its reengineering effort, Mound developed an approach for integrating safe shutdown and D&D and improving the general efficiency of its existing process. It is estimated that this approach is capable of improving the efficiency of facility disposition by approximately 30 percent and thereby saving $142 million in total project costs. Through this approach Mound would focus on the decisions that must be made to disposition a facility and conduct activities only as necessary to make decisions.[6]

[6] Mound's reengineered process is consistent with DOE's promotion of the graded approach, as mandated in 10 CFR Part 830, *Nuclear Safety Management*. This approach allows for tailored application of requirements depending on the specific conditions of a project, activity, or facility.

UNCERTAINTY MANAGEMENT

Efforts to improve the facility disposition program at the Mound site are ongoing. In addition to the approaches that Mound is already implementing, the site may apply the uncertainty management approach it uses for environmental restoration (ER) projects to facility disposition. This approach has helped the site to cost-effectively reduce the risk that the uncertainty inherent in environmental remediation poses to achieving protection of human health and the environment and meeting the project's budget and schedule. Under this approach, the site does not attempt to reduce all uncertainties through extensive upfront data collection. Rather, the project manager identifies uncertain factors at the beginning of a project and evaluates the risk that leaving each factor uncertain poses to the success of the project. Based on this assessment, the project manager determines if: (1) the factor can be left uncertain because it poses no risk; (2) the uncertainty should be reduced through additional data collection and analysis prior to implementation; or (3) the uncertainty can be managed during implementation through monitoring and contingency plans. By determining the most appropriate approach for addressing each uncertainty, the site reduces data collection and expedites action while effectively managing project risk.

This module discusses the issues and applicability of uncertainty management to facility disposition projects. The implementation section provides general guidelines for managing uncertainties for facility disposition based on the lessons learned in Mound's application of this approach in its ER program. The ***Notes*** section of this module describes the ongoing remediation of Operable Unit (OU) 4 at the Mound site and the use of uncertainty management to improve this project. This section provides specific examples of the benefits Mound has achieved through use of uncertainty management.

The issues

Based on the cost and schedule benefits that this approach has provided for the site's ER program, Mound is considering applying a similar approach to facility disposition. Two issues challenging facility disposition indicate that uncertainty management approach may be applicable to these projects:

1) ***Encountering deviations from expected conditions during implementation may increase cost and schedule of facility disposition***. If unexpected facility conditions are encountered when a disposition approach is being implemented, the disposition approach may no longer be protective. The project may be delayed and costs will increase if the approach needs to be modified. For example, based on sampling data for a facility, a site may expect chemical contamination to be confined to one area and therefore wash-down only this portion of the facility. If the site detects additional contamination during verification sampling, rework necessary to address these additional areas (e.g., remobilization of personnel and equipment) will delay the final disposition of the facility.

2) ***Full characterization of a facility requires costly data collection and delays implementation.*** Mound is working to reduce facility disposition costs whenever protective and practicable. Attempting to reduce all uncertainty prior to implementation through full facility characterization is costly and time-consuming and may be unnecessary for protective disposition. In some cases, the site may not need to be certain about a factor in order to disposition a facility. For example, if existing information indicates that an entire facility must be disposed of as LLW, the site does not need to know the exact concentration of each radionuclide in each area of the facility.

   In other cases, although a factor must be known eventually it may be protective and cost-effective to leave the factor uncertain and manage this uncertainty during implementation. For example, a site may be unsure if the soil underlying a facility is contaminated and requires a response action. Making this determination prior to demolition would require boring through the foundation of the facility. The site may determine that although the condition of the soil must be known eventually, certainty about this factor is not required in order to begin implementing the disposition option. Therefore, rather than reducing this uncertainty upfront, the site may decide to manage this uncertainty by sampling the soil following demolition and establishing an appropriate response plan to be implemented if contamination is found.

The applicability and benefits of uncertainty management for facility disposition

Application of the lessons learned through Mound's use of uncertainty management in its ER program can provide guidance in successfully resolving the issues discussed above; however, the differences in the application of the approach and the benefits it can provide should be recognized upfront.

In general, there is a higher level of uncertainty associated with environmental restoration than facility disposition. It is difficult for a project manager to make predictions about or accurately determine all of the conditions of contamination in a natural system through upfront data collection. For example, the boundaries of impacted medium may be difficult to define, the different sources and the type of releases may not be known, and/or the behavior of contaminants in the medium (e.g., ability of a chemical to migrate within a soil type) may not be fully understood. Uncertainty management in ER projects allows a project manager to manage the risk that exists because it is impossible to understand or accurately predict the exact conditions of an environmental medium.

Conversely, because a facility is a fixed, engineered structure and there is generally information on the activities conducted within the facility, it is less difficult to predict or determine, through data collection, the conditions that will be encountered. For example, while it may be difficult or impossible to predict the amount of soil that will need to be

excavated and disposed of in order to achieve cleanup levels, the volume of debris generated by disposal of a facility can be easily estimated.

Although it is possible for project managers to more easily resolve uncertainties for facility disposition projects, uncertainty management may nonetheless improve these projects and reduce the risks that uncertainties pose to achievement of project goals. Even with information on the physical conditions of the facility and its process history, uncertainty about the facility conditions and other factors related to disposition may remain. For example, although the project manager may know the total volume of debris that will be generated, the amount of demolition waste that is contaminated such that it must be disposed of as LLW may be uncertain. While it is possible for a project manager to greatly reduce uncertainty about facility conditions through extensive data collection and analysis, these activities may be costly and can comprise a large portion of the disposition schedule (i.e., increase life-cycle costs).

In addition to being costly and time-consuming, resolution of all uncertainties at the beginning of the disposition process is not *necessary* to achieve facility disposition project goals (e.g., protection of human health and the environment, budget, schedule, and regulatory compliance). The uncertainty management approach described in this document allows a project manager to reduce characterization by differentiating among those uncertainties that must be reduced through upfront data collection, those that can be resolved during implementation, and those that have no impact on the project and can be disregarded.

In addition to technical factors, facility disposition projects may involve other non-technical uncertainties that pose a risk to completion of a project within the schedule and budget (e.g., when a project will receive funding or whether regulators will approve of a particular aspect of the disposition approach). Because the risks posed by this type of uncertainty are similar for environmental restoration and facility disposition projects, these uncertainties can be effectively managed through a similar approach.

MODULE 1: THE CORE TEAM APPROACH

Implementation

This module presents the framework for implementing a core team approach for facility disposition, based on its implementation at the Mound site. The participation and level of involvement for each team member will vary depending on the site and the project; however, the following principles are fundamental to this approach:

- The site and its regulators work as a ***core team*** of decision-makers that reaches concurrence on decisions necessary to select and develop a protective facility disposition approach.

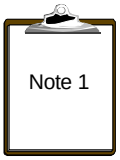
- The ***project team*** (i.e., DOE and its contractors) strengthens the decision-making process by providing the technical input needed to select an appropriate disposition. This involvement is also important because the project team is responsible for implementing this disposition and therefore needs to understand the core team's objectives.

- The site involves ***stakeholders*** as appropriate. In addition to ensuring that it meets CERCLA public participation requirements, the site may solicit specific input from stakeholders (e.g., future landlord) to strengthen decision-making.

Even if a site does not currently have a strong working relationship with its regulators, the following steps will help the site to improve this relationship while expediting decision-making and gaining approval/support from its regulators and stakeholders.

I. Establish the decision-making framework

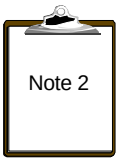
The decision-making framework defines: (1) the key decisions that must be made to determine if action is needed and identify an appropriate facility disposition approach; and (2) the members of the team that should be involved in each decision. By establishing its decision-making framework upfront, the site can determine how the core team approach should be applied to its facility disposition process and thereby develop an appropriate evaluation process (e.g., obtain regulator approval on those decisions necessary).



See Note 1 for a description and graphical representation of the Mound's decision-making framework for facility disposition.

Under the CERCLA removal action framework, regulators must be informed of the disposition approach and provide concurrence that the site has achieved protection of human health and the environment. In order to realize the full benefits of this approach, the site should begin by identifying all decisions that its regulators should be involved in making, given this regulatory authority. In general, this includes any decision that the

regulators must agree with for disposition to be successfully executed (e.g., avoid implementation delays and changes in project direction, obtain concurrence that the final disposition of a facility is protective). After identifying these decisions upfront, the site can work with regulators, as a core team, in reaching consensus on all identified decisions necessary to select and implement a protective disposition option.



See Note 2 for an example of how Mound has reduced the cost and accelerated the schedule for disposition of a facility by reaching upfront agreement with its regulators on these issues.

The site may identify facility disposition decisions that do not require core team consensus. For example, if the site and regulators have determined that the facility is clean and protective under any disposition alternative, the site considers other factors (e.g., cost-effectiveness) in identifying the most appropriate option. As long as protectiveness is achieved, there is minimal risk that regulators will disagree with disposition decisions and block or delay action. (*See Exhibit 1.1*)

Exhibit 1.1: Decisions that may not require core team consensus

The following exemplify decisions that may not require core team consensus but may be strengthened by input from the project team or stakeholders:

- If the core team has agreed, based on existing information, that the facility is protective under any end state, the site may consider input from the future landlord in order to determine if the facility should be reused or demolished and disposed.

- Once the site has determined the additional information the regulators require to substantiate protectiveness for unconditional or conditional release intact, the site may consult the project team in deciding if it is more cost-effective to 1) collect additional data so that the facility can be released; or 2) assume that the facility is not protective and demolish and dispose of as regulated waste (e.g., hazardous, LLW).

Once the decision-making framework has been established, the site initiates and implements the core team approach.

II. Form the core team

The core team should represent all parties with decision-making authority for facility disposition. In general, decision-makers include regulatory agencies from which the site must obtain concurrence on facility disposition decisions (e.g., that the option selected is protective); however, a site may identify additional parties with decision-making authority (e.g., co-owner or potentially responsible party for the site). By including *all* parties with

decision-making authority or veto-power over the project, the site minimizes the risk that the consensus reached by the core team will be challenged by any agency later in the process and that changes in the disposition approach (e.g., additional planning and rework) will be required. In addition, the site can clearly identify all of the regulators' requirements (e.g., data collection) and therefore avoid performing work not needed to obtain concurrence.

The core team is formed so that the site can reach agreement with regulators as evaluation is conducted on how to ensure protective facility disposition. Therefore, it is important that either:

- Core team members have decision-making authority for the regulatory agencies they represent; or

- These representatives have established procedures for quickly obtaining concurrence from the agency's upper management once the core team has come to agreement on an issue.

III. Define guidelines for core team decision-making

In order to realize the full benefits of this approach, the core team must come to agreement on decision-making guidelines that will help team meetings to run smoothly and ensure successful decision-making. Mound has determined that the following guidelines are effective:

- ***Team members commit to attending all meetings.*** Issues that require agreement from all decision-making authorities cannot be effectively resolved unless the entire team is present. If a meeting is not fully attended, the time spent may be unproductive for those in attendance.

- ***The team follows agreed-upon rules for making each decision.*** For example, the team may establish that a unanimous vote is required to resolve each issue. If the team deviates from these rules in particular instances, the legitimacy of the decision may be called into question later in the process.

The core team is more effective if members are committed to decisions that have been made. Therefore, core team members should establish that once a decision has been finalized through agreed-upon rules, it will stand and the team will not revisit this issue. In some cases, however, it may be appropriate to reconsider a decision (e.g., if additional data becomes available that calls into question a core team decision). The core team should define, upfront, what conditions may warrant reconsideration of a finalized decision.

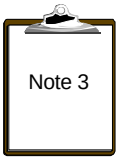
Once the core team approach is initiated, the site and/or core team may determine how to strengthen decision-making by involving the project team and future landlord through participation on the extended project team.

IV. Define the role of the project team

Based on the input and support it needs, the site and/or core team determines the extent and timing of involvement of technical personnel/contractors. Generally, the project team is involved throughout the decision-making process and provides the core team with technical information needed to support decision-making. The core team works closely with the project team in making decisions to ensure that: (1) its approach is technically defensible; and (2) the personnel executing the approach understand the core team's decisions so that they are properly implemented (e.g., collect specific data necessary to fulfill regulatory requirements). Although the project team provides critical input in determining the disposition option, these individuals do not have a vote in making decisions. After providing input, they must be willing to step aside and allow the core team to resolve the issue.

V. Involve stakeholders

The core team should determine the appropriate approach for involving different stakeholders in the decision-making approach. If a site is pursuing exit and has identified a future landlord, the site determines how this stakeholder should be involved in making facility disposition decisions. For example, a site may determine that although a facility has only low levels of contamination, pursuing release of the facility intact is not worthwhile if the future landlord has no interest in reusing it. In this case, input from the future landlord will allow the site to identify the most appropriate facility disposition. Mound has determined that working with its future landlord during the decision-making process will ultimately facilitate site exit.



See Note 3 for information on how Mound has solicited input from its future landlord.

VI. Apply the core team approach

The core team approach is flexible; the site determines, based on the decision/issue being addressed, which of these key players should be involved and the proper role and extent of involvement. The participation and input needed from members of the team in making each facility disposition decision varies depending on the issue that is being addressed.

In addition to achieving cost and schedule benefits for specific projects, the site can use this approach to tackle issues common to many facility disposition projects that require regulator approval. For example, if numerous facilities at a site are contaminated in a similar manner, the site can obtain regulator approval on: (1) how to determine if a problem exists; (2) the response action necessary to address the problem; and (3) the data needed to verify that the action has been successfully implemented. Each time a defined

problem is encountered, the site can immediately proceed with action and substantiate that the action has successfully addressed the problem, based on its upfront agreement with the regulators. For example, if a site contains numerous facilities that were used for testing explosives, it may get upfront concurrence from its core team that this process history knowledge, in and of itself, is sufficient to define that a problem exists. The core team may also agree that, following a wash down, the facility will be protective of human health and the environment as long as the required verification substantiates that the agreed-upon action has been successful (e.g., that rinse water is sampled and does not contain hazardous constituents above a defined level).[7]

The approaches identified by Mound and described in this document rely on applying a core team approach. The following modules highlight the specific benefits of regulator and stakeholder involvement in facility disposition.

[7] This generic approach for addressing environmental problems is encouraged by DOE. For further information about this type of approach, see the fact sheet entitled *Expediting Cleanup through Contingent Removal Actions* [DOE/EH/(CERCLA)-003] issued jointly by DOE and EPA. To obtain a copy of this document, access the EH-41 website (http://www.eh.doe.gov/oepa/).

