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Decommissioning Process for Fossil-Fueled Power Plants

Cover photo by Chris White. Used by permission. Stack demolition, June 28, 2008. Xcel Energy High Bridge Power Plant

Decommissioning Process for Fossil-Fueled Power Plants

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PRODUCT DESCRIPTION

This report describes a staged process for the decommissioning and possible demolition of fossil-fueled power generating facilities. Drawn from experience with power and major industrial facilities, the report provides the owner/operator of a plant that is approaching the end of its useful life with an overview of the key elements necessary to successfully implement decommissioning. The process is applicable to full decommissioning, demolition, and closure; to partial scenarios (that is, partial dismantling, remediation, and reclamation of the plant site); and to mothballing (that is, layup of a plant in operable condition).

Results and Findings

The decommissioning process is organized into five stages: project framing; site characterization; remediation and reclamation planning; implementation (the actual environmental abatement, demolition, and site remediation); and closure. In addition to steps within each stage, the role of the project team is described, addressing: project management, communication and consultation, and technical teams. Defining objectives for post-decommissioning land use early in the process has been found to be important to successful decommissioning. The report indicates how to manage bidding and contractual relationships and how to contain costs by managing contingencies through providing substantial data. The report includes charts and checklists that outline the stages, steps, and responsibilities.

Challenges and Objectives

The Electric Power Research Institute (EPRI) described case studies of decommissioning three power plants in a 2004 report (1011220). The current study, initiated for a firm involved in the closure of an urban power plant, organizes the many tasks and decisions involved in decommissioning a power plant into a step-wise, chronological framework delineating milestones, deliverables, and team roles. The process was introduced at EPRI's Plant Closure, Remediation, and Redevelopment Workshop held in November 2009.

The objective of this study is to describe a process for decommissioning fossil-fueled power plants that is adaptable to different sites and facilities with unique attributes, operating histories, and objectives. For this reason, the study is not an in-depth report on layup engineering options and the secondary market in plant equipment and components, for example, but rather a higher level review of decommissioning process management informed by lessons learned from similar undertakings. The process excludes fuel supply (such as mines at mine-mouth facilities), fuel transportation (for example, oil and gas pipelines), and electric transmission facilities (for example, high-tension power lines), which typically have their own operating approvals and separate processes.

Applications, Value, and Use

Companies embarking on decommissioning evaluations will be able to draw on this document for guidance in understanding and organizing stakeholder inputs and the flow and range of steps involved in plant decommissioning evaluations and implementation.

EPRI Perspective

The process described in this report serves as a guide and checklist for understanding the scope of efforts and involvement of multiple parties in full and partial decommissioning projects. Its strength is tapping broad experience in industrial facility decommissioning and land use decisions. With refinement and incorporation of site-specific information, the process defined here should assist companies in developing their own decommissioning procedures and mapping out the complexities, time, and costs that could be involved. Publication of this report coincides with EPRI's launching of the Power Plant Decommissioning Interest Group. This group taps into growing interest across the power industry in managing the retirement and replacement of older power plants as age, surging renewables generation in some areas, improved economics of gas-fired generation, and environmental pressures cause companies to restructure their generation portfolios.

Approach

Investigators convened a project team with broad experience in closures of large industrial facilities, environmental reviews, project management from permitting to construction, operation and decommissioning, and interaction with regulatory agencies. The document represents an assimilation and compilation of their experience.

Keywords

Decommissioning process
Fossil-fueled power plants
Plant closure
Power plant retirement
Site remediation and reclamation

ABSTRACT

This report structures the tasks and decisions involved in decommissioning a fossil-fueled power plant into a step-wise, chronological framework that delineates milestones, deliverables, and team roles. The decommissioning process is organized into five stages: project framing, site characterization, remediation and reclamation planning, implementation (the actual environmental abatement, demolition, and site remediation), and closure. In addition to steps within each stage, the role of the project team is described, addressing: project management, communication and consultation, and technical teams. Further, the report indicates how to manage bidding and contractual relationships and how to contain costs by managing contingencies through providing substantial data. The report includes charts and checklists that outline the stages, steps, and responsibilities.