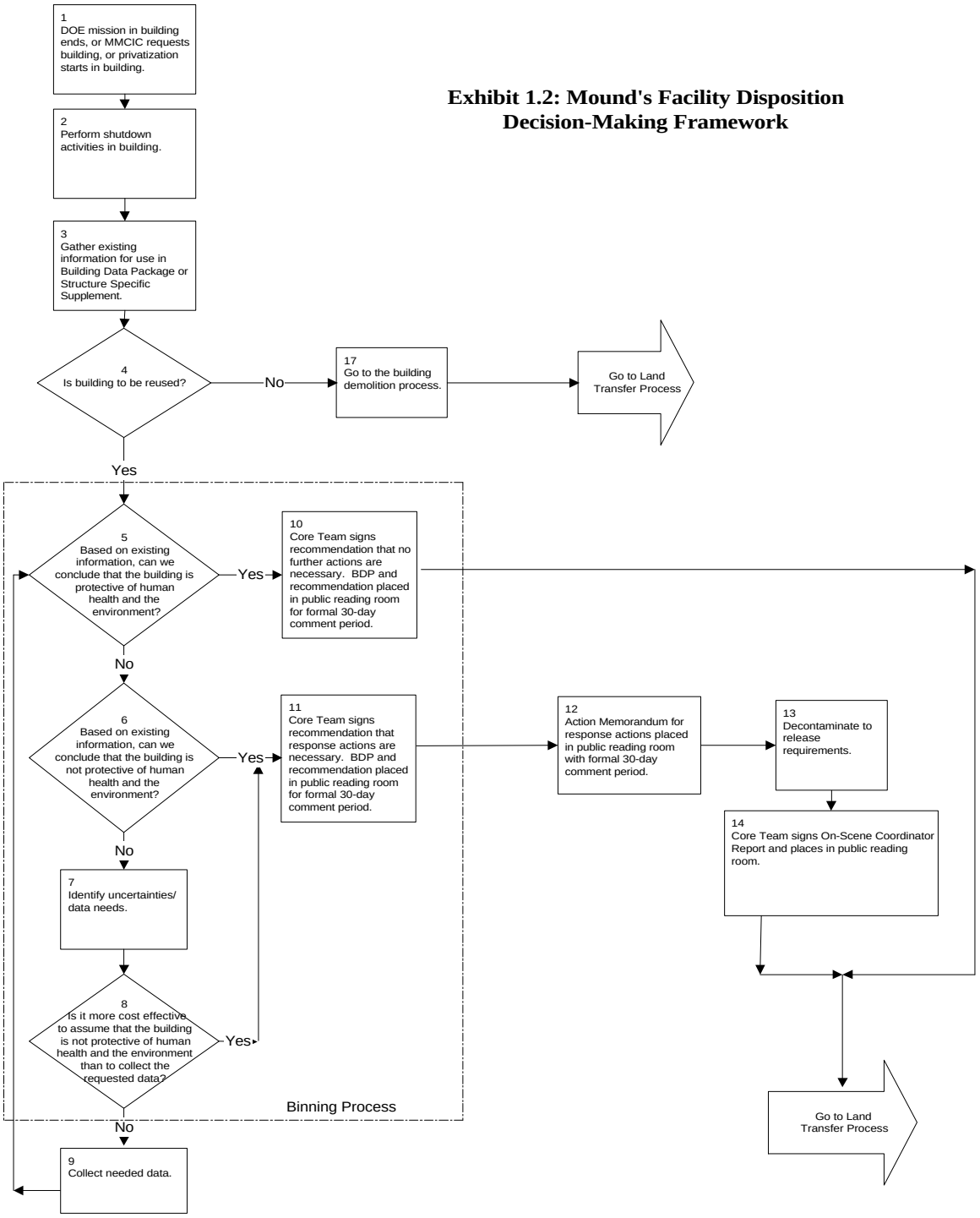
Notes

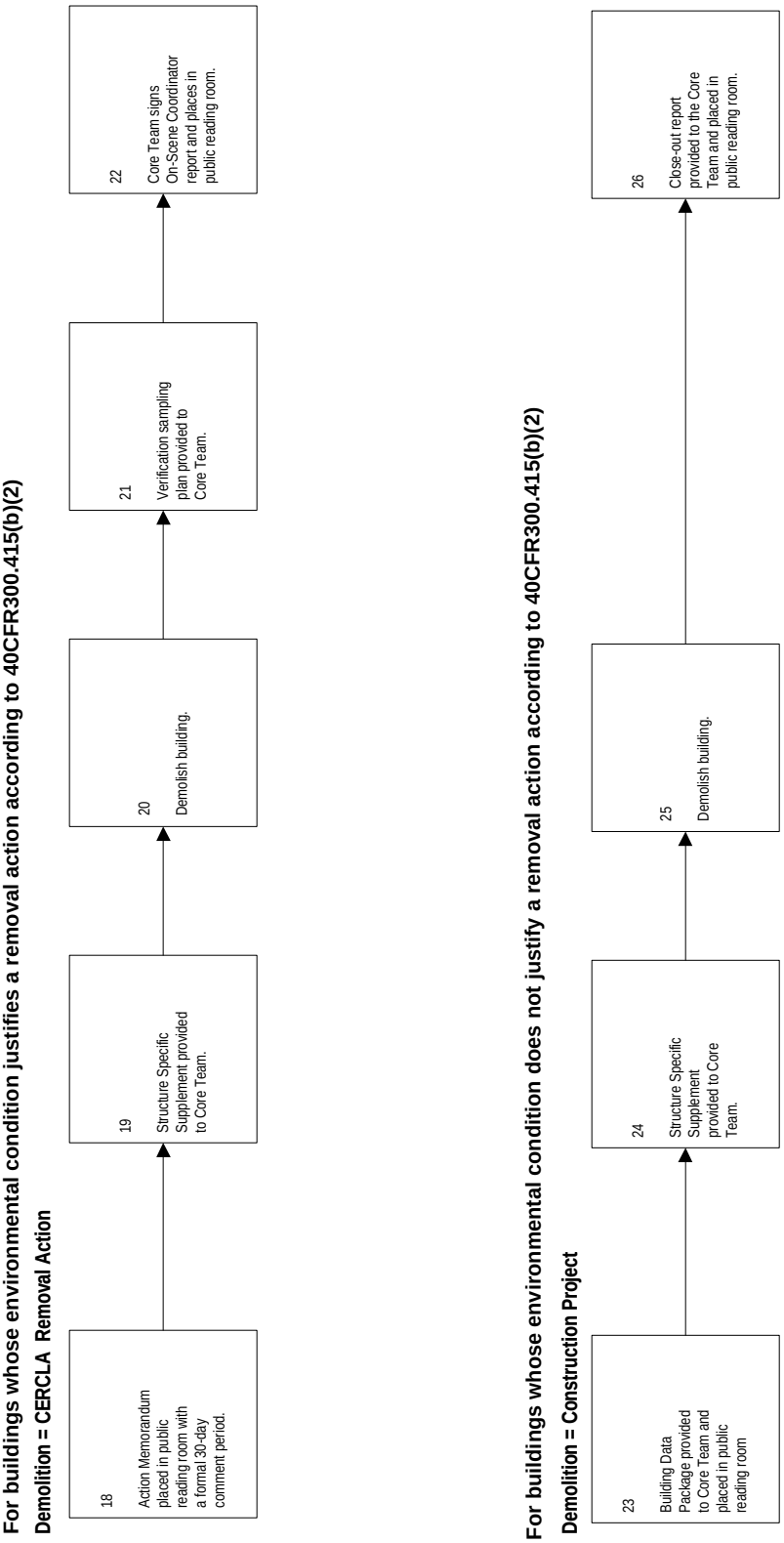
1. Establish a decision-making framework using the core team approach

Mound has established a decision-making framework that expedites determination of the most appropriate disposition option for a facility. In order to develop this framework, Mound identified those decisions for which regulator approval is required (i.e., lack of approval could block or delay progress) and those points in the disposition process where input from the future landlord is beneficial. Exhibit 1.2 illustrates Mound's decision-making framework and indicates where the core team, project team, and the future landlord are included in this process.

Inclusion of core team members upfront allows Mound to reduce costs and move a facility disposition project more quickly to implementation. For example, rather than assuming that characterization is required prior to determining the appropriate disposition option, Mound works with its core team members to determine which facility disposition decisions can be made based on existing information. The core team first assesses if existing information can substantiate that a facility is protective of human health and the environment without decontamination. The core team then determines if it can conclude that the facility is ***not*** protective, and therefore requires action (e.g., decontamination, demolition for disposal). When existing information cannot substantiate either of these decisions, Mound's core team identifies what specific data is required to make this determination. Prior to collecting this information, the site determines, based on the type and amount of data collection that will be needed, if taking action (and therefore assuming that a problem exists) is more cost-effective than collecting the identified data to determine if a problem exists.

Exhibit 1.2: Mound's Facility Disposition Decision-Making Framework





Exibit 1.3: Mound's Building Demolition Process

2. Example of a benefit achieved through application of the core team approach at Mound

By working with regulators as a core team, Mound was able to reduce costs and schedule for Building 87.

Building 87 was constructed in 1985 and was used for destructive testing of explosives and fabrication of electronic test systems to support weapons production. The building contains office space, a cafeteria, three large explosive test cells, the electronic equipment to operate the test cells, environmental chambers, and rest rooms. It also contains three surge tanks used for dissipation of explosive energy during testing.

In the original baseline planning documentation (e.g., Ten Year Plan), Mound assumed that decontamination of Building 87 would be required (i.e., wash down the building for hazardous constituents), costing approximately $251,000. After an evaluation of existing information, the core team determined that any potential contamination was restricted to the building's ducts and surge tanks. These areas are inaccessible to potential receptors (e.g., future building occupants). The core team concluded that because potential contamination is inaccessible, there is no exposure route, and, consequently, no risk. Further, decontamination prior to reuse would be inappropriate, because the activities that will be conducted in the building (i.e., explosives testing) will result in similar contamination. As a result of this evaluation, the core team determined that the building, in its current state, is protective of human health and the environment for industrial use. Because decontamination is unnecessary, the cost and schedule originally estimated to decommission this building have been reduced (i.e., $251,000). To ensure protection, the building will be transferred with deed restrictions limiting the future owner from modifying the building in a way that exposes existing contamination.

3. Soliciting input from the future landlord

The Miamisburg Mound Community Improvement Corporation (MMCIC), a non-profit organization formed by the City of Miamisburg, is in the process of developing the strategy for economic redevelopment of the Mound site (e.g., identifying future tenants, identifying desired facilities for reuse). After potential tenants express interest, MMCIC communicates to the site what facilities it would like transferred intact for reuse. If transfer intact is a potentially protective and cost-effective option for a facility, Mound considers pursuing this option. Mound solicits input from MMCIC through the Sale of the Site Team; this team's role is illustrated in Exhibit 1.2 in Note 1 of this module. This upfront input allows Mound to effectively consider and reflect, when appropriate, the interests of the future landlord in facility disposition decisions. Mound considers MMCIC input in determining the schedule for facility disposition. For example, if MMCIC has already identified future tenants for a facility that the core team has determined can be released intact, Mound may prioritize completion of work for this facility. Further, by communicating with MMCIC, the future landlord clearly understands why the site is taking certain actions.

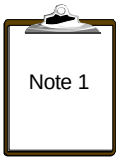
MODULE 2: EFFICIENT IDENTIFICATION OF AN APPROPRIATE DISPOSITION

Implementation

Based on the lessons learned at the Mound site, this module describes how a site may reduce data collection and expedite action by identifying the appropriate disposition as efficiently and early in the decision-making process as possible. In order to achieve the full benefits of this approach, the site should work with its regulators as a core team in making all decisions that are necessary to determine if a disposition is protective of human health and the environment. (*See Exhibit 2.1*) Below are basic guidelines for a site to follow in implementing this approach:

I. Evaluate existing information to support facility disposition decisions

Evaluation of existing information is the starting point in answering questions necessary to determine the appropriate disposition. To the extent that a site can use this information make this decision, it reduces or eliminates the need for future characterization efforts. Even if existing data is not sufficient to conclusively determine the appropriate disposition, it may nonetheless help a site to identify the specific steps needed to make this determination. Existing information may be available from a number of sources, including inspection and operations records, and site maps and facility drawings. Knowledge of a facility's process history will also help a site to determine the contaminants present and the degree of contamination.



See Note 1 for an example of the information that Mound compiles and evaluates to support early identification of the appropriate disposition.

II. Identify the appropriate disposition OR define range of options

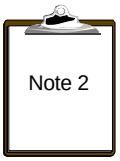
Based on existing information, a site can often identify the appropriate disposition for a facility or define the range of realistic options. The site makes this determination based on the following factors:

- ***Protectiveness:*** Based on existing information, a site can often immediately identify those disposition options that are protective of human health and the environment and eliminate those that are not. For example, if a facility contains widespread radiological contamination, release of the facility or its debris in its current state will not be protective. For this facility, the only protective options are demolition for disposal in an appropriate facility or decontamination to protective levels. Conversely, if a site can substantiate through existing information that a facility is clean, both release intact and demolition and disposal of debris as non-radiological waste are protective disposition options.

- ***Cost-effectiveness:*** Budget restrictions necessitate that a site disposition its facilities as cost-effectively as possible. Therefore, once the range of protective

disposition options is defined, the site should identify the least costly option. The site may be able to make this determination based on existing information. For example, if it is clear that there is widespread contamination in a facility, the site may be able rule out decontamination to allow for release because it will be too costly.

If existing information is not sufficient for a site to fully evaluate these factors and identify the appropriate disposition, the site should define the range of feasible options in order to focus further evaluation.



See Note 2, which illustrates how Mound incorporated efficient identification of an appropriate disposition into its facility disposition process.

Exhibit 2.1: Using the core team approach to identify an appropriate disposition

In order to streamline data collection and reduce the risk of late-stage regulator disagreement the core team should be involved in:

- **Upfront evaluation of existing information.** At this early stage, the site can begin to identify the regulators' concerns and data requirements for substantiating protectiveness. Similarly, the regulators become familiar with the basis for the site's approach to disposition, which may minimize documentation.
- **Identification of any additional data needed to determine the disposition.** If existing information is not sufficient for the site and its regulators to identify an appropriate disposition, these decision-makers agree on the specific additional data needed.
- **Selection of the appropriate disposition.** Whether this decision is made based on existing information or after additional data collection, the site should ensure that regulators agree that the disposition is protective before moving forward with the project.

In addition to obtaining regulator agreement, the site should solicit participation from its stakeholders during, rather than after, the appropriate disposition is selected. For example, if the site and its regulators have agreed that a facility is protective for release and reuse, a site pursuing exit may solicit input from the future landlord to determine if there is interest in reusing the facility. Although cost-effectiveness must be the primary criterion, the site may consider this input in determining the most appropriate disposition. By obtaining this input early, the site can ensure that the interests of the future landlord, public interest groups, and other stakeholders are taken into account in identifying the appropriate disposition.

III. Focus evaluation to identify the appropriate disposition from a range of feasible options

If existing information is insufficient to determine the appropriate disposition option, additional data collection and evaluation may be required. The following methods may be useful in focusing these activities in order to select the most appropriate disposition as efficiently as possible:

- ***Data collection:*** The site may be unable to identify the appropriate disposition because there is insufficient information on facility conditions (e.g., level and extent of contamination or the physical conditions of the facility). In this case, the site can make its data collection effort more efficient by identifying:

    1) Those facility conditions that are the ***determining factors*** in choosing the appropriate facility disposition; and

    2) The specific ***thresholds*** that indicate when one disposition is more appropriate than another.

Exhibit 2.2: Identifying the specific data needed to select between potential disposition options

The following is an example illustrating the process of identifying the ***determining factor*** and ***threshold*** for a specific facility.

Using existing information, a site determined that the following options will achieve protectiveness for a facility: (1) decontamination for release intact, based on criteria established in DOE Order 5400.5; or (2) demolition for disposal as LLW. The site then performed the following steps to identify the specific data needed to determine which of these protective options costs less:

1) **Identified the determining factor:** The site determined that if decontamination beyond 1 inch is required to allow for release, then this disposition option will be more costly than demolition and disposal as LLW. Therefore, the depth of contamination is the ***determining factor*** in choosing the least costly disposition. Conversely, because the actual concentrations of the radionuclides present do not impact the relative costs of either option, the specific concentrations of each radionuclide are ***not*** a determining factor.

2) **Defined threshold:** In order to determine which of the two protective disposition options is less costly (release intact or demolition for disposal), the site only needs to know whether the depth of contamination is above or below 1 inch; determining the specific depth is unnecessary. Therefore, 1 inch is the ***threshold*** at which one facility disposition is preferable over the other.

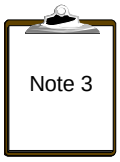
One way a site can focus data collection on identifying the appropriate disposition is to establish a decision rule agreed to by its regulators.[8] The decision rule establishes the specific information that the core team agrees is necessary to identify and substantiate the appropriate disposition for a facility. By establishing a decision rule or set of rules, the core team comes to agreement on: (1) the factor key to determining a disposition is appropriate; (2) the threshold at which one disposition becomes preferable over another; and (3) the method for obtaining the data needed to substantiate which facility conditions exist.

[8] For more specific information on using a decision-rule DOE's *Remedial Investigation/ Feasibility Study (RI/FS) Process, Elements, and Techniques Guidance* and DOE's *Phased Response/Early Actions Guidance*. To obtain a copy of this document, access the EH-41 website (http://tis-nt.eh.doe.gov/oepa/).

Exhibit 2.3: An example decision rule

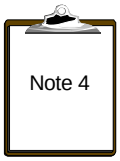
The following is an example of a decision rule for the scenario presented in Exhibit 2.2:

If the depth of contamination (determining factor) exceeds 1 inch (threshold) as determined by one core sample per each wall, taken at a depth of 1.1 inches in the area known to have the highest level of surface contamination (method for obtaining data), then the facility will be demolished and the debris disposed of as LLW (the appropriate disposition).



See Note 3 for an example of Mound's use of a decision rule to assess a facility for release.

- ***Cost evaluation:*** In some cases, a site may know that all of the options in the defined range are protective; however, it may not be obvious which of these options is the least costly. Without conducting a detailed cost estimate, the site can use existing information to approximate the relative costs of each of the protective options through an order of magnitude cost-benefit evaluation. This analysis allows the site to eliminate cost-prohibitive alternatives from consideration and determine the most cost-effective way to disposition the facility.



See Note 4 for a description of an order of magnitude cost-benefit evaluation conducted by Mound.

IV. Uncertainty management in implementing a selected disposition

Once a disposition has been identified, a site may expedite implementation by distinguishing those factors that need to be known prior to execution of the disposition from those that do not. This concept is similar to the method by which a site efficiently identifies the appropriate disposition by focusing on the determining factors. Under an uncertainty management approach, the site:

1) Identifies the conditions it expects to encounter during implementation (i.e., ***expected conditions***)

2) Defines the realistic ways in which actual conditions may deviate from these expectations (i.e., ***reasonable deviations***)

3) Evaluates the ***probability*** that a deviation will occur and the ***impact*** of the deviation on the effectiveness of the disposition option

Based on the evaluation of the reasonable deviations, the site differentiates among those factors that:

1) ***Must*** be understood before implementing a disposition approach;

2) ***Can*** be managed during implementation through monitoring and upfront contingency planning; and

3) ***Can*** be ignored because it is unlikely that they will occur or they have no impact on the effectiveness of the disposition.

(Module 4 describes in detail the general principles of uncertainty management and explains how this concept can be applied to expedite implementation of facility disposition.)

V. Achieve programmatic benefits

By identifying the dispositions for a number of its facilities, a site may improve the management of its facility disposition program. Coordination of similar disposition efforts that are in close proximity allows a site to minimize personnel and equipment mobilization costs. In addition, early identification of the appropriate disposition for a set of facilities may help a site to expedite baseline schedules by prioritizing projects so that those with the longest expected schedules are conducted first.

Notes

1. Existing information compiled and reviewed by Mound to support facility disposition

In order to support early identification of the appropriate disposition and reduce necessary data collection activities, Mound compiles and evaluates all existing information on a facility. This information is gathered by conducting interviews with technical contractors and reviewing existing sources of information. These sources include facility inspection records, historical aerial photographs and maps, federal and state regulatory agency records, and Mound site records.