ACKNOWLEDGMENTS

EPRI acknowledges the financial assistance of Exelon Power and the guidance of James M. Reilly, responsible for managing Exelon's decommissioning process. The motivation for this project is to bring a structure to fossil plant decommissioning that extends the insights gained in several case studies reported in a previous EPRI evaluation of decommissioning, or in the case of Exelon, to their considerable work on the scope and responsibilities of the team of individuals involved in gauging and implementing potential layup, dismantling, and decommissioning projects.

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OVERVIEW OF THE DECOMMISSIONING PROCESS

This document describes a staged process for decommissioning and demolition of fossil-fueled power generating facilities. **The intent of this document is to provide an owner or operator of a plant approaching the end of operational use with an overview of the key elements necessary to successfully implement the decommissioning project.** As such, this document does not include operation-level details concerning procedures, methods, or decisions. The document may also be useful for regulatory agencies and community stakeholders who have some level of involvement in a fossil-fueled power plant decommissioning project.

***Important note**: For the purposes of this document, the term "decommissioning" is intended to mean the process for removing from a plant site structures, infrastructures, impacts, and other encumbrances that may be present on a property. This includes environmental abatement and decontamination within super structures; demolition of structures, foundations, utilities, and other subsurface structures, remediation of impacts to the surface and subsurface, and reclamation of the property depending on the designated end use. The term "remediation" in this document is a general term to mean environmental abatement and decontamination of an existing structure (prior to demolition) as well as the cleanup of impact to the environment.*

This staged process described herein begins after the decision to decommission a plant has been made, and ends with confirmation that the plant and corresponding property have been remediated and reclaimed in a manner that meets the post-decommissioning land use objectives for the site.

This document builds upon the descriptions of decommissioning tasks presented in previous power plant decommissioning guidance documents, such as EPRI's *Decommissioning Handbook for Coal-Fired Power Plants* (2004, 1011220) and the Environment Canada's *Environmental Codes of Practice for Steam Electric Power Generation – Decommissioning Phase* (1992). However, unlike these previous documents, the current document is more focused on organizing the many tasks involved in decommissioning a power plant into a step-wise framework that presents the tasks in chronological order. This document also places a major emphasis on describing milestones, deliverables and team roles along with the descriptions of various tasks involved in each step of the process.

It should be noted that this document does not specifically discuss project scenarios other than full decommissioning and demolition, such as partial decommissioning (i.e., partial dismantling, remediation and reclamation of only a portion of the plant or site) or "mothballing" (i.e., layup of the plant in operable condition so that it may be restarted at a future date) of the plant. However, most of the steps and concepts of this process would apply to any decommissioning scenario.

The process described in this document is intended to be applicable to any fossil-fueled power plant, including those fueled by coal, oil, natural gas, and petroleum coke ("petcoke"), and also is applicable to plants fueled by wood and waste products. It is the authors' experience that the environmental issues associated with specific power plants will vary with the types of fuel(s) used through the operational history of the plant; however, the process of decommissioning (as described in this document) is universally applicable, regardless of the fuel type.

In this document, the focus is on decommissioning the infrastructure that is directly involved in the generation of electric power, including main generating structures, support buildings, fuel and process chemical handling and storage facilities, power house and cooling structures (e.g., towers or ponds); and waste handling facilities that directly support the generation of power, including wastewater collection and treatment ponds and ash storage facilities. This document does not discuss the decommissioning of fuel supply (e.g., mines in "mine-mouth" facilities) or fuel transportation facilities (e.g., gas or oil pipelines), nor does it discuss decommissioning of electricity transmission facilities (e.g., high-tension power lines). These types of facilities typically have their own operating approvals, and therefore require a separate decommissioning process.

Overview of the Decommissioning Process

The process for decommissioning a fossil-fueled power generating plant is summarized on Figure 1-1.

Quick Note:
The processes described herein are included on the attached figures for quick reference. Please refer to these flow charts as you read!