Mound compiles the results of its evaluation of existing information into a Facility Data Package which provides the core team and technical personnel with easy reference to the facility information that is already available. This document may include the following types of information:

Presence and level of contamination: Existing sources may provide specific information on the presence and concentrations of contaminants in a facility. Mound may include in the package:

- A history of spills and releases
- Past sampling data (including radiation surveys and chemical history)
- Information on known lead, asbestos, or radon sources in the facility

General facility inspection information may be helpful in developing expectations about contaminants that may be present in a facility; for example, the data package may include:

- An inventory of hazardous substance containers and unidentified substance containers
- A list of hazardous substances may be associated with various uses/materials in the facility (e.g., heating/cooling system, drains and sumps, wastewater)
- Any indications of PCBs or solid waste disposal

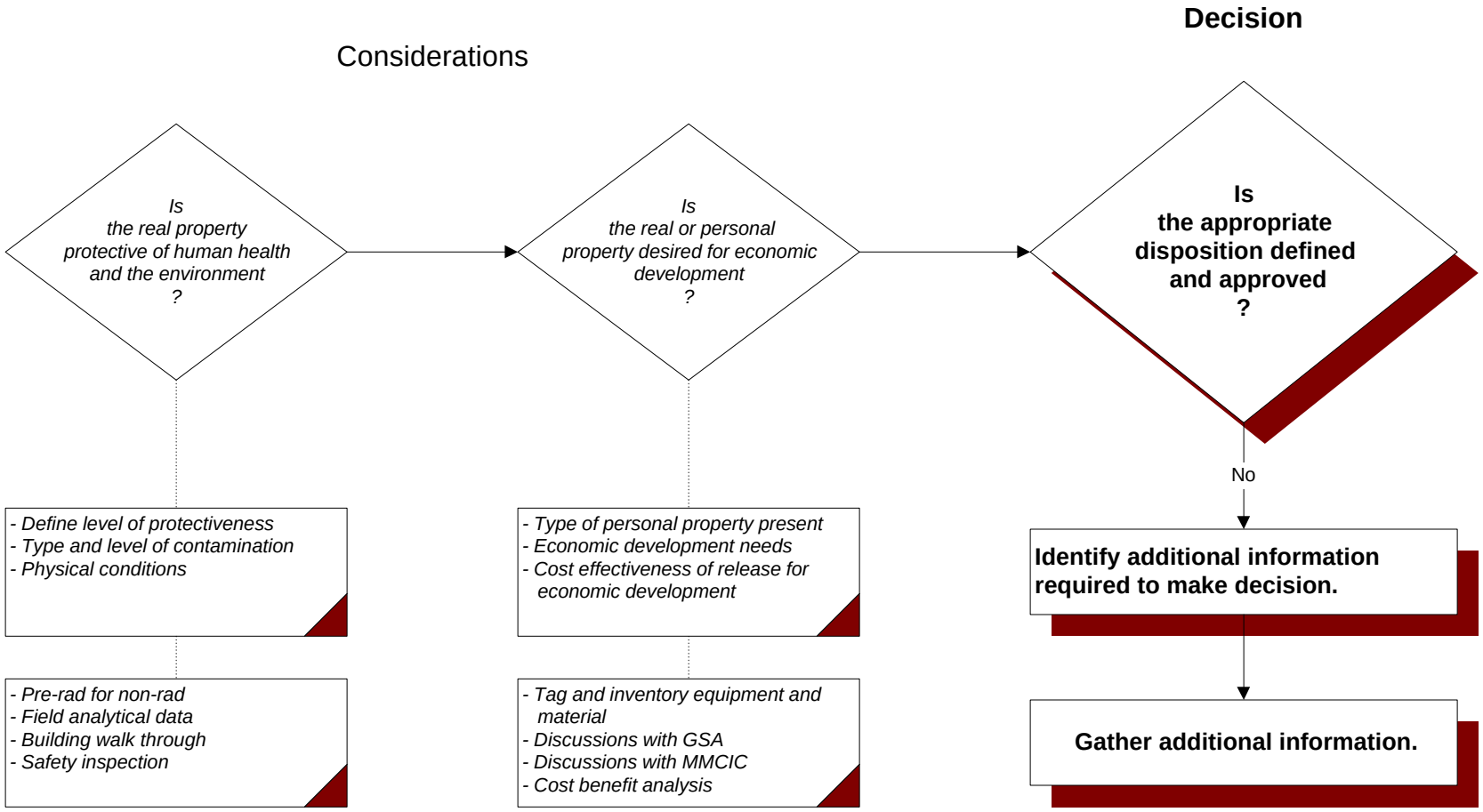
The physical condition of the facility and state of the surrounding structures/areas. In order to facilitate this assessment, Mound may compile information on:

- Past and current uses of the facilities
- Uses of adjacent facilities
- Descriptions of structures, roads, and other improvements associated with the facility
- Information reported by user regarding environmental liens or specialized knowledge or experience

2. Incorporating early identification of an appropriate disposition into the facility disposition process

Through its reengineering process, Mound determined that early identification of the appropriate disposition often reduces the subsequent activities that are needed to proceed with facility disposition (e.g., by linking characterization with collection of data required for implementation), and consequently expedites action. In order to achieve these benefits, Mound incorporated this approach into the reengineered facility disposition process by including this decision point (i.e., the determination of a appropriate disposition) early in the process. (*See Exhibit 2-4*.)

Exhibit 2-4: Identifying the appropriate disposition



3. An example order of magnitude cost-benefit evaluation

Under the Building 21 pilot project, Mound evaluated the possibility of release of facility debris for disposal as non-radiological waste rather than as low-level waste (LLW). Because demolition costs are the same for both options, Mound recognized that release would only be cost-effective if the savings achieved by disposing of debris as non-radiological waste rather than LLW exceeded the cost of any necessary decontamination and verification. Therefore, Mound conducted an order of magnitude cost-benefit evaluation to estimate the potential savings it could achieve through release of building debris. The following summarizes the results of this evaluation:

Disposal Facility	Total Cost
1. Envirocare - disposal as LLW hauled by lined railcar	$174,219
2. Local industrial landfill - disposal as non-rad waste	$14,808
Potential savings	***$159,411***

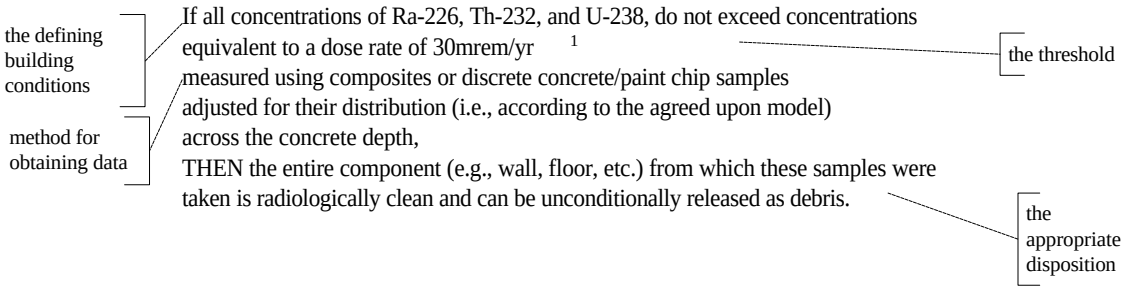
Mound estimated that decontamination, including air monitoring and labor for scabbling 100 percent of the interior walls, would cost approximately $179,570. This estimate does not include the cost of verification sampling and obtaining regulatory approval. Because only $159,411 would be saved by disposing of the debris as non-radiological waste, it is more cost-effective to leave contamination in place and dispose of the debris as LLW.

Through this cost estimate, Mound was able to reduce the range of feasible disposition alternatives to demolition and disposal of debris as non-radiological waste if the building meets release criteria *without* decontamination; or demolition and disposal of debris as LLW.

4. Use of a decision rule to assess a facility for release

Establishment of decision rule

During the Building 21 pilot project, the site used the following decision rule to determine if the building was appropriate for release without decontamination:



Application of decision rule

Because Mound had already conducted extensive destructive sampling for this building, there was sufficient existing information for the site to evaluate the building based on this decision rule (i.e., to determine if the contamination concentrations in the facility meet the specific criteria equivalent to a 30 mrem/yr dose limit). *(See Notes 4 and 5 in Module 3 for a detailed discussion on how Mound derived specific criteria from a dose limit.)* By comparing the data on concentrations in the building to the derived criteria, Mound determined that the building *is not* appropriate for release without decontamination. Because decontamination is too costly (*See Note 3*), the site determined the appropriate disposition for Building 21 was demolition and disposal as LLW.

[1]Mound conducted this evaluation to determine if debris from Building 21 may be released concurrent with discussions with regulators on the appropriate dose limit. Because Mound's regulators had not reached agreement on the appropriate dose limit, the 30 mrem/yr dose limit was used to conduct this evaluation with the recognition that the dose limit the regulators ultimately agree on may be lower.

MODULE 3: RELEASE OF FACILITIES WITH RADIOLOGICAL PROCESS HISTORY

Implementation

This module describes a general framework for efficiently identifying those facilities with radiological process history that are appropriate for release either intact or as demolition debris, and substantiating to regulators that this disposition is protective of human health and the environment.

By using this framework, a site can effectively design a release disposition approach that addresses regulator concerns and requirements. *(See Exhibit 3.1)* The basis for this framework is identification of criteria that regulators agree are appropriate for release. Consequently, the first portion of this section focuses on considerations for identifying and deriving release criteria. Following establishment of release criteria, this section describes the following methods to improve the efficiency of a release process:

- ***Gain regulator approval*** on the release of a facility and minimize the risk of rework by ensuring upfront and continual involvement of all decision-makers through a core team approach.

- ***Focus data collection*** on determining if release of the facility in its current state is protective (i.e., meets criteria) and, if not, identifying the level and extent of decontamination necessary to achieve protectiveness;

- ***Evaluate if release is cost-effective***. The release disposition is only appropriate if the cost of activities necessary to implement this option (e.g., data collection and decontamination) is less than the savings achieved (i.e., money saved by disposing of debris as non-radiological rather than LLW or releasing the facility intact).

Exhibit 3.1: Use of a core team to establish release options

To successfully release a facility intact or as debris, regulators must agree that this disposition is protective of human health and the environment. Under a core team approach, a site obtains upfront and continual input from regulators on their requirements and concerns for release dispositions (*See Module 1 for guidelines on implementing a core team approach*). This approach allows the site to define with its regulators what data are necessary to substantiate release and, if required, a methodology necessary to derive release criteria (e.g., dose limit, exposure scenario). All agencies with the authority to decide when a facility is radiologically clean and ready for release, and what data is required to substantiate that determination, should be represented on the core team.

By communicating with regulators upfront, the site may determine that the decontamination and data collection necessary to meet regulators' requirements will cost more than the savings achieved through release of a facility. This determination allows the site to eliminate upfront those facilities that cannot be cost-effectively released. When release is cost-effective, continuing to involve regulators throughout the evaluation process reduces the risk that the site will spend time and money pursuing release only to fail to obtain regulator approval to implement this option.

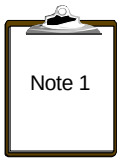
Part I. Identify appropriate criteria

If there is any potential for radiological contamination in a facility, the most straightforward method for determining if release is protective is to compare data on the facility's level of contamination with release criteria that regulators have agreed are protective of human health and the environment. Generic criteria, established in DOE Order 5400.5, can be used to determine if unconditional release of a facility intact is protective of human health and the environment.[2] However, generic release criteria do not exist for: (1) disposal of demolition debris as non-radiological waste; (2) recycling of facility materials; (3) release an intact facility with bulk/volume contamination; and (4) release an intact facility for conditional use.

When generic criteria do not exist, there are two methods for establishing release criteria:

1) determine if existing criteria are appropriate; or
2) derive criteria based on a dose limit.

Even if generic criteria do not exist for the specific selected end use of a facility, a site may not need to derive criteria based on a dose limit. Rather, if a site and its regulators can agree that existing criteria, established for a different end use, are appropriate, these criteria can be used. For example, generic criteria do not exist for the ***conditional*** release of an intact facility, but a site and its regulators may determine that the criteria established in DOE Order 5400.5 for the ***unconditional*** release are also appropriate for a conditional end use. Conversely, the site and its regulators may determine that the criteria in DOE Order 5400.5 are overly conservative based on the deed restrictions that will limit the future use of the facility. Rather than use these criteria, the site and its regulators may decide to derive criteria specifically for conditional release.



See Note 1 for information on the release criteria that Mound is using to conditionally release intact facilities for reuse

[2] Unconditional release criteria, established in DOE Order 5400.5, are for facilities with surface contamination. These criteria are not intended for facilities with radiological contamination in bulk.

Exhibit 3.2: Considerations for deriving release criteria from a dose limit

- ***Dose limit protective of human health and the environment.*** This dose limit is the basis for ensuring that release is protective of human health and the environment. Since the EPA, the Nuclear Regulatory Commission (NRC) and DOE have not concurred on an appropriate dose limit at a national level, the site and its regulators (i.e., the core team) must agree on what is protective.

- ***Appropriate exposure scenario.*** To accurately estimate the contaminant concentrations that will ensure that the dose limit is met, the site and its regulators (i.e., the core team) must identify the probable exposure scenario (i.e., how radioactivity may reach human and environmental receptors). In addition to the parameters which will be the same for all of a site's facilities, there are facility-specific factors which impact the dose that must be defined (e.g., specific radionuclide contaminants, porosity of facility material, volume of waste).

- ***Effective modeling system.*** Given the parameters of the exposure scenario, the site models the transport of contaminants to identify the contaminant concentrations in a facility that correspond to the agreed-upon dose limit. For example, if a site is deriving criteria for release of demolition debris in a landfill, the site should use a model which has dose assessment capabilities and is capable of evaluating contaminant migration in soil.

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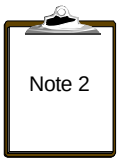
There are considerations specific to release of demolition debris for disposal as non-radiological waste. Because demolition debris will be disposed of in a landfill, the potential exposure pathways are different than those associated with release of an intact facility. If contamination exists within the building material (e.g., within a concrete wall of a facility), exposure pathways could be created by demolishing the facility. Consequently, the release criteria for disposal of demolition debris from a facility with radiological process history should be based on the concentration of contaminants in the entire volume of material.

Exhibit 3.3: Additional considerations for deriving release criteria for demolition debris

Through use of the modeling system, a site determines the total volume concentration that each contaminant must be below in order to meet the appropriate dose limit. Prior to using these criteria to evaluate a facility for release as debris, the site should:

- ***Determine if total volume concentration criteria are appropriate.*** These criteria represent the level of radionuclides that can be present in the total volume of demolition debris. In order to measure the *total volume* concentration of contaminants in facility material while the structure is intact, core sampling is required. If many areas of the facility will have to be sampled to ensure that release of debris is protective, this sampling method will likely be cost-prohibitive. Alternately, the site may extrapolate *near-surface* concentration criteria from the *total volume* criteria, based on assumptions about the distribution of contamination through the wall/floor. The concentration of contaminants at the surface of the wall can be determined relatively inexpensively (e.g., through chip sampling).

- ***Ensure that the minimum detection limit of the survey equipment is below the release criteria.*** If equipment is unable to determine if concentrations are below the criteria, the site may be able to avoid investing in new equipment by converting total volume criteria to near-surface concentration criteria. In making this conversion, the site must be able to make the assumption that radiological contamination is concentrated near the surface of the wall.



See Note 2 for information on the release criteria that Mound is finalizing with its regulators to release demolition debris from its facilities.

Part II. Improve the efficiency the release process

1. ***Evaluate existing information to identify path forward.*** Existing information may be sufficient to assess contamination levels and the cost-effectiveness of release. By using existing information as a starting point in evaluating a facility, the site can make the most efficient use of its resources in determining if it is appropriate for release. Because regulators are involved in evaluating this information, the site is able to either (1) decide upfront if a facility can be protectively released (with or without prior decontamination) for reuse or disposal as non-radiological waste; or (2) identify the specific additional information needed to determine if a release disposition can be pursued.

   Through evaluation of existing information, the site is able to do one of the following:

- ***Eliminate release as an appropriate (i.e., feasible, cost-effective) disposition for the facility.*** Implementation costs are incurred if: (1) decontamination is necessary to achieve release criteria; and/or (2) data collection is required to substantiate that release is protective. By evaluating existing information the site may determine that these costs exceed the savings afforded by this disposition option. Elimination of this option upfront, allows the site to avoid potentially costly and time-consuming additional characterization.

- ***Substantiate that release is protective.*** Regulators may concur that a facility is protective of human health and the environment based on existing information alone. In these cases, the site need only determine if a facility should be released intact or demolished for disposal based on cost and, if appropriate, the interests of future landlords.

- ***Determine that release is appropriate following decontamination.*** Through existing information, the site may be able to: (1) define the specific areas that must be decontaminated to meet release criteria and satisfy regulator concerns; and (2) conclude that this is a cost-effective disposition approach.

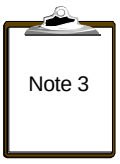
- ***Identify the additional data needed to determine if release is appropriate (i.e., protective and cost-effective).*** Existing information may not be sufficient to conclusively determine if release of the facility is appropriate; however, the site may determine that it is worthwhile to further evaluate the facility for this disposition. Through a review of existing information with the regulators, a site may identify the specific data necessary to pursue release and thereby expedite this evaluation as described in the next step. *(See Module 2 for additional guidelines on use of existing information in determining an appropriate disposition.*)

2. ***Focusing additional evaluation.*** For some facilities, existing information may not be sufficient to determine if release is feasible or cost-effective. The site may focus further evaluation by:

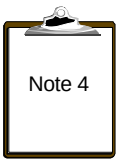
    - ***Determining, if possible, whether the appropriate disposition is demolition and disposal or release intact.*** The criteria for release intact, established in DOE Order 5400.5, are measured in terms of surface contamination (e.g., disintegrations per second) and dose rates (mrad/h). These data can be collected without destructive sampling. In contrast, for release of demolition debris derived from a dose limit, a facility must meet concentration criteria (e.g., picocuries/gram), which is generally obtained by taking chip samples. By determining the disposition upfront, the site can focus data collection on obtaining the type of information (e.g., destructive or non-destructive sampling) necessary to substantiate release.

    - ***Forming expectations about the facility's level and extent of contamination.*** The site and its regulators (i.e., the core team) may not be able to determine the appropriate disposition of a facility based on existing information, but may come to

agreement on expected facility conditions and the appropriate path forward if these expectations are confirmed. The core team should then identify the data needed to verify its expectations and proceed with implementation. If the expectations are not confirmed, the core team can reevaluate its options and approach based on this new information. For example, a core team may expect a facility to be clean but determine through a confirmatory survey that there are areas with contamination above existing release criteria. Depending on the level of contamination, the site may eliminate release as a feasible disposition option or determine that release can be pursued through either decontamination or segregation of clean portions of the facility. If the site decides to pursue a release disposition, the data from the confirmation survey may be used in delineating those areas that must be decontaminated or segregated for disposal.



See Note 3 for a description of the process that Mound developed with other Ohio federal facilities that uses evaluation of existing information to expedite evaluation of facilities with radiological process history.



See Note 4 for a description of the pilot project that Mound conducted. The pilot project evaluated a building through the process developed by Mound and other Ohio federal facilities to evaluate release of facilities with radiological process history.

Notes

1. Criteria for conditional release of an intact facility

Mound and its regulators determined that the criteria established in DOE Order 5400.5 are appropriate to release intact facilities for conditional use. The facilities that remain intact when the Mound site is transferred must be used in accordance with the deed restrictions for the site and, consequently, will be used only for industrial use. However, Mound and its regulators have determined that using existing criteria, established for unconditional release (i.e., levels protective for ***any*** use), not only ensures protection of human health and the environment, but is a less costly option than deriving separate criteria.

2. Criteria for release of demolition debris

Mound is finalizing with its regulators its process for releasing demolition debris from facilities with radiological process history. Specifically, Mound is determining appropriate data to substantiate release. The following discussion lays out the requirements for release of concrete as clean debris based on the expected conditions.

If a facility is ***expected to be clean***, Mound must verify, through a non-destructive survey over a limited or gross area (i.e., a confirmatory survey), that no unexpected contamination exists. The equipment used for this type of survey measures disintegrations per minute (dpm) or disintegrations per second (dps). If no radiological surface contamination is detected, the facility may be demolished for disposal in a landfill.[3]

If a facility is ***potentially contaminated***, Mound must verify that demolition and disposal is protective by comparing the level of activity in the concrete against criteria derived from a dose limit. Concrete chip samples from potentially contaminated areas must be taken and analyzed to determine the concentrations of specific radionuclides present. Mound, OEPA, and ODH agreed that these criteria need to be: (1) based on a resident scenario (rather than a resident farmer scenario since crops cannot be grown on pulverized concrete); and (2) radionuclide-specific, based on a dose limit.

Based on the above requirements, Mound and its regulators have agreed to use draft NUREG 1500. This draft NRC document contains derived criteria (for a 15 mrem/yr dose limit, a 3 mrem/yr dose limit, and a 1 mrem/yr dose limit) for a number of radionuclides based on a resident scenario.

Mound is currently working with its regulators to identify a dose limit that is acceptable to all decision-making authorities. DOE Order 5400.5 and 10 CFR 20 establish a dose criteria of 100 mrem/yr for all exposure modes from all DOE sources of radiation. However, existing regulations do not establish a method to apportion the 100 mrem/yr dose given that more than one source is present. Mound and its regulators are currently considering a dose limit of 15 mrem/yr above background. If the decision is made that this dose limit is appropriate, the criteria corresponding to that dose limit, the radionuclide of concern, and the resident scenario in draft NUREG 1500 would apply.

If material is ***known to be contaminated***, Mound has determined that generally it is not cost-effective to purse release.

[3] Mound and its regulators have also agreed that if a facility is expected to be clean, this type of survey can substantiate release intact.

3. Release evaluation process

Mound participated as part of the Cleanup Standards Committee for the Ohio Federal Facilities Forum to develop a decision-making framework to use in (1) evaluating if release is an appropriate disposition for a facility; and (2) determining what data is necessary to substantiate that the facility is ready for release. Figure 3.1 on the following page illustrates this decision-making framework.

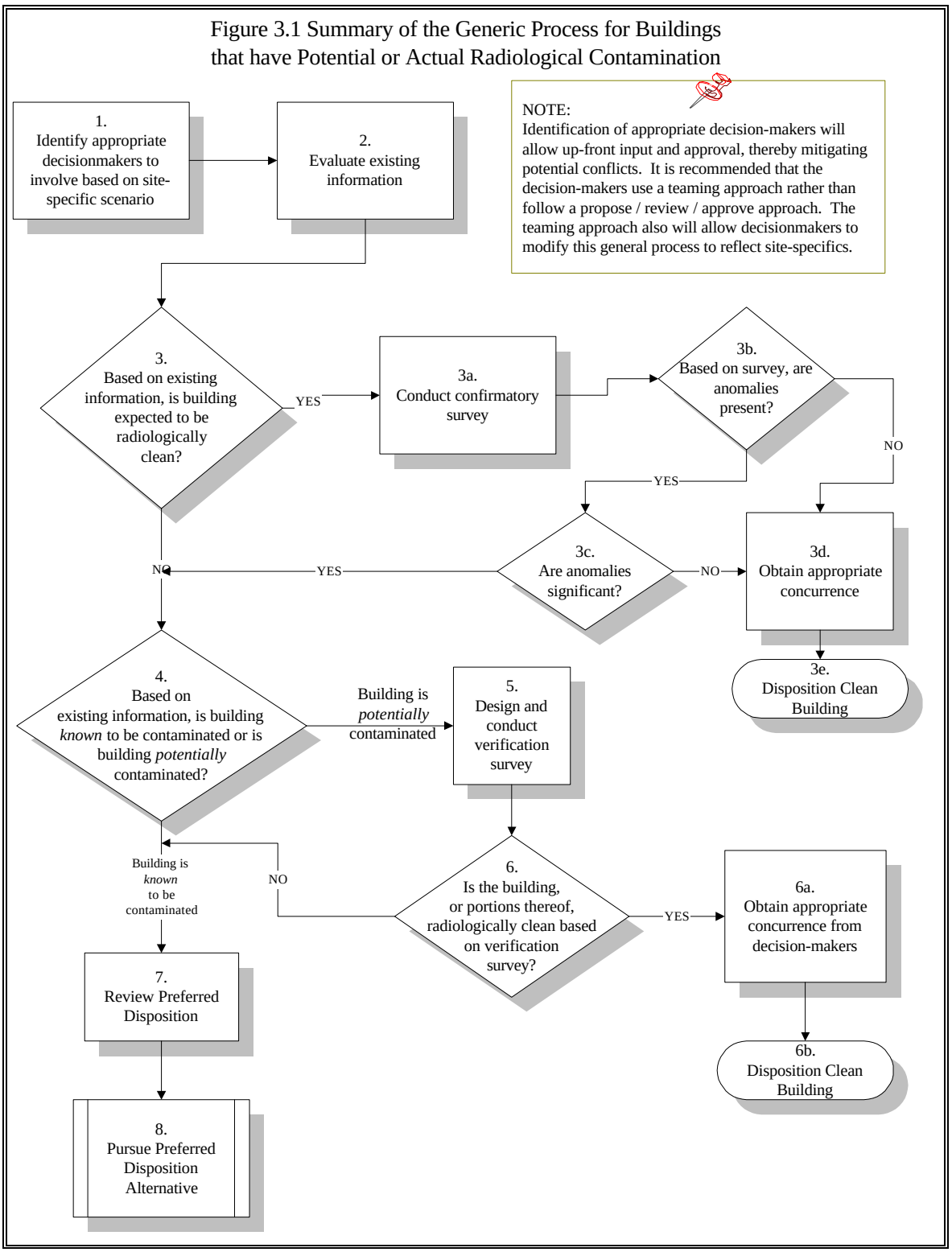
The use of existing information to focus data collection is a key element of this decision-making framework. After forming a core team, these decision-makers evaluate existing information in order to develop expectations about the level of contamination in the facility. Depending on expected conditions, the process has identified three types of data/surveys as effective in substantiating these expectations and determining if release is appropriate. If the core team concurs that existing information is of a high enough quality and quantity to substantiate release, additional data/surveys are not needed. However, when existing information is not sufficient to allow for release, the Cleanup Standards Committee developed these general guidelines to focus additional data collection.

Facility is expected to be clean: If the facility is expected to be radiologically clean, a confirmatory level survey is appropriate to substantiate that the facility is ready for transfer. This type of survey is a non-destructive survey over a limited area (or gross area) that is conducted to confirm that no unexpected contamination exists. It should focus on only those areas which the core team concur have a high potential for unexpected contamination (e.g., floor, air vents, floor drains).

Facility is expected to be potentially contaminated: In order to substantiate that a facility, which is potentially contaminated, is clean and can be released, a verification level survey is required. This type of survey is also non-destructive, but it is designed to be more intense than the confirmatory survey; a greater area of the facility is surveyed and more time is spent per area surveyed.

Facility is known to be radiologically contaminated: If a facility is known to have radiological contamination, and release is the preferred disposition, a characterization level of survey is required to determine the extent and location of contamination to ensure that decontamination efforts will be thorough. This type of survey is similar to a verification survey, except that it may include destructive testing to determine the specific radionuclides present in the facility, the concentration of these radionuclides (measured in pCi/g), and depth of contamination (e.g., core samples). *Note: The process recommends that if a facility is known to be extensively contaminated, the core team should reconsider if the release disposition should be pursued. If the core team decides to pursue demolition and disposal as LLW as the preferred disposition, this intensive survey is not needed to substantiate this disposition.*

Figure 3.1 Summary of the Generic Process for Buildings that have Potential or Actual Radiological Contamination



4. Building 59 -- A pilot project of the release evaluation process

The Cleanup Standards Committee determined that a pilot project should be conducted to test the committee's release evaluation process *(described in Note 3)*. Mound volunteered Building 59 at the Mound site. The following is a discussion of the Cleanup Standards Committee's evaluation of this building through the release evaluation process.

Background: Building 59, constructed in 1977, served as a neutron radiography and neutron activation facility. A Californium multiplier unit was housed on the second story of the building inside a concrete "donut." This facility ceased operations in 1990. Although the Californium source was removed in 1995, the concrete donut remains in place. This structure may be activated in volume or bulk. Further, because radionuclide materials were handled in the building, other areas are potentially contaminated.

Evaluation: The Cleanup Standards Committee identified the appropriate decision-makers to evaluate Building 59 based on two factors: (1) Mound is an Atomic Energy Act (AEA) exempt site; and (2) the preferred disposition of Building 59 is known to be demolition for disposal. Based on this preferred end state, there are two potential options for final disposition:

1. Disposal of clean material in an off-site construction and demolition debris (C&D) landfill;[4] and
2. Disposal of material that is not clean in an off-site permitted waste disposal facility. For the portions of Building 59, which are expected to contain low levels of radioactive contamination or activation, the proper type of disposal facility is expected to be a LLW facility.

Based on these factors, the appropriate decision-makers to involve are: DOE, USEPA, OEPA, the Bureau of Radiological Protection of ODH, the disposal facility,[5] and Department of Transportation (DOT).[6]

At Mound there is agreement that decisions will be made based on unanimous concurrence from all site decision-makers (i.e., DOE, USEPA, OEPA, ODH), unless otherwise noted.

[4] See *Note to readers*, page 3-15

[5] For release of debris, involvement of the disposal facility entails giving the facility notice and ensuring it has appropriate licensing; for conditional release of debris, involvement entails ensuring the facility has capacity and meeting the facility's WAC.

[6] Involvement of DOT entails ensuring that the material/waste meets packaging and transportation requirements.

4. Building 59 -- A pilot project of the release evaluation process (continued)

Following identification of decision-makers, the Cleanup Standards Committee evaluated existing information to develop expectations about the condition of the building. The expected building conditions serve as the basis for determining the approach forward (e.g., survey requirements) and appropriate disposition alternative (e.g., disposal as clean material in a C&D landfill).

The Cleanup Standards Committee's review of existing information included: a tour of the building; interviews with site personnel discussing the use, and operational procedures of the facility; as well as any accidents that occurred within or in the vicinity of the facility; and a review of existing characterization data, inspection records, site maps and facility drawings. Based on this evaluation, the Committee categorized Building 59 as follows:

- ***Portions KNOWN to be volume/bulk CONTAMINATED (i.e., activated):*** the inside portion of the "donut" and the U-tube where the source was stored. These areas are known to be activated based on existing sampling data and the process history of the building.

- ***Portions POTENTIALLY volume/bulk CONTAMINATED:*** areas of the building adjacent to where the source was transported, including the concrete wall adjacent to the transport pathway, the metal railing, fire protection piping, metal screws in wall, and the sump area. These areas have the potential for contamination/activation because: (1) the material (i.e., metal) is susceptible to activation; and (2) the material was in close proximity to where the source was stored and/or transported. However, existing sampling data does not confirm that the material is either contaminated/ activated or clean.

- ***Portions EXPECTED to be CLEAN:*** the remainder of the building (i.e., those areas not classified as potentially or known to be contaminated). These areas are expected to be clean because: (1) existing sampling data indicates that there is no contamination/activation of these areas (e.g., direct surveys did not detect contamination); and (2) based on the operational use and process knowledge of the building, these areas are not expected to be contaminated (e.g., no liquid contaminants were used during facility operation, no airborne contaminants have been detected, and the walls have not been covered with a layer of paint during/following operational use).

In order to determine the path forward for the building, the Cleanup Standards Committee evaluated each portion according to the categorizations defined through use of existing information, as described below. Prior to conducting any of the following surveys, however, the Cleanup Standards Committee recommended that Mound remove and disposition the building's insulation, rail, piping, screws, and grating to eliminate those easily accessible areas that are likely to have, or shield, contamination (i.e., activation).

4. Building 59 -- A pilot project of the release evaluation process (continued)

PART I. EVALUATION OF AREAS EXPECTED TO BE CLEAN

Based on the release evaluation process, a confirmatory survey is required to confirm that the portions of Building 59 that the group expects to be radiologically clean do not contain radiological contamination (Step 3a). The Cleanup Standards Committee determined that the following confirmatory survey would be appropriate:

- Smear surveys on the floor and walls (following removal of insulation). This should include approximately one survey every 10 ft^2; and
- Direct surveys (also following removal of insulation), taken approximately every 10 ft^2.

The Cleanup Standards Committee agreed upfront that:

- ***If*** no anomalies are detected in either survey, ***then*** the portions of the building surveyed may be unconditionally released.
- ***If*** anomalies are detected in either survey, ***then*** decision-makers must reconvene to evaluate the significance of the anomalies and determine the path forward.

Requirements for release of concrete as clean debris based on a confirmatory survey: Since the areas are assumed to be clean, the Cleanup Standards Committee determined that surface surveys are adequate to verify this assumption. If no anomalies occur at the surface then it is judged that no volume/bulk contamination is likely and the material may be dispositioned as non-radioactive material.

4. Building 59 -- A pilot project of the release evaluation process (continued)

PART II. EVALUATION OF AREAS EXPECTED TO BE POTENTIALLY CONTAMINATED

For each portion of the building that is potentially contaminated, the Cleanup Standards Committee agreed on the survey requirements and appropriate next steps corresponding to the potential outcomes of the survey *(Step 5)*. These agreements are as follows:

Sump

To determine if the sump is suitable for disposition as non-radioactive material, the Cleanup Standards Committee determined that the following survey is appropriate:

- Smears and direct scan over the entire surface of the sump; and
- Measurements taken with a 2" x 2" NaI meter, placed directly under the hole of the donut. *[Note: The Committee determined that this type of survey is appropriate because the sump area had the greatest exposure for activation. If activation occurred, the gamma ray emitted from Cobalt 60 would be strong enough to be detected, even if the activation portion of the concrete was at a depth.]*

The Cleanup Standards Committee decided upfront that:

- ***If*** no anomalies are detected by the smear and direct scan surveys and the NaI meter does not detect gamma radiation, ***then*** the sump area is clean and the debris from this area can be disposed of in a C&D landfill.
- ***If*** anomalies are detected in either survey, ***then*** decision-makers must reconvene to evaluate the significance of the anomalies and determine the path forward.
- ***If*** surveys detect contamination / activation at levels exceeding existing standards (e.g., DOE Order 5400.5), ***then*** the sump area is contaminated and should be disposed of as LLW.

Wall

To determine if the concrete wall adjacent to where the source was stored and transported is suitable for disposition as non-radioactive material, the Cleanup Standards Committee determined the following survey is appropriate:

- Smears and direct scan over the surface of this portion of the wall; and
- Concrete chips of the surface of the wall *[Note: These chips will provide data on the specific radionuclide (if any) and activity.]*

The Cleanup Standards Committee decided upfront that:

- ***If*** smears and direct scans detect no anomalies, and concrete chips contain no radionuclides, ***then*** the concrete wall adjacent to where the source was stored and transported is clean and the debris from this area can be disposed of in a C&D landfill.

4. Building 59 -- A pilot project of the release evaluation process (continued)

PART II. EVALUATION OF AREAS EXPECTED TO BE POTENTIALLY CONTAMINATED (CONTINUED)

- ***If*** smears and direct scans detect anomalies and/or concrete chips establish that radionuclides are present, ***then*** decision-makers must reconvene to evaluate the significance of the anomalies and determine the path forward. However, if radionuclides are present at such low levels that they are equal to or below levels for release based on a dose criteria, the concrete is clean and debris from this area can be disposed of in a C&D landfill.

- ***If*** smears and direct scans, or concrete chips establish that contamination exceeds established or derived criteria, ***then*** that portion of the concrete wall is contaminated and should be disposed of as LLW.

Soil:

To determine if the soils adjacent to the U-Tube are suitable for disposition as non-radioactive material, the Cleanup Standards Committee determined that direct scanning as the soils are removed (per Mound's standard procedures for radiologically contaminated soil) is an appropriate approach.

The Cleanup Standards Committee decided upfront that:
- ***If*** soils do not contain radionuclides above established criteria, ***then*** soils are clean and excavation can cease.
- ***If*** soils contain radionuclides above established criteria, ***then*** soils are contaminated and should be disposed of as LLW.

Requirements for release of concrete as clean debris based on a verification survey:
The requirements, identified by the Cleanup Standards Committee, for the release of concrete as clean debris based on a verification survey are detailed in Note 2 of this module.

PART III EVALUATION OF AREAS KNOWN TO BE CONTAMINATED

The Cleanup Standards Committee agreed that the appropriate disposition for the inside portion of the concrete donut and the source tube is demolition, without decontamination, and disposal as LLW. In order to implement disposition for these portions of Building 59, characterization is needed only to ensure that waste meets the disposal facility's WAC and DOT's requirements.

Notes

Note to readers:

As participants in its development, regulators concurred that Mound's release process effectively identifies facilities that can be released intact and demolition debris that can be disposed of in a conventional construction and demolition debris (C&D) landfill without posing a risk to human health and the environment. Upon subsequent review, however, the state regulators (i.e., Ohio EPA and Ohio Department of Health) determined that certain applications of this process would violate the Ohio Revised Code. Based on their interpretation of these state-specific regulations, Mound's regulators determined that disposal of the debris in a state landfill is not allowed if any residual radiological contamination exists above background. Therefore, although regulators agree that the process described in this document ensures protectiveness and is technically sound, DOE MEMP cannot legally dispose of debris with any residual radiological contamination in a state landfill. State regulators have indicated, however, that Mound may be able to use this release process to identify debris that can be placed onsite as clean fill.