The reason for outlining a specific process is to guide the decommissioning through successive steps of evaluation and decision-making that will ultimately lead to a decommissioned site that (Environment Canada, 1992):

1. Minimizes risk to human health and safety;
2. Minimizes environmental impacts;
3. Complies with all applicable laws and regulations, that is, is consistent with all applicable codes, guidelines and recommended practices, and complies with federal, state and municipal land use requirements;
4. Is suitable for post-decommissioning land use objectives, whether this means unrestricted land use or a specific proposed land use;
5. Does not represent an unacceptable liability to present and future owners; and,
6. Is aesthetically acceptable.

Further, following a specific, proven process allows the owner / operator with the added benefits of:

- Cost containment due to a defined scope of work and elimination of variables;
- Management of liabilities related waste handling, as the process described herein places boundaries and requirements on how contractors can manage waste streams generated from the decommissioning process;

- Ability for the owner / operator to focus on other important issues not directly related to the decommissioning project, as this process allows other Team members to manage the day to day work elements.

The decommissioning process proceeds through five separate stages, each with specific tasks, team roles, deliverables and completion milestones. The stages are briefly introduced in this section of the document, and described in more detail beginning with Chapter 2.

Stages in the Decommissioning Process

- **Stage 1 - Project Framing.** This step is arguably the most important stage in the decommissioning process. It is in this stage that owner / operator, regulatory, and stakeholder expectations are first identified; project management, communication and consultation and technical teams are formed; a process for making site management decisions is developed; project management systems are developed and put in place; preliminary project schedule and funding arrangements are developed; and, preliminary post-decommissioning land use objectives are defined.

  It is the authors' experience that the more effort that is put into Stage 1 of the process, the more likely it is that the project will be completed successfully – that is, when the project is finished, the objectives defined during the project are met.

  Quick Note:
  One of the most critical elements to a successful decommissioning project is defining objectives for post-decommissioning land use early in the process.

- **Stage 2 - Site Characterization**. This stage involves a series of focused site investigations, the findings for which provide an understanding of the potential subsurface environmental issues at the site, a description of hydrological and hydrogeological conditions on the property, an understanding of potential waste streams generated during the abatement and demolition work, and identification of constraints to meeting the preliminary post-decommissioning land use objectives for the site. Various agencies have developed guidance for tiered environmental site investigations; for the purposes of this document, we have elected to use the following nomenclature:
  - Phase I Environmental Site Assessment - a non-intrusive study of the historical uses of the property to identify potential environmental concerns.
  - Phase II Environmental Site Assessment - typically includes an intrusive sampling and analysis program designed to determine if residual impact is present in the surface or subsurface, and the corresponding magnitudes.
  - Phase III Environmental Site Assessment - involves additional sampling and analysis of subsurface media to further identify the magnitude and extent of impact so that strategies for future remedial action options can be developed.