Although Mound may not apply this process to dispose of demolition debris with residual radiological contamination in a state C&D landfill, EH-41 feels that the approach should be communicated to other DOE sites. Other sites may not have similar regulatory constraints, and consequently, may be able to apply this process to offsite disposal of demolition debris, in addition to release of intact facilities and onsite placement of debris as clean fill.

MODULE 4: FACILITY DISPOSITION REENGINEERING

Implementation

The reengineering process is based on the recognition that the basis of facility disposition is the underlying decision-making framework (i.e., the set of decisions that a site makes in dispositioning a facility). Specific activities are conducted to support these key decisions (i.e., to implement facility disposition).

The principles described in this section will allow a site to:

1) Identify the key decisions that the site needs to make to disposition a facility in accordance with its mission (i.e., establish an appropriate decision-making framework); and

2) Determine the most efficient way to implement this framework by ensuring that only those activities needed to support key decisions are conducted

In order to realize the full benefits of this approach, a site should evaluate and revise its entire facility disposition process (i.e., all programs that conduct activities to bring a facility from the end of its mission to final disposition). Evaluation of its entire process allows the site to:

- Establish a single, streamlined framework for facility disposition which includes *all* decisions necessary to disposition a facility; and

- Identify all opportunities to improve efficiency by eliminating redundancy and overlap between all programs that support facility disposition.

Exhibit 4.1: Achieving benefits despite implementation barriers

At sites where EM now has total landlord responsibilities, there should not be extensive impediments to integrating all facility disposition programs. At sites where the activities/processes that a facility goes through between end of mission and final disposition are conducted by different offices, implementation of facility disposition as a single process may be too difficult to achieve because of funding issues. Although responsibilities may have to remain divided among separate functional organizations because of these issues, these sites may nonetheless improve efficiency by evaluating disposition as a single process. For example, sites may:

- Create mechanisms through which information and experience gained during primary phases of disposition can be shared with successor organizations;

- Develop ways to minimize the project delays resulting from internal property transfer issues and staff changes; and

- Eliminate redundant or unnecessary activities

The following steps provide guidance for a site in reengineering its facility disposition process:

I. Define the mission and objectives of facility disposition

The goal of reengineering is to develop an approach that fulfills the facility disposition mission as efficiently as possible. Therefore, the site should begin by clearly stating the mission of the facility disposition process. The site can then refer back to this statement throughout the reengineering effort to ensure that the process it is establishing is consistent with, and the most efficient means of achieving, its mission.

Exhibit 4.2: Mound's mission statement for facility disposition

Mound defined the following mission for its facility disposition program: *Make real and personal property available for sale and/or transfer through decontamination, demolition, and removal while ensuring protection of human health and the environment and performing work in a safe, cost-effective, and timely manner.*

Establishment of specific objectives for improving the existing process helps a site to work more effectively towards its broader mission. By establishing these objectives, the site defines specifically how facility disposition should be conducted and what it must accomplish in order for the site to successfully meet its mission.

Exhibit 4.3: Mound's facility disposition objectives

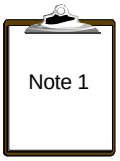
Mound's objectives for facility disposition include:

- *Perform all facility disposition activities as a single project with a single project manager and group/streamline similar efforts where practicable.*
- *Focus projects on upfront decision-making rather than the formal document/review/approve cycle.*
- *Perform projects consistent with CERCLA removal action authority and provide for regulatory and public involvement as necessary.*

II. Define the existing facility disposition process(es)

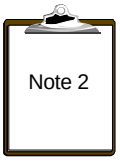
In order to maximize the efficiency of its disposition process, a site should identify the set of objectives or decision-making framework underlying the activities it conducts. By comparing its existing process to the key decisions and primary objectives of disposition, the site can more effectively identify inefficiencies and opportunities for improvement.

A site can identify the decision-making framework underlying its facility disposition process by first identifying the entire range of activities conducted between a facility's end of mission and its final disposition.



See Note 1 for the sources Mound used to define its existing process.

The site then identifies why these activities are conducted (i.e., the purpose and intent of each activity), a site is able to discern the decisions that these activities support. By defining the decisions underlying all activities, the site can construct the fundamental decision-making framework for the process.



See Note 2 for a detailed description of how Mound defined the two separate decision-making frameworks underlying safe shutdown and D&D.

Exhibit 4.4: Mound's facility disposition programs

Prior to conducting its reengineering effort, Mound's facility disposition process consisted of the safe shutdown and the D&D programs. Throughout the facility disposition process, varying surveillance and maintenance (S&M) activities were conducted (depending on the state of the facility) to ensure protection of human health and the environment prior to final facility disposition. Because S&M is not a decision-making process, Mound did not evaluate this program as part of its effort to integrate all facility disposition programs; rather, it considered opportunities to improve general facility management throughout the disposition process.

All key players involved in disposition should concur that the identified activities represent the facility disposition process and that the underlying decision-making framework is accurate prior to further evaluation. By involving the technical personnel/contractors who implement facility disposition, the site (1) determines specific ways to improve the process; and (2) increases the likelihood that the revised process will be accepted.

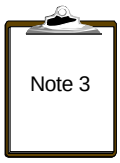
III. Improving the efficiency of the facility disposition process

Once the site has identified the decisions it is making to conduct facility disposition (i.e., the decision-making framework underlying its facility disposition processes) and the activities it conducts to support those decisions, the site can identify opportunities to improve its existing process.

Implementation

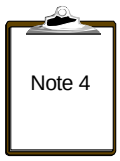
The following steps will guide a site in identifying specific opportunities to improve the efficiency of its existing facility disposition process:

1) ***Overlie all decision-making frameworks for all programs.*** This step allows a site to determine if it is making similar, or identical, decisions at different points in the facility disposition process. These overlapping or redundant decisions are generally supported by similar activities. For example, separate programs to complete different phases of facility disposition will generally include decisions related to the risks posed by a facility (e.g., level of contamination). Consequently, data collection may be conducted more than once to support these decisions.



See Note 3 for a description of how Mound compared its two facility disposition processes.

The site can expedite the overall process and reduce the number of activities needed to support decision-making by integrating similar or identical decisions. The step allows the site to establish a single, streamlined framework for the entire disposition process and to determine how activities should be conducted to efficiently support these decisions.



See Note 4 for a graphical representation of Mound's integrated process.

2) ***Compare the single decision-making framework to the site's mission and objectives.*** This step allows a site to pinpoint those decisions it must make to disposition facilities in accordance with its current mission. Decisions and supporting activities that are not consistent with this mission should be eliminated. For example, if a site is working toward exit, the facility disposition mission is to transfer or demolish all facilities on site. Decisions related to preparing a facility for long-term surveillance and maintenance are no longer relevant or beneficial and should be eliminated.

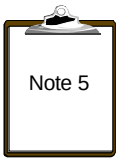
3) ***Organize decisions to move project more quickly to implementation.*** The site can further improve the efficiency of its process by ensuring that it makes decisions and conducts activities such that the site focuses on implementation as early in the process as possible. There are a number of ways a site can focus the process on implementation and avoid delays in action; for example, the site may:

- Insert decisions and activities that reduce data collection necessary to support specific facility disposition decisions. For example, by deciding the appropriate disposition as early in the process as possible, the site reduces data collection

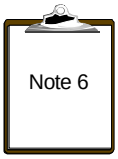
and expedites action. (*See Module 2 for more detail on the early identification of an appropriate disposition approach.*) As part of this improvement, the site should ensure that existing information is used to the maximum degree possible to support facility disposition decisions.

- Provide for early participation of decision-makers and technical support functions (e.g., health physics) to ensure that the needs and interests of the participants are known prior to initiating any action. (*See Module 1 for an explanation of how upfront and continual regulator involvement prevents delays in action.*)

4) ***Identify areas where compliance with DOE orders can be achieved through the CERCLA process.*** Because facility disposition projects are now to be conducted as non-time critical removal actions under CERCLA, a site can, where appropriate, meet the intent of, and comply with DOE Orders through the CERCLA process. By determining where the CERCLA removal action process and DOE Order requirements overlap, the site can identify opportunities to integrate activities by incorporating the substantive requirements of DOE orders into CERCLA activities. For example, the "Policy for Demonstrating Compliance with DOE Order 5820.2A for On-site Management and Disposal of Environmental Restoration Low Level Waste" states that the CERCLA process should "be used to demonstrate compliance with the requirements and intent of DOE Order 5820.2A with regard to the safe management and disposal onsite of environmental restoration LLW."



See Note 5 for a description of Mound's identification of opportunities to comply with DOE orders through the CERCLA process.



See Note 6 for Mound's general considerations in evaluating the efficiency of its existing facility disposition process.

IV. Considerations for effectively implementing the revised facility disposition process

The revised facility disposition process may greatly impact how a site conducts facility disposition projects. To ensure proper implementation of the revised process, a site should spend time upfront educating program and project managers on the new method for conducting facility disposition. Especially when a site is combining previously distinct programs or processes (e.g., safe shutdown and D&D), it will have to redefine roles and responsibilities for the facility disposition process and may need to reorganize personnel accordingly.

Implementation

Modification of a site's baseline schedule in light of the new facility disposition process also helps to ensure its successful implementation. By redefining its baseline, the site will be able to estimate the cost and schedule benefits that the revised process will achieve, thereby substantiating that it should be implemented. In addition, by incorporating the adjusted schedules for particular facility projects into the baseline schedule, the site formally asserts that it will conduct disposition in this way; i.e., the site establishes enforceable milestones for projects that can only be met by conducting disposition according to the revised process.

Notes

1. Information sources used by Mound to define its existing process

At the Mound site, site personnel were the most valuable resource in developing an accurate description of the existing facility disposition process. These technical and administrative personnel provided assistance and guidance in the gathering, review, and confirmation of the information compiled to evaluate the existing process. Working with site personnel on a detailed level increased project awareness and identification of potential areas for improvements. Further, through direct involvement, site personnel were convinced of the benefits and therefore will likely act as champions of the process if it is implemented.

In addition, Mound conducted a detailed review of technical manuals, baselines, Federal Regulations, DOE Orders (particularly the 5400 Orders), and examination of any relevant regulatory or administrative drivers or guidance document to ensure that the process was accurately represented. Examples of key sources of information include:

- *Mound Decontamination and Decommissioning Program Management Systems Manual 820*; and
- Technical Manual MD-10431, *Mound Safe Shutdown Standard Operating Procedures*

2. Mound's methodology for defining its decision-making framework for facility disposition

In order to define the decision-making framework, Mound began by identifying all of the activities and documentation associated with disposition. Then each activity was thoroughly evaluated to determine its specific role in the disposition process. Based on this evaluation, Mound developed a comprehensive description of all of the activities conducted to disposition facilities.

Key components of the description
The analysis focused on locating information to establish the:

- Current business practice (technical and administrative activities);
- Scope of activities;
- Regulatory framework;
- Communication pathways and interfaces; and
- Cost and schedule information.

Given this description, key players in the disposition process then came to agreement on the intent/purpose of each activity or document; i.e., the decision it supports. For example, Mound identified the following decisions as the drivers for facility disposition activities (specific activities are indicated by underlined italics):

Under safe shutdown:
Are remaining hazards/liabilities identified, documented and addressed? Risks and liabilities such as chemical hazards, unresolved safety questions, and structural deficiencies are identified, documented, and addressed. The ***facility is surveyed*** for radioactive contamination to evaluate levels of both fixed and removable contamination. Industrial Safety, Fire Protection, Operational Security, and Facility Maintenance ***perform an inspection of the facility that contributes to a liability inventory***. Maintenance and Utilities works with other Mound employees to ***de-energize non-essential equipment/****systems and affix lockout/tagout devices* to machines and equipment in the facility.

Under D&D:
Have D&D objectives been met? ***In-process monitoring*** (e.g., confirmation sampling) is performed during action to ensure the project is being executed in accordance with the decommissioning package (e.g., health and safety requirements) and that project objectives have been met (i.e., decontamination to established release / performance criteria). In addition, ***verification sampling*** (i.e., CERCLA verification) is performed in support of final property transfer. The appropriate level of data needed for final verification is defined and approved by regulating agencies (i.e., EPA, OEPA).

(*See Exhibit 4.6 for an example of the comprehensive description Mound developed for each activity.*)

2. Mound's methodology for defining its decision-making framework for facility disposition (*continued*)

By determining the decisions underlying all activities/documentation associated with facility disposition, Mound defined separate decision-making frameworks for its two distinct processes, safe shutdown and D&D. (*See Exhibits 4.7 and 4.8*)

Exhibit 4.6: An example of Mound's Activity Summary Sheets

In support of its reengineering effort, Mound organized the information it compiled about each facility disposition activity into a separate table, as exemplified below.

Program: Safe Shutdown
Activity: Inventory Remaining: Chemicals, Components, Consumables, and Wastes
Description: Obtain the chemical inventory for the facility from the Chemical Database Manager. Update as necessary. Remove all inert components, except for items identified for Economic Development. Remove all consumables from the facility, except for items identified for Economic Development. Disposition all relocatable wastes in the facility according to appropriate regulatory and permit requirements.
Regulations/Requirements Driving Activity: DOE 1540.2 DOE 5480.3A DOE 5632.5 49 CFR, Subtitle B, Chapter 1, Subchapter C, Parts 171-180 EM Acceptance Criteria 4, 5, 7 MD-10130 Hazard Classification and Labeling of Energetic Material Containers MD-10024 Energetic Material Waste Disposal Control System MD-81070 Mound Plant Waste Acceptance Criteria RCRA TSCA
Activity Predecessors: -Containers designated for Economic Development or Reconfiguration/Stockpile Support should have been labeled with a bar code.
Activity Successors: -Exceptions II form (if applicable)
Interfaces: (internal/external) Participation and review by Maintenance and Utilities; participation by Non-Nuclear Reconfiguration, Waste Generators, and Unit Manager or Team Leader; review by Waste Management.
Decision/Question: Is the scope of safe shutdown defined?