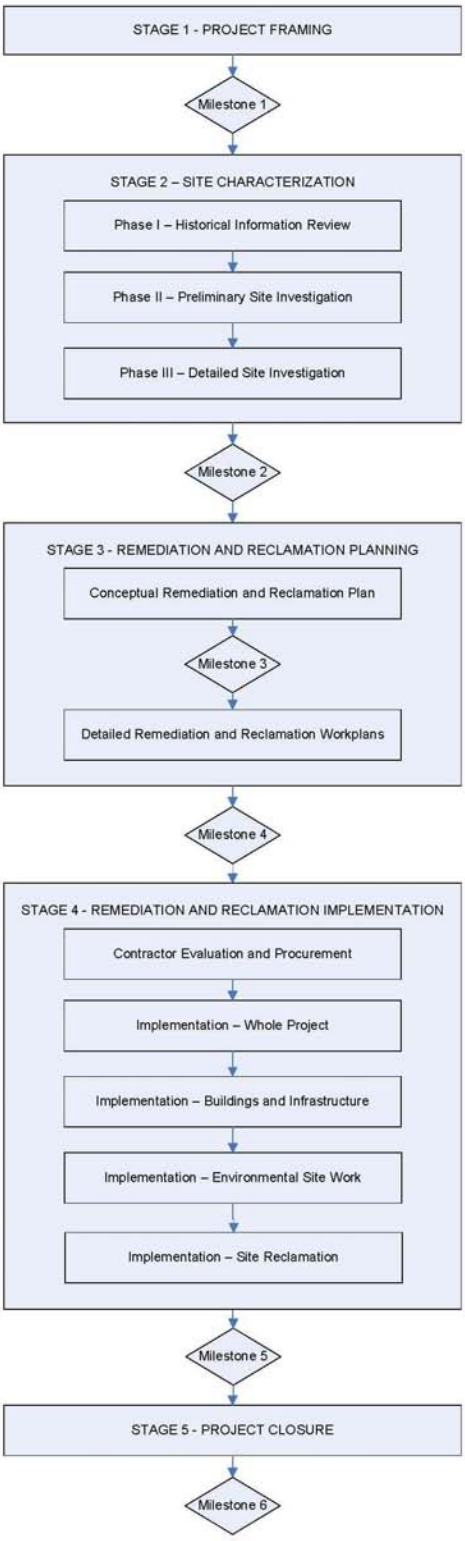


Figure 1-1
Staged Approach to Decommissioning Fossil-Fueled Power Generating PlantsStage

- **Stage 3 - Remediation and Reclamation Planning**. This stage includes the development of remediation and reclamation solutions that address the environmental issues, site conditions and constraints identified during Stage 2. These solutions must be developed in a manner that is consistent with the post-decommissioning land use objectives for the site. Stage 3 consists of two sub-stages:
    - the development of a Conceptual Remediation and Reclamation Plan;
    - the completion of a "pre-demolition" survey to identify environmentally-regulated materials and to confirm underground structures and utilities; and,
    - the development of Detailed Remediation and Reclamation Plans and Contract Documents.
- **Stage 4 - Implementation**. This stage includes the site workings according to plans developed in Stage 3. In this stage, environmental abatement, demolition, and site remediation occurs; the site is reclaimed according to the post-decommissioning land use objectives; and any long-term risk management measures are installed.
- **Stage 5 - Project Closure**. This stage includes those tasks necessary to confirm that the remediation and reclamation of the site has been successfully completed, the site meets the post-decommissioning land use objectives defined in earlier stages of the project, and that owner / operator, community stakeholders and regulatory review agencies have all confirmed their approvals for the project. Closure also prepares the site for ownership transfer, and/or redevelopment consistent with the post-decommissioning land use objectives. Long-term risk management controls (e.g., notification for deed to property, environmental monitoring programs and approvals, institutional access controls) are also put into place during this stage.

Project Teams

A successful decommissioning project requires the involvement of people with necessary interests and expertise. To accomplish the objectives of the decommissioning process, and to clarify roles and responsibilities, organization of project members into the following teams is suggested:

Project Management Team

The Project Management Team is responsible for managing the decommissioning process from start to finish, and ensuring that the objectives of the decommissioning process are met. The Project Management Team should include representation from, and perhaps lead by, the power plant operator. This is important because in most situations the operator also owns the site and has significant input into the decision as to what the post-decommissioning land use objectives are for the site. In other cases, the project management team may be led by a consultant hired by the plant operator.

The project management team leader should, ideally, have experience in the relevant facets of the decommissioning of large industrial sites – although not necessarily fossil-fueled power plants. It is the experience of the authors that the challenges of managing the entire process of

decommissioning an industrial facility from start to finish are relatively similar regardless of the type of industrial process; and that these challenges are typically greater than the challenges of understanding the specifics of decommissioning a power plant. In other words, a project manager that has experience in decommissioning industrial facilities that were not exclusively power plants is more likely to be successful than a project manager who has extensive knowledge of power plant operations, but no decommissioning experience.

In addition to the team leader, the project management team should include (or at least have access to) personnel with the following expertise and roles:

- Senior management from the power plant operator, who understands and can represent the long-term corporate risk management policies and obligations (including financial, contractual and environmental risks) of the operator;
- Coordinators and/or communication facilitators, who can organize, chair and report on meetings held within the project team during planning and implementation;
- Public Relations specialists, who can be utilized for the communication of sensitive information to the public or media, if deemed necessary;
- Information management specialists, who will be responsible for managing the immense amount of data, figures, photos, reports and other information that will be used and/or generated by the project teams. These specialists may require expertise in databases, geographical information systems (GIS) or other systems necessitated by the project.
- Project management and coordination specialists, who will assist the project management team lead by coordinating the various project teams, and who will also track project deliverables, schedules and budgets.