Exhibit 4-7: Mound's initial decision-making process for safe shutdown

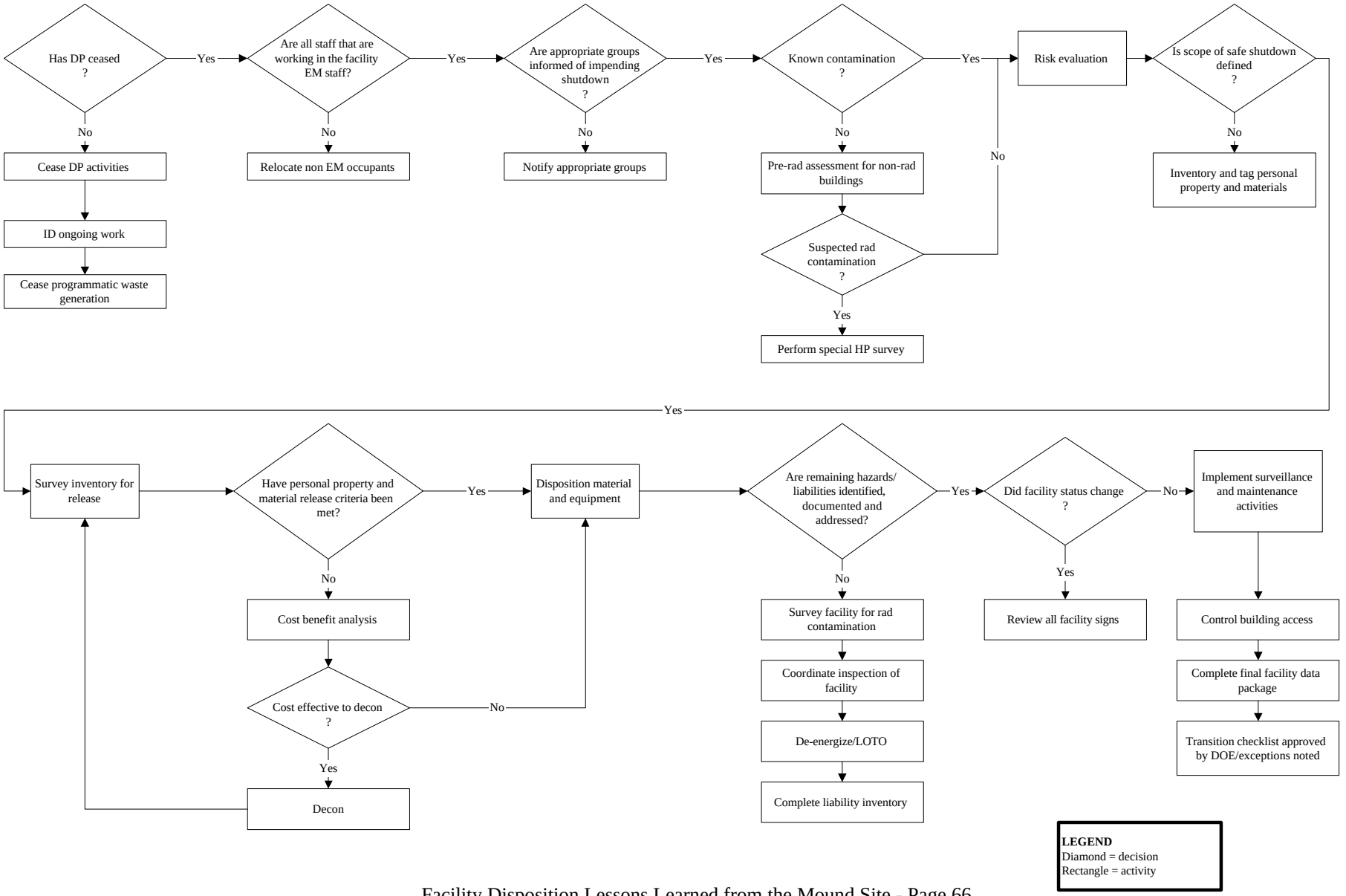
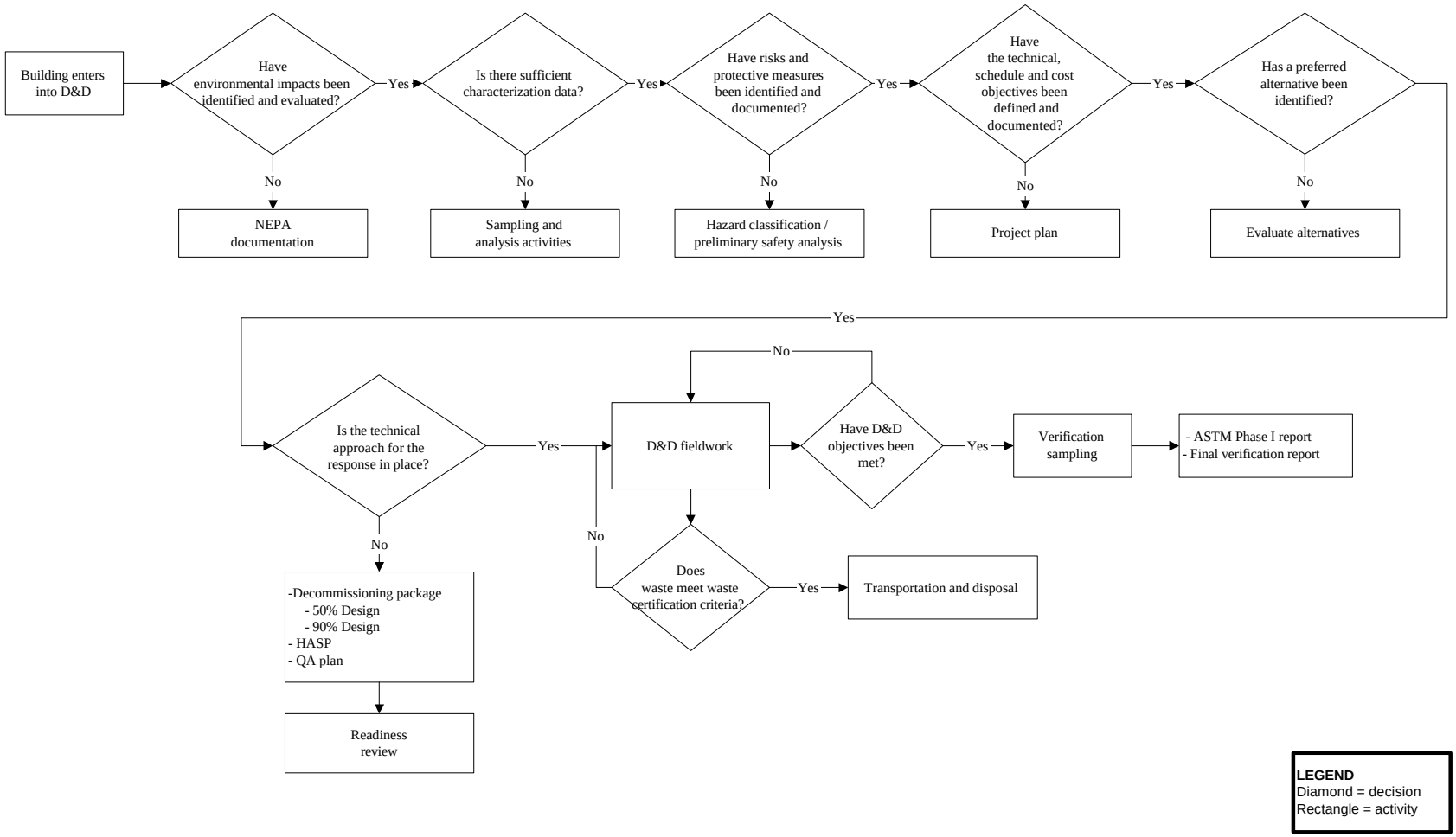


Exhibit 4-8: Mound's initial decision-making process for D&D



3. Identifying overlap between safe shutdown and decontamination & decommissioning

Once Mound had defined the decision-making framework underlying each process and the supporting activities and documentation, Mound compared these two processes in order to identify areas of inefficiency. Exhibit 4.9 illustrates the overlaps and redundancies in decision-making and activity/documentation revealed by comparing the two decision-making frameworks.

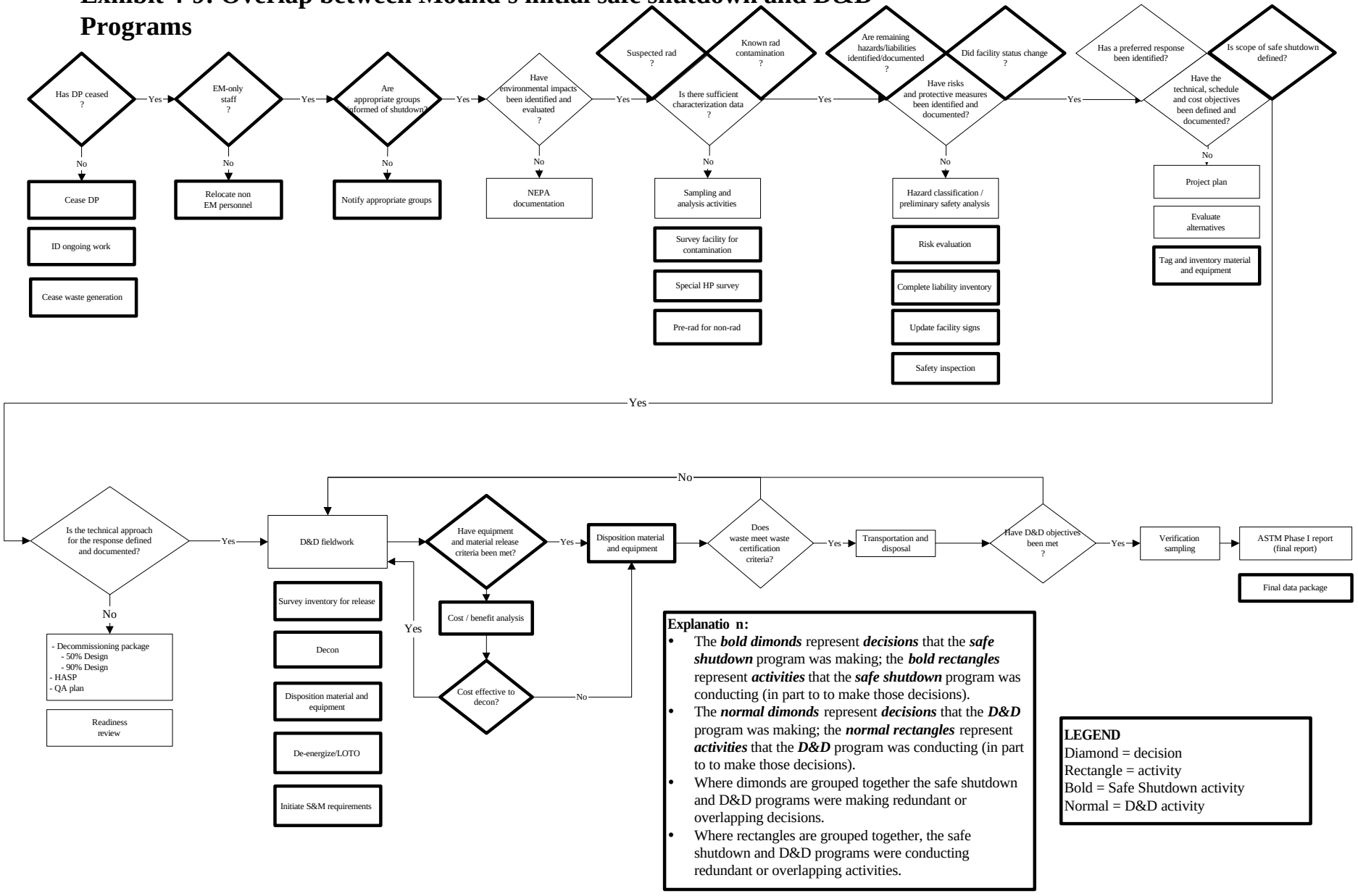
This comparison identified several safe shutdown and D&D decisions and activities with similar scope and intent in the five major areas: (1) characterization; (2) risk/hazard identification; (3) definition of technical, schedule and cost objectives; (4) action; and (5) project close-out. The following descriptions illustrate the types of specific overlap identified:

Characterization:
Both safe shutdown and D&D include decisions related to the nature and extent of contamination in a facility. Both processes conduct activities that collect and/or evaluate data to support these decisions. For example, safe shutdown surveys for radioactive materials in both radiologically and non-radiologically controlled areas to evaluate fixed and removable levels of contamination in order to focus any safe shutdown-related decontamination efforts. Similarly, D&D conducts sampling and analysis activities to determine the methods and extent of D&D required. ***This overlap identifies that resources are being spent on redundant characterization efforts.***

Risk / Hazard Identification:
Both safe shutdown and D&D include decisions that determine if risks/hazards are associated with a facility (i.e., known contamination and physical hazards are identified). The activities conducted to support these decisions include determining the magnitude of risks /hazards in the facility, and documenting those health and safety concerns and associated protective measures. For example, safe shutdown completes a risk evaluation to determine the effort required for programs, projects, or processes to eliminate or minimize the consequences of failure. Likewise, D&D completes an analysis of hazards (e.g., hazard classification which identifies risks and hazards associated with the facility and D&D activities); and identifies the necessary measures to eliminate or minimize the risks and hazards. ***The risks and hazards in a facility are being evaluated more than once for similar planning purposes.***

Notes

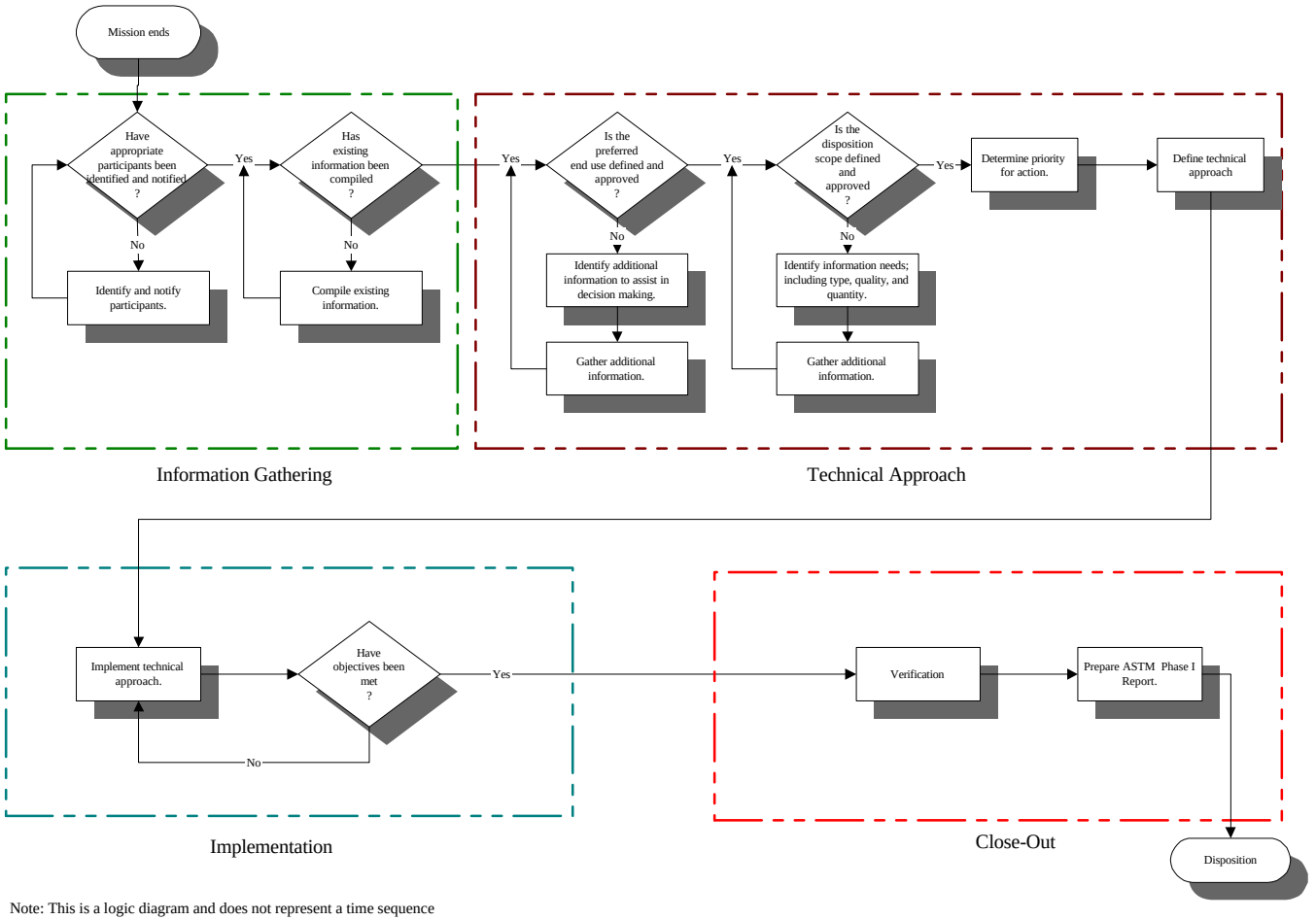
Exhibit 4-9: Overlap between Mound's initial safe shutdown and D&D Programs



4. Mound's single, integrated facility disposition process

By addressing the overlap and redundancy in decision-making between safe shutdown and D&D, Mound was able to develop a single, streamlined disposition process. This process encompasses each of the key decisions identified in the evaluation of the existing process. Activities and documentation are organized to support these decisions, as necessary, in a logical manner. The revised process was further improved by incorporating the core team approach and efficient identification of an appropriate disposition. *(See Exhibit 4-10.)*

Exhibit 4-10: Mound's revised approach to facility disposition (following the reengineering effort)



Note: This is a logic diagram and does not represent a time sequence which would incorporate opportunities for phasing.

5. Complying with DOE Orders through CERCLA

Based on evaluation of its existing disposition process, Mound determined that there is uncertainty regarding how to conduct facility disposition as a CERCLA removal action. Specifically, Mound determined that it was not taking advantage of the opportunity to meet the intent of, and comply with DOE Orders through the CERCLA process. Conversations with site personnel indicated that there is no clear direction as to whether a NEPA evaluation is required, or if D&D activities performed under CERCLA cover the intent of NEPA. This uncertainty indicates that the site may be expending resources on unnecessary NEPA documentation.

Review of the following policies was helpful in determining how to streamline compliance activities:

- The "Decommissioning Under CERCLA" Information Sheet (May 1995) establishes that NEPA values are to be incorporated into CERCLA documentation. This incorporation satisfies the requirements of DOE Order 5440.1E "NEPA Compliance Program" employed for non-CERCLA actions.

- The "Policy for Demonstrating Compliance with DOE Order 5820.2A for On-site Management and Disposal of Environmental Restoration Low Level Waste" states that the CERCLA process should "*be used to demonstrate compliance with the requirements and intent of DOE Order 5820.2A* with regard to the safe management and disposal onsite of environmental restoration LLW." The policy establishes that whenever practical and consistent with site-specific technical and regulatory issues "*the substantive requirements of [this order] should be directly incorporated into the CERCLA process.*" If incorporated or otherwise complied with through CERCLA, these requirements "*need not be applied separately…*"

In order to streamline compliance activities, Mound compared DOE Orders applicable to facility disposition with requirements under the CERCLA as illustrated in Table 4.1. This evaluation identified specific opportunities to streamline regulatory compliance by demonstrating compliance with DOE Orders through the CERCLA process.

Table 4-1: Overlap between DOE Orders and the CERCLA process identified by Mound

Decision/Activity	CERCLA Removal Action	DOE Orders
Mission Ends	Not Applicable	Not Applicable
Have appropriate participants been identified and notified?	Not Applicable	Not Applicable
Has existing information been compiled?	Removal Site Evaluation (300.410) • Preliminary Assessment (300.410(c)) • Preliminary Site Inspection (300.410(d))	Not Applicable
Is the preferred end use defined and approved? • Desired for Economic Development • Protection of Human Health and the Environment Is the disposition scope defined and approved? • Extent of problem • Health and safety • Waste management	Sampling and Analysis (300.415(4)(ii)) • Field Sampling Plan (300.415(4)(ii)(A)) • QA Plan (300.415(4)(ii)(B)) EE/CA or equivalent (300.415(4)(i)) Site characterization - includes site description/background; previous actions; source, nature and extent of contamination; analytical data; streamlined risk evaluation Identification of removal action objectives - includes determination of removal scope; determination of removal schedule; planned remedial activities Identification and analysis of removal action alternatives - analysis includes consideration of protection of public health and community; protection of workers during implementation; protection of environment; compliance with ARARs; ability to achieve removal action objectives; technical feasibility; availability of resources; administrative feasibility; cost. Recommended removal action alternative - the EE/CA identifies the action which best satisfies the evaluation criteria considered in the detailed and comparative analysis of alternatives. Action memorandum serves as primary decision document to substantiate the need for a removal response, identify the proposed action and explain the rationale for the removal.	5480.23 (Safety of Nuclear Facilities) 430.1 (Life Cycle Asset Management) 5480.1B (Environment Safety and Health Program for DOE Operations) 5820.2A (Radioactive Waste Management) DOE-EM-5502-04 (Hazard Baseline Documentation) DOE-STD-1027-92 (Hazard Categorization) 5480.11 (Radiation Protection for Occupational Workers) 5400.5 (Radiation Protection of the Public and Environment) 5480.5 (Safety of Nuclear Facilities) 440.1 (Worker Safety and Health Program) 460.1 (Packaging and Transportation Safety) 5440.1E (NEPA Compliance) 5480.7A (Fire Protection) 5480.21 (Unreviewed Safety Question) 5480.24 (Nuclear Criticality Safety) 5480.28 (Natural Phenomena Hazards Mitigation)
Determine Priority for Action	Not Applicable	Not Applicable

Table 4-1: Overlap between DOE Orders and the CERCLA process identified by Mound

Decision/Activity	CERCLA Removal Action	DOE Orders
Define Technical Approach	EE/CA (300.415 (4)(i)) Removal Action Work Plan	5480.23 (Safety of Nuclear Facilities) DOE STD-3006-93 (DOE Standard Planning and Conduct of Operation Readiness Reviews) 5700.6C (Quality Assurance) 5480.1B (Environment Safety and Health Program for DOE Operations) 425.1 Startup, and Restart of Nuclear Facilities 5480.22 Technical Safety Requirements 5820.2A (Radioactive Waste Management) DOE-EM-5502-04 (Hazard Baseline Documentation) 5480.11 (Radiation Protection for Occupational Workers) 5400.5 (Radiation Protection of the Public and Environment) 5480.5 (Safety of Nuclear Facilities) 440.1 (Worker Safety and Health Program) 430.1 (Life Cycle Asset Management) 460.1 (Packaging and Transportation Safety) 5440.1E (NEPA Compliance) 5480.7A (Fire Protection) 5480.21 (Unreviewed Safety Question) 5480.24 (Nuclear Criticality Safety) 5480.28 (Natural Phenomena Hazards Mitigation)
Implement Technical Approach	Removal action consistent with design and planning documents (e.g., work procedures, health and safety requirements, quality assurance requirements). Verification SAP to support project completion.	Substantive requirements of DOE Orders are satisfied through implementation of technical approach defined above.
Have D&D objectives been met?		
Verification		
Prepare ASTM Phase I Report	Prepare closeout documentation to substantiate that the objectives of the response have been achieved and that the property is protective of human health and the environment for its intended use.	5820.2A (Radioactive Waste Management)
Disposition	Not Applicable.	Not Applicable.

6. General considerations for identifying inefficiencies in the existing process

The following general considerations helped Mound in identifying its key facility disposition decisions and determining where activities were not efficiently supporting these decisions.

- ***Are similar decisions and supporting activities included more than once within the process?***
  Decisions and supporting activities are conducted during both safe shutdown and D&D to determine if objectives [e.g., release criteria for material and equipment, and the facility; waste acceptance criteria (WAC)] have been met. These "hands on" action related decisions and activities are complimentary and could be more effectively coordinated (e.g., by performing in-facility activities in concert such that resources including survey equipment and personnel are used more efficiently).
- ***Are excessive activities conducted to support a single decision?***
  Mound determined that excessive activities might be conducted during safe shutdown to evaluate hazards in a facility prior to starting work. In addition to formal procedures to evaluate for contamination and identify hazards, program staff identified that a similar, informal evaluation takes place earlier in the process. This earlier evaluation is not, however, explicitly identified in the technical manuals and does not provide effective documentation and review.
- ***Are activities conducted that are not necessary to support critical decisions?***
  Mound conducts activities to ensure that only EM personnel are left in a facility during the final stages of the safe shutdown. These activities include compiling and updating a list of all remaining facility occupants. The completion of this activity satisfies one of the 10 EM Acceptance Criteria, which were established for transferring a facility from DP to EM. These criteria and activities are no longer needed because EM now has all landlord responsibility at the site. This activity also keeps in place review and documentation requirements that are no longer needed.
- ***Are critical decisions and supporting activities conducted to maximize the use of site resources and expedite disposition?***
  Both safe shutdown and D&D make decisions regarding the nature and extent of contamination in a facility. Both processes conduct activities that collect and / or evaluate data to support these decisions. For example, safe shutdown surveys for radioactive materials in both radiologically and non-radiologically controlled areas to evaluate fixed and removable levels of contamination in order to focus any safe shutdown-related decontamination efforts. Similarly, D&D conducts sampling and analysis activities to determine the appropriate methods and extent of D&D required. This overlap represents resources being spent on redundant characterization efforts.
- ***Is the process organized and conducted to focus on the decisions critical to facility disposition?***
  Because the preferred disposition is not identified or considered early in the process, the site cannot conduct activities to focus on supporting this key decision.

MODULE 5: UNCERTAINTY MANAGEMENT

Implementation

Like environmental restoration, facility disposition projects involve uncertainty. Uncertain factors are generally technical (e.g., contaminants present, depth of contamination) but may also be regulatory (e.g., acceptable release levels for each contaminants) or programmatic (e.g., available funding). Although the project manager may be able to identify the ***likely*** (or expected) conditions for a facility disposition project, if some factors are uncertain there is a possibility that ***actual*** conditions may deviate from these expectations. If actual conditions turn out to be different from the project manager's expectations, the selected disposition approach may no longer be capable of achieving protection of human health and the environment or satisfying regulatory requirements. In addition, encountering deviations from expected conditions may increase cost and schedule if the project manager must significantly change the disposition approach. Because of the potential impacts of encountering likely deviations from expected conditions, the presence of uncertain factors may pose a risk to the success of facility disposition projects.

There are generally three ways to proceed if an aspect of a project is uncertain: the project manager may (1) disregard the uncertainty; (2) attempt to eliminate the uncertainty; or (3) manage the uncertainty. An uncertainty is managed by establishing a monitoring plan that will identify if a deviation from expected conditions exists and a contingency plan that can effectively address this deviation, thereby minimizing the impact on project success. None of these options is appropriate for, or will effectively address all uncertain factors; rather, the appropriate approach to dealing with each particular uncertainty varies depending on three factors:

- ***The risk posed by the uncertainty.*** This risk depends on the probability that a likely deviation from an expected condition exists, and the impact that the deviation will have on achievement of project goals. Deviations may have a negligible impact. For example, if the concentration of one contaminant in an area is such that that demolition debris must be disposed of as LLW waste, the exact concentration of other potential radiological contaminants does not change the selected disposition approach. Conversely, deviations from expected conditions may affect the success of a project. For example, the site may attempt to decontaminate a facility without reducing the uncertainty about the depth of contamination. If contamination extends further than expected and decontamination is therefore unfeasible or cost-prohibitive, the site will have to select an alternate disposition approach. The work already completed represents an unnecessary cost and increase in the project schedule.

- ***The need to reduce the uncertainty prior to implementation.*** Although an likely deviation from expected conditions may pose a risk to the project, the project manager may determine that it is appropriate to manage this uncertainty during implementation rather than reducing it upfront. This is the case if (1) monitoring and contingency plans can minimize the impact of encountering likely deviations

from expected conditions; and (2) it is more cost-effective to resolve the uncertainty during implementation than through upfront characterization. For example, the site may not know if the level of dust emissions that will be generated during implementation requires that workers wear a specific type of PPE. Rather than attempting to resolve this issue through data collection and analysis prior to implementation, the site may require that workers wear the PPE initially and establish a monitoring plan to determine the level of emissions. If the level is low enough, use of the PPE can be discontinued. This approach minimizes upfront evaluation, ensures worker protection, and allows the site the possibility of reducing project costs (i.e., by discontinuing use of PPE that may limit productivity, if emissions are low enough).

- ***The possibility of reducing the uncertainty.*** In some cases it is not feasible to resolve an uncertainty upfront and therefore it must be managed.

Exhibit 5.1 Risk VS. Uncertainty

Although risk and uncertainty are sometimes used interchangeably, a simple but important distinction should be made between these two concepts. In general, **uncertainty** refers to a condition, quantity, or event with a variable (and potentially unknown) outcome. On the other hand, **risk** is defined as the negative consequence of uncertainty. The opposite of risk is reward, i.e., an uncertain condition can produce either risk (a negative outcome) or reward (a positive outcome). In addition, risk is generally evaluated by two parameters, namely, the frequency of its occurrence (probability) and the magnitude of its outcome (impact). For clarity, this distinction will be maintained throughout this module.

Based on lessons learned from ER projects conducted at Mound, this module presents guidelines for determining the most appropriate approach for addressing the likely deviations from expected conditions associated with facility disposition projects.[9] *(Module 2 discusses the applicability of uncertainty management to early identification of an appropriate disposition..)*

Uncertainties may be evaluated and addressed through the following general steps:

1) Define expected conditions, identify uncertain factors, and determine likely deviations from expected conditions

2) Assess the likelihood that deviations from expected conditions will occur

3) Evaluate the potential impacts these deviations will have on achievement of project goals

[9] This general approach may also be applied at a programmatic level to evaluate and determine the most effective method for addressing uncertainties that pose a risk to a number of projects (e.g., level of funding the program will receive) or to accomplishing program/site goals (e.g., achieving baseline schedule, working within established budget).

4) Determine the overall risk posed by the uncertainty (a combination of the likelihood of occurrence and the potential impact of unexpected conditions)

By performing this evaluation, the site can determine if an uncertain factor should be:

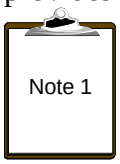
- ***Disregarded***. The site may determine that an uncertain factor poses no significant risk because encountering a deviation from expected conditions is highly unlikely and/or its impact on achieving project goals is insignificant.

- ***Reduced.*** The site may determine that an uncertainty must be reduced prior to moving forward because encountering an likely deviation from expected conditions poses an unacceptable risk (i.e., it has a high probability of occurring and may prevent project success) and the impact of the deviation cannot be effectively managed during implementation.

- ***Managed***. The site may determine that although an uncertainty poses a risk, it should be managed because the uncertainty cannot be reduced or it is not cost-effective to reduce the uncertainty upfront; i.e., the site can identify a deviation from expected conditions by monitoring and can effectively respond to this deviation by implementing a pre-established contingency plan.

Because the site eliminates uncertainties that pose a minimal risk from consideration and focuses on reducing or managing those uncertainties that present an unacceptable risk, data collection and planning prior to moving forward are minimized. Monitoring and contingency planning allow the site to further reduce upfront data collection while minimizing the risk that uncertainty poses to project success.

The following discussion provides more detailed guidelines for implementing the general steps of this uncertainty management approach using a qualitative approach. The evaluation performed in each of these steps may also be performed quantitatively. The most appropriate and effective application of these general steps varies depending on the type of uncertainties being evaluated and the objectives of the project team. The **Notes** section, which presents Mound's use of uncertainty management for an ER project, provides an example of a quantitative application of this approach.



See Note 1 for a discussion of the background and objectives of this project.

I. Identifying project uncertainties

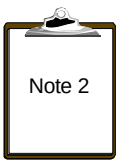
The project team begins by developing a list of the uncertain factors that may pose a risk to the site's ability to achieve its goals. In addition to technical uncertainties (e.g., contaminant concentrations, waste volumes), the project team may be uncertain about programmatic factors, such as fiscal year funding and site prioritization strategy. For each

uncertain factor, the project team defines the conditions it expects to encounter and then identifies any reasonable deviations from these conditions. For example, based on existing information, the team may expect that contamination is confined to a specific area of the facility; however, it may recognize that contamination potentially extends beyond this area. Because the team is uncertain about this factor, it is a reasonable deviation from expected conditions. It is important that the project managers participate actively in this step, as they generally possess expertise in all relevant areas of work at their sites.

Table 5.1 illustrates an example of an uncertainty management matrix, which may be a useful tool in identifying, evaluating, and determining the appropriate approach for addressing uncertainties. In addition to identifying the expected conditions and reasonable deviations for facility disposition factors (e.g., contaminant depth and debris volume), this table includes an assessment of the risk posed by the uncertainties and the approach for managing that risk (the guidelines for defining this information are described in subsequent steps).

Table 5.1. An uncertainty management matrix for facility disposition

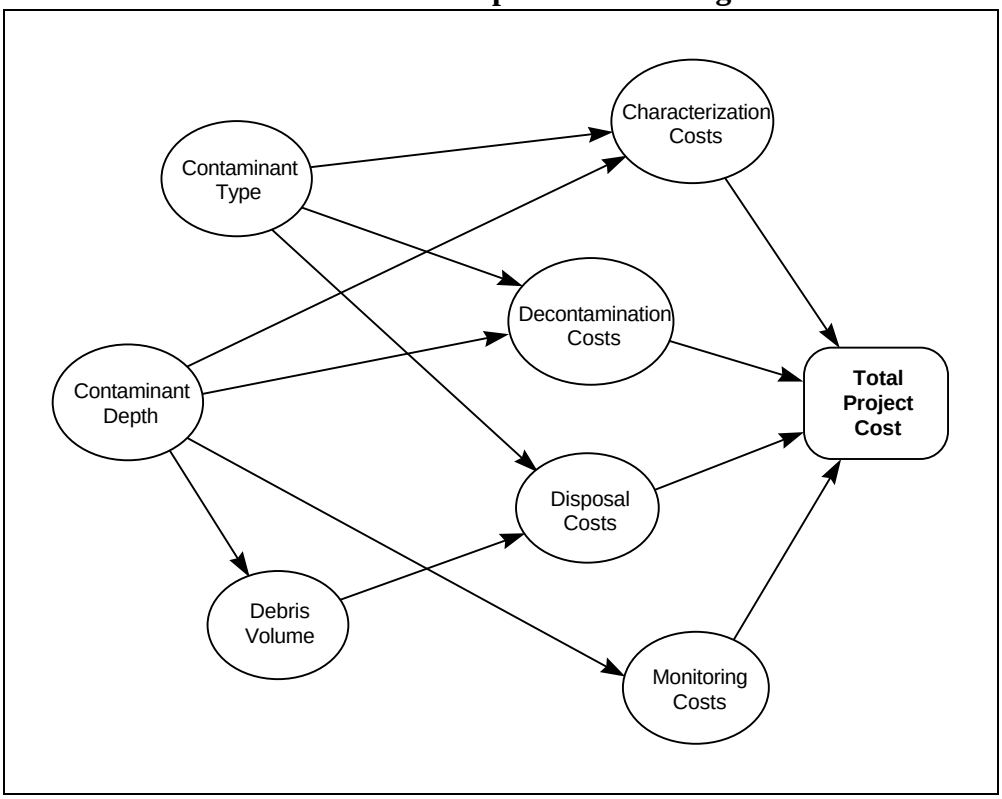
Uncertainty	Expected Condition	Reasonable Deviation	Probability of Occurrence	Potential Impact	Addressing the Uncertainty
Contaminant concentration [Selected disposition: release for reuse]	Concentrations are below established cleanup levels	Concentrations exceed these levels	Medium. Facility stored radiological constituents	High. Selected disposition is no longer appropriate if extensive contamination exists.	***Uncertainty is reduced prior to implementation.*** A characterization survey is conducted focusing on areas expected to have high concentrations. If contamination is found, decontamination will be considered. If this is not cost-effective, facility will be demolished and disposed of appropriately.
Presence of contamination beneath facility [Selected disposition: demolition and disposal as LLW]	Soil below facility is not contaminated above action levels	Contamination in soil exceeds action levels.	Low. Facility foundation is thick; no known leakage from or spills around facility.	Medium. Selected disposition for facility is still appropriate. Excavation and disposal of soil as appropriate will be required.	***Uncertainty is managed during implementation.*** Monitoring plan: Sample soil underlying facility following demolition. Contingency: Prepare for possibility that disposal of a greater volume of waste will be required (e.g., identify procurement needs, potential disposal facility, and funding required).

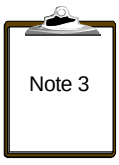


Note 2 presents examples from the uncertainty management matrix prepared for the OU4 soil remediation project at the Mound site.

The various uncertainties in a project may be related. For example, the project team may identify total debris volume that must be disposed of as LLW as an uncertain factor. This uncertainty is a result, in part, of uncertainty regarding the extent and concentration of contamination. The question of acceptable release levels also contributes to this uncertainty. In some cases, defining the relationships among various project uncertainties may help the project team to assess the overall risk to achievement of project goals. An influence diagram is one tool that may be applied to graphically represent these relationships and the impact of project uncertainties on the success of the project (e.g., cost, schedule, regulatory compliance). (*See Exhibit 5.2.*) Influence diagrams are particularly useful for communicating the sources of project uncertainty to parties not directly involved in their identification (e.g., regulators) to obtain their consensus on the logic used to select a preferred disposition approach.

Exhibit 5.2. An example influence diagram

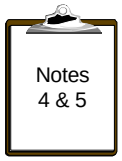




Note 3 presents Mound's use of influence diagramming for the OU4 removal action project.

II. Assessing the likelihood the deviations from expected conditions will occur

A major component of the risk posed by an uncertainty is the likelihood that actual conditions will deviate from the conditions the project team expects to encounter (i.e., that a reasonable deviation will be encountered). The first step in evaluating the risk posed by an uncertainty is assessing this likelihood. The project team may define this probability qualitatively (e.g., by using a five-step incremental scale ranging from "very low" to "very high"). For example, the project team may be uncertain about the depth of contamination. The project team may expect, based on existing information and the behavior of the contaminant, that the contamination does not extend more than one inch from the surface of a wall. Although there is a potential that contamination extends beyond this depth, the project team may determine that the probability is low that actual conditions deviate from its expectations.



See Notes 4 & 5 for a description of Mound's use of the quantitative Monte Carlo method to perform a probability assessment.

III. Evaluating the impacts of deviations on the success of the project

In addition to the likelihood that a deviation will occur, the project team should determine the impact that the deviation will have on achievement of project goals (i.e., protection of human health and the environment, budget, schedule, regulatory compliance). The project team selects and designs the disposition approach based on the expected facility conditions; therefore, if deviations from these expected conditions exist, the disposition approach may no longer be effective or implementable. For example, based on existing information on contaminant concentrations, the project team may have determined that a particular area of the facility can be disposed of as non-hazardous waste following demolition. If contaminant concentrations are higher than the project team expects and actually exceed cleanup levels, the selected disposition approach is not protective and will have to be adjusted after work has begun. This unexpected change in project direction may necessitate rework and will increase the cost and schedule of the project.