In addition to the above-mentioned personnel, the project management team will include senior representatives of the communication and consultation team and the technical teams, which are described below.

Communication and Consultation Team

The communication and consultation team represents the interests of the operator, the applicable regulatory agencies (if applicable), and community stakeholders. Membership on this team includes representation from the power plant operator (which may include representatives of management and labor); but should also include representation from the regulatory agencies who will be reviewing the site decommissioning, and representation from affected community stakeholders who have a vested interest how the site is decommissioned and what land use(s) the site will be suitable for after the decommissioning is complete. The communication and consultation team provides operator, regulatory and community stakeholder input into the process of determining the post-decommissioning land use objectives for the site, and also provide input into decisions on how these objectives are to be met.

The specific membership of the team and amount of weight given to each member's input into decisions is best determined through a formal consensus-based decision structure. The overall objectives provide the context for this process, as described in the concluding comments on

> ***Quick Note:***
> *The need to have more or less representation from the operator, regulatory agencies and community stakeholders is project-specific.*

"Making Site Management Decisions". If the site is located in a jurisdiction that has well-defined standards applicable to power plant decommissioning, and there are few or no affected community stakeholders with an interest in the site, then the need to have regulatory and community stakeholder input into the decommissioning process is lessened. However, if there is regulatory uncertainty (e.g., no jurisdictional standards for decommissioning, no precedents), or a high degree of community interest (e.g., the site is located in a developed area with many potentially competing desires for the site), then more emphasis must be put on the role of the communication and consultation team.

Technical Teams

The decommissioning of a fossil-fueled power plant requires that the project team includes, or at least has access to, an experienced group of engineering, scientific and other support specialists. If a project is complex, these specialists can be organized into two sub-teams, "environmental" (responsible for environmental assessment, remediation and reclamation of the site) and "infrastructure" (responsible for dismantling the above and below ground infrastructure).

Membership on the environmental and infrastructure technical teams may include, as warranted by the project, experts in the following disciplines:

- Power plant operations
- Industrial facility decommissioning
- Asset valuation and reuse
- Contaminated site assessment
- Human health and ecological risk assessment
- Soil science and soil quality assessment
- Water quality assessment
- Reclamation
- Hydrology and surface water engineering
- Hydrogeology
- Geotechnical engineering
- Civil engineering
- Hazardous materials management
- Occupational Health & Safety
- Aquatic and, or, terrestrial ecology
- GIS, database and drafting; and
- Report production (administrative, editorial)

Tasks and Deliverables

Each stage in the decommissioning process includes specific tasks and sub-tasks to be administered in a chronological or, if appropriate, parallel manner. The project management, communication and consultation and technical teams have specific roles to play on each of the tasks, and in many cases there are specific deliverables that are produced at the completion of tasks. The tasks, team roles and deliverables associated with each stage of decommissioning are described in Chapter 2.

Decision Milestones

The staged decommissioning process requires that defined milestones be met at the end of each stage, before the next stage is started. The six decision milestones are shown in Figure 2, and introduced below. The specific tasks, deliverables and team roles that lead to each decision milestone are described in Chapter 2.

- **Milestone 1** is reached at the end of Stage 1, Project Framing, and includes the acceptance by the project management and communication and consultation teams of the project decision support structure, project boundary description and initial description of post-decommissioning land use objectives. By accepting that this milestone has been reached, the project team also agrees to proceed with the next stage in the process, Site Characterization.

> ***Quick Note:***
> *The decision and progress milestones are shown on the attached flow charts at chronological positions. This helps to recognize the value of these important decision-making elements.*

- **Milestone 2** is reached at the end of Stage 2, when the Site Characterization is complete and there is good understanding of environmental issues and constraints. At this milestone, the project management, communication and consultation, and technical teams compare the results of the Site Characterization with the post-decommissioning land use objectives developed in Stages 1 and 2, and determine whether or not there are incompatibilities. In other words, the question is asked: *"Do the results of the Site Characterization suggest that the site can be remediated and reclaimed in a way that meets the requirement of the intended post-decommissioning land use?"* If the answer is "no", then the project team must revise the post-decommissioning land use objectives. If the answer is "yes", then the process can advance to Stage 3, Remediation and Reclamation Planning.

- **Milestone 3** is reached at the completion of the Conceptual Remediation and Reclamation Plan for the site, in Stage 3 of the decommissioning process. The Conceptual Remediation and Reclamation Plan outlines remedial solutions for the site, given the results of the Site Characterization completed in Stage 2. At Milestone 3, the question is asked: *"Will the site remediation and reclamation as described in the Conceptual Plan meet the requirements of the post-decommissioning land use objectives?"* If the answer is "no", then the project team must revise the post-decommissioning land use objectives. If the answer is "yes", then the process can advance to the development of Detailed Remediation and Reclamation Workplans.

- **Milestone 4** is reached at the end of Stage 3, once the Conceptual Remediation and Reclamation Plan and the Detailed Remediation and Reclamation Workplans have been completed. The same question is asked as that in Milestone 3. If the answer is "yes", then the process can advance to Remediation and Reclamation Implementation, which is Stage 4 in the decommissioning process.

- **Milestone 5** is reached at the end of Stage 4, once the site has been remediated and reclaimed according to the Conceptual Plan and Detailed Workplans. At this milestone, the majority of the site works have been completed according to plan, with the exception of a few risk management tasks that occur in Stage 6. Milestone 5 includes acceptance by the project management, communication and consultation and technical teams that the remediation and reclamation of the site is complete, and the site will meet the post-decommissioning land use objectives defined and refined throughout the project.

- **Milestone 6** is reached when the decommissioning project reaches completion, and is one final check that the project management, communication and consultation and technical teams agree that the site decommissioning is complete, any required long-term risk management measures are in place and the site is suitable for the finalized post-decommissioning land use objectives. At completion of this milestone, the site may be redeveloped in a manner consistent with the post-decommissioning land use objectives, either by the power plant operator or another party.

Post-Decommissioning Land Use Objectives

One of the most critical elements to a successful decommissioning project is defining objectives for post-decommissioning land use early in the process. Post-reclamation land use objectives are the umbrella for all technical and contractual decisions made. These objectives drive the degree of site assessment, demolition, remediation, reclamation and long-term risk management required on the site.

The post-reclamation land use objectives are influenced by the short- and long-term risk management goals of the property owner. However, the definition of post-reclamation land use objectives should also include input gained from consultation with the appropriate regulatory agencies (if warranted) and community stakeholders. Involving regulatory agencies and community stakeholders in decisions about post-decommissioning land use objectives will greatly increase the probability that project acceptance will be achieved from the local community and the reviewing regulatory agencies.

Post-decommissioning land use objectives should take the form of a formal land use classification (e.g., "industrial", "commercial", "agricultural", "parkland", "residential") that is consistent with the land use designations used by regulatory agencies in the jurisdiction where the site is located. Typically, these land use classifications denote specific types of activities (human and ecological) that must be supported on the post-reclamation landscape, and are also reflective of the environmental receptors and exposure pathways that will be considered when assessing and making decisions regarding risk to people and ecological receptors on the site (see Chapter 3, Site Characterization for more details). Supported activities, exposure pathways and receptors that are incorporated into land use classifications vary to a great degree amongst

different classifications and jurisdictions. Therefore, consultation with the applicable regulatory agencies regarding land use designations and supported land use practices is fundamentally important.

Preliminary post-decommissioning land use objectives are developed during Stage 1 of the decommissioning process through consultation amongst the appropriate Team members. As information becomes available (e.g., results of the Site Characterization), these preliminary land use objectives are re-examined for appropriateness and adjusted as necessary.

It is often the case that remediating the entire site to the highest environmental standard, which would allow unrestricted post-decommissioning land use, is not practically achievable. For example, it is possible that portions of the site may best be suited only for redevelopment as an industrial site. In these cases, which are more often the situation than not, future land use restrictions must be put in place (see the discussion on Closure, end of Chapter 2). Also, in any case where unrestricted land use is not possible, consultation with applicable regulatory agencies and community stakeholders throughout the decommissioning process becomes even more important.

Making Site Management Decisions

Ultimately, the closure/decommissioning process results in an altered land use configuration of the plant property; and potentially, the contiguous lands surrounding the property. Each plant site has the potential to bring new opportunities and challenges to the decision-making arena. Arriving at well-conceived, effective decisions is critical to the success of the project; this can be complicated because decisions are often made by committees evaluating and interpreting information without the context of the overall objectives or a focused plan. The figures in Appendix A provide a graphical representation for site management decision-making, including team responsibilities."

2
THE STAGED APPROACH TO DECOMMISSIONING

Stage 1 - Project Framing

Project Framing or Stage 1 of the decommissioning process is probably the most important stage in the decommissioning of a power plant (Figure 1-1 and Figures A-1 and A-2).[1] Stage 1 essentially sets the decommissioning project up for success or failure.

In Project Framing, the expectations of the site owner and operator, regulatory agencies and community stakeholders are first identified; project management, communication and consultation and technical teams are formed; a process for making site management decisions is developed and tried; project management systems are developed and put in place; preliminary project schedule and funding arrangements are developed; and, preliminary post-decommissioning land use objectives are defined.

> ***Quick Note:***
> *The reader can easily use this Chapter as a checklist; the idea is to provide items for readers to consider. How one names and designates responsibilities to the project committees should be project-specific. A condensed check-list is provided in Appendix B.*

Tasks

The tasks to be accomplished in Stage 1 – Project Framing, include (in chronological order of when tasks are first initiated):

1. The site owner and power plant operator establishes the Project Management (PM) Team, which will be responsible for implementing and managing the tasks required as part of Stage 1;
2. The PM Team develops a framework for the decision-making process for the project;
3. If necessary to refine funding requirements, the owner/operator engages the PM Team to obtain "directional" estimates for different end use scenarios - the directional estimates are intended as guidelines to facilitate end use decisions only.

[1] Appendix A provides charts delineating the tasks within each stage and the responsibilities of team members and other stakeholders. Appendix B offers a brief "checklist" of the major steps of the decommissioning process described in this chapter. Appendix C provides guidance on procedures for preliminary cost estimating.

4. The PM Team develops a preliminary description of the project boundaries, including obtaining information on the following, at a minimum:

    - relevant, applicable or affected stakeholders (which may include potential future property developers); the decision as to the breadth of stakeholders is made on a project-specific basis;
    - corporate policies, bylaws or environmental management systems (EMS) that may be applicable;
    - acknowledgement of relevant regulatory agencies (may include federal, state, municipal, tribal, international);
    - anticipated project timelines and schedules;
    - post-decommissioning land use objectives, taking into account long-term liability and indemnification goals as appropriate;
    - roles and responsibilities for other project team members;
    - labor considerations (union contract requirements if applicable, etc.).

> ***Quick Note - Estimating:***
> *Estimating is an important step; the reader should engage the assistance of an engineer or reputable contractor to help estimate for funding purposes. It is best to provide the estimator with a boundary of scope scenarios - it can be as easy as a one page list - to frame in a more accurate estimate. Hint: do not simply call a demolition contractor and receive a cost over the phone!*
> *Further comments in Appendix C.*

5. As part of the decision support structure, applicable operator and operator representatives, regulatory agencies and community stakeholders are identified and enlisted into the Consultation and Communication Team;
6. The PM and Consultation and Communication Teams meet to finalize the decision support structure for the project, and describe the roles, responsibilities and decision-making weightings for the each of the Consultation and Communication Team members;
7. The PM Team, working with the regulatory agency representatives (as necessary) on the Consultation and Communication Team, identify applicable requirements. Considerations related to current operating permits (i.e., the need to cancel, revise, maintain or replace) are also assessed at this time, and a preliminary plan is developed on how these impacts are best addressed.
8. The PM and Consultation and Communication Teams finalize the project boundary descriptions, taking into account the preliminary post-decommissioning land use objectives and decision-making elements;
9. The PM Team develops a project management system, which includes