The uncertainty management matrix in Table 5.1 provides an example of assessing the impact of encountering deviations from expected conditions. The assessments, made using the five-step incremental scale to estimate the likelihood that the deviation will occur, are supplemented by narrative descriptions. These descriptions may be helpful in communicating concerns to regulators and stakeholders, and developing monitoring and contingency plans. (S*ee Step V.*)

IV. Determining the appropriate approach for addressing the uncertainty

The overall risk posed by an uncertainty is a combination of the likelihood that actual facility conditions deviate from the condition the team expects for a particular factor, and

the impact that the deviation will have on the success of the project. Consideration of these two factors is key to determining if an uncertainty can be disregarded or must be reduced or managed. If the likelihood is low and the impact negligible, then the team may decide that uncertainty poses no risk to the project and can be disregarded. Conversely, if there is a high likelihood that a deviation exists and this deviation has a major impact (e.g., prevents achievement of protectiveness), the risk posed by the uncertainty is high.

For those uncertainties that are not excluded from consideration, the team should determine if the uncertainty should be reduced upfront or managed during implementation, as described in Step V. In general, the uncertainty of a factor should be reduced prior to implementation if the project team determines that:

1) The disposition approach will not be protective of human health and the environment if conditions deviate from expectations; and/or

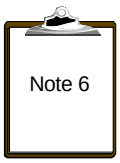
2) The cost of adjusting the disposition approach to account for the deviation, including the cost of rework, etc. and delays in schedule, is greater than the cost of reducing the uncertainty upfront through data collection and additional analysis.

For these uncertainties, the team may conduct additional evaluation prior to implementation of the disposition approach in order to reduce the uncertainty.

If an unexpected condition will impact the success of the project, but the uncertainty cannot be reduced prior to implementation, the uncertainty should be managed during implementation. In addition, the team may determine that managing an uncertainty during implementation is an appropriate, cost-effective approach if:

1) The disposition approach can be adjusted so that protection of human health and the environment is achieved if likely deviations from expected conditions are encountered; and

2) The cost of determining if conditions deviate from expectations and adjusting the disposition approach accordingly is less than the cost of reducing the uncertainty upfront.



Note 6 describes Mound's identification of the factors posing the greatest risk to achievement of project goals for OU4.

V. Developing monitoring and contingency plans

For each uncertainty that can or needs to be managed during implementation, the team establishes a monitoring plan to determine if likely deviations exist and a contingency plan to minimize the impact of these deviations. Monitoring plans may include periodic testing

for additional contaminant types, systematic measurement of actual contaminant depths, or tracking of debris volumes per waste type. Contingency plans that can be readily implemented if monitoring indicates that unexpected conditions exist are established upfront. Depending on the factor and the potential deviation, a contingency plan may include completely changing or adjusting the disposition approach. By establishing such measures prior to implementation, the site minimizes the impact of the deviation on the project. Because the plan can be readily implemented, there are no major schedule or cost delays.

Notes

1. Mound's application of uncertainty management for the Operable Unit 4

There are many methods, both quantitative and qualitative, for managing the risk posed by project uncertainty. The following is an example of Mound's use of quantitative techniques to evaluate and determine the most appropriate approach for addressing uncertainties. Mound has also applied qualitative methods to manage uncertainties.[10]

The ongoing remediation of OU4 at the DOE Mound site is a non-time critical removal action being conducted under the CERCLA for a portion of the disused Miami-Erie Canal containing plutonium contaminated soils. OU4 is located adjacent to the Mound site in the city of Miamisburg, Ohio. As the result of a pipe rupture and storm water runoff from the Mound site in 1969, plutonium contaminated soils were deposited in the canal. Subsequent sediment deposits carried into the canal by the Mound site drainage system have buried the contaminated soils several feet below the surface. Recent sampling studies identified plutonium-238 (Pu-238) concentrations in the canal of up to 4560 pCi/g. With input from stakeholders including the USEPA, the city of Miamisburg, and local public interest groups, Mound has undertaken the removal action to excavate all Pu-238 contaminated soils and sediments at concentrations exceeding 75 pCi/g.

In order to reduce the risk that uncertainties posed to the site's ability to achieve protection of human health and the environment for OU4 within the established budget and schedule for the project, Mound's contractor decided to apply an uncertainty management approach; specifically, the contractor conducted a quantitative cost risk analysis. The OU4 project team identified the following objectives for the cost risk analysis:

- To verify that the chosen remediation strategy could be implemented in a cost effective manner,
- To determine potential impacts of project uncertainties on the baseline cost estimate, and
- To identify risky project elements that should be monitored during the removal action.

Through Mound's quantitative application of uncertainty management, the site was able to identify the factors that pose the greatest risk to achievement of project goals (i.e., the factors most likely to increase cost.) Specific information on Mound's application of this approach are provided in the following notes.

[10] Examples of other applications of uncertainty management are provided in DOE's *Remedial Investigation/ Feasibility Study (RI/FS) Process, Elements, and Techniques Guidance,* and DOE's *Phased Response/Early Actions Guidance*. . To obtain a copy of this document, please access the EH-41 website (http://www.eh.doe.gov/oepa/).

2. Example uncertainty management matrix

Prior to performing a quantitative analysis, the project team conducted a qualitative assessment of project uncertainty. This included identifying all the technical and programmatic uncertainties surrounding the OU4 project and establishing expected conditions and reasonable deviations. Next, the team qualitatively evaluated a probability of occurrence for each uncertainty, as well as the potential impact of those deviations in terms of the project technical scope, cost, and schedule. In order to assess the potential for managing the uncertainty during implementation, the site also assessed the amount of time it would take to respond if the deviation from expected conditions occurred. The table presented on the following page provides examples of the different types of uncertainties identified and assessed for this project.

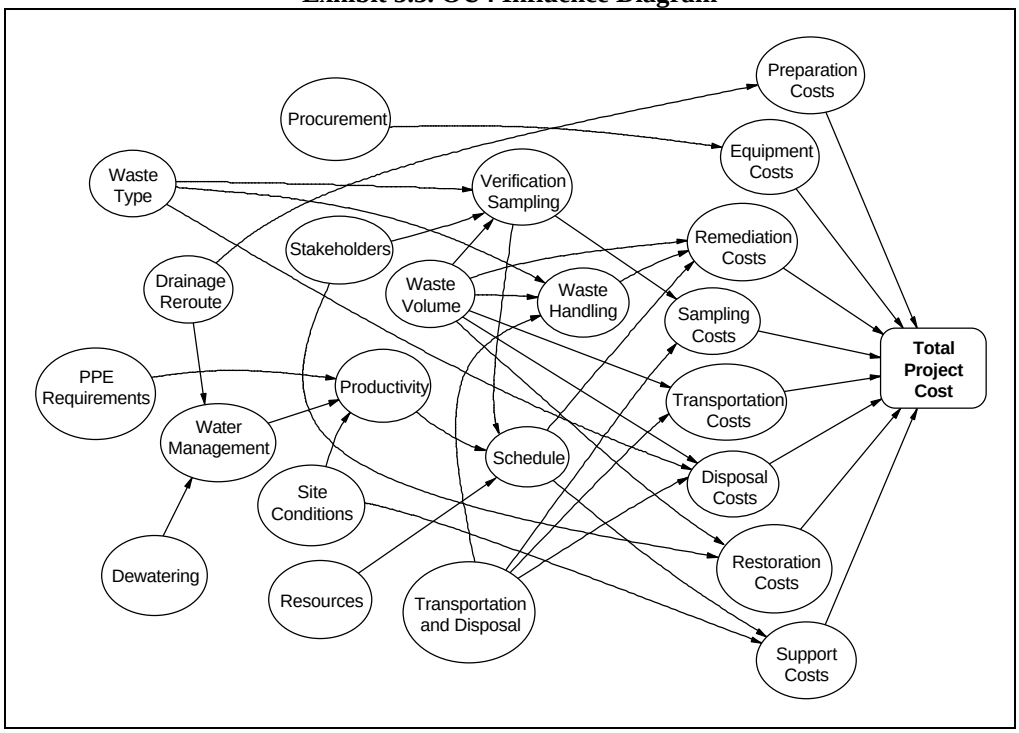
Table 5.2. Examples from the Uncertainty Management Matrix for OU4

UNCERTAIN FACTORS		IMPACTS				
EXPECTED CONDITIONS	POTENTIAL DEVIATIONS	Technical	Cost	Schedule	Time to Respond	Probability of Occurrence
1. Procurement Uncertainties - equipment and supplies might not be delivered or procured on time.						
All excavation equipment will be delivered before excavation is scheduled to begin	One or more pieces isn't procured before project begins	Excavation delayed	Low	High	Short	Low
Articulated haulers will be delivered before excavation is scheduled to begin	One or more pieces isn't delivered before project begins	Excavation delayed	Low	High	Short	Low
2. PPE Requirements Uncertainties - PPE could have to meet additional requirements.						
PPE will be used for level D safety requirements	Contamination is detected above level D safety requirements	New safety requirements must be implemented delaying excavation	Med	Med	Short	Low
Health and safety requirements are only needed for low levels of plutonium contamination	Health and safety requirements must be followed for mixed waste	New safety requirements must be implemented delaying excavation	Med	Med	Short	Med
3. Waste Volume Uncertainties - waste volumes might be higher that planned.						
Plutonium contamination (i.e., > 75 pCi/g) is confined to the soil on average 2.5 feet below surface	Contamination is found deeper than 2.5 feet below surface on average	Increased waste handling, sampling, remediation, transportation, disposal, restoration, and excavation delayed.	High	Med	Long	Low
Plutonium contamination is confined to the canal bed	Contamination is found outside the canal bed	Increased waste handling, sampling, remediation, transportation, disposal, restoration, and excavation delayed	High	Med	Long	Low
4. Waste Type Uncertainties - wastes other than Pu-238 might be encountered.						
Mixed waste will not be detected above planned hauling requirements between canal and plant	Mixed waste is detected above limits	New requirements must be satisfied for hauling waste to mound plant and excavation delayed, new sampling procedures	High	High	Short	Med
Mixed waste will not be detected above planned staging requirements at plant	Mixed waste is detected above limits	New requirements for staging waste must be met and excavation delayed, new sampling procedures	High	High	Short	Med
5. Schedule Uncertainties - the project might not be completed on time.						
Project will be completed in two years	Project is not completed in two years	Increased project support, disposal plans	Low	High	Short	Low
6. Project Resources - resources might not be sufficient to carry out the project as planned.						
Proper project personnel (e.g., health and safety) will be available	Proper personnel is not available	Excavation delayed	Med	Med	Short	Low
Baselines will be approved and funded each year	Budgets are not approved	Excavation and transportation delayed	Med	High	Short	Low

3. Example of Influence Diagramming

The project team created the influence diagram shown in Exhibit 5.3 to define the relationships among project uncertainties and project costs for the OU4 project. In the quantitative analysis that Mound conducted, these relationships were the basis for developing probability trees for calculating the value (i.e., probability) that expected condition will occur.

Exhibit 5.3. OU4 Influence Diagram



Although rather complex, this influence diagram was used for a project at Mound and proved valuable to the core team.

4. Example Result from a Monte Carlo Simulation

Mound used a Monte Carlo simulation to determine the likelihood that actual project conditions would deviate from expected conditions. Monte Carlo simulation is used to develop probability distributions for summary level cost/schedule elements (i.e., the probability that deviations from expected conditions will result in a positive or negative impact on the cost or schedule of the project).

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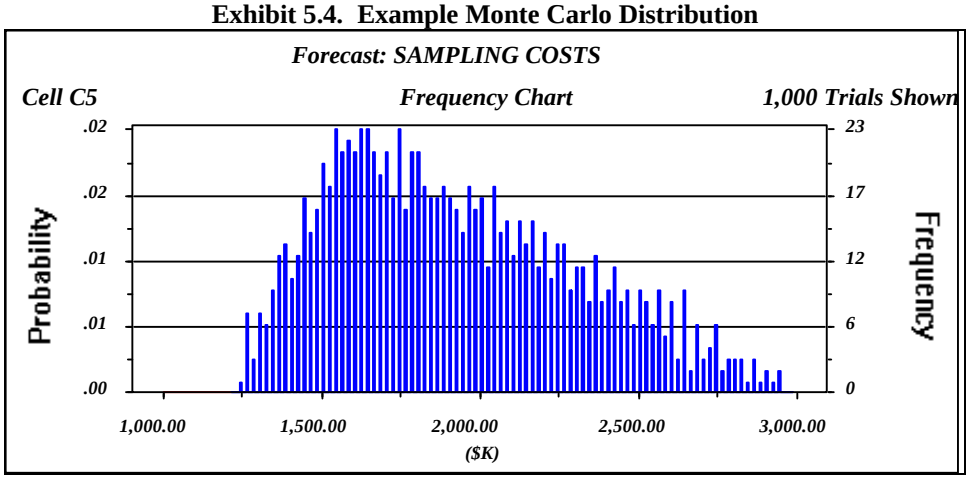
The values used in the OU4 influence diagram model for sampling costs were obtained from a Monte Carlo simulation of three separate cost distributions for canal verification sampling, overflow creek verification sampling, and mobile lab operations. A representation of the summary distribution, resulting from a Monte Carlo simulation, is shown below in Exhibit 5.4. The tenth, fiftieth, and ninetieth percentile values from the summary distribution were used to quantify optimistic, expected, and pessimistic values for sampling costs. Probabilities of incurring these fixed values based on precedent relationships were then captured in the influence diagram model.

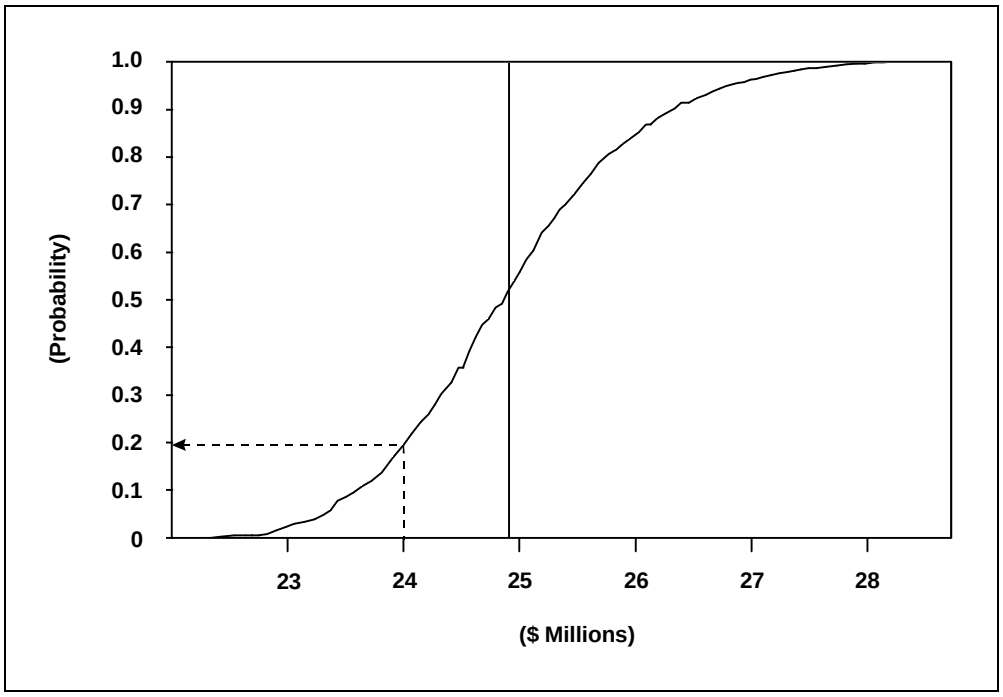
Exhibit 5.4. Example Monte Carlo Distribution



5. Cumulative Cost Distribution

Based on the Monte Carlo simulation, a quantitative analysis of the influence diagram model provided an expected value of nearly $25 million for the total project cost. The model also produced a distribution of potential project costs ranging from $22 million to $28 million, offering only a 20% probability of completing the project within the $24 million baseline cost estimate (*see Exhibit 5.5*).

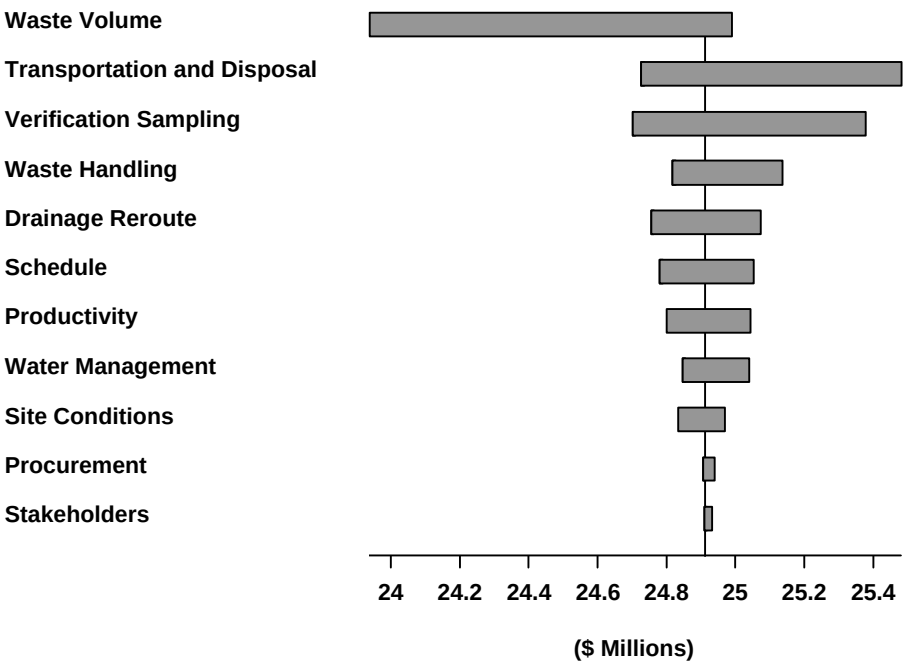
Exhibit 5.5. OU4 Cumulative Cost Distribution



6. Example Sensitivity Analysis

Mound's quantitative assessment predicted that the total project cost was most likely to increase due to additional waste volume, changes in transportation and disposal requirements, and increased verification sampling (*see Exhibit 5.6*). The site's contractor was able to use this information to minimize its exposure to cost risk by refining and improving the project design and by developing specific field procedures for monitoring the performance of high-risk variables. This allowed the contractor to focus its limited resources on managing the project elements having the largest potential to increase the final cost of the removal action.

Exhibit 5.6. OU4 Sensitivity Analysis



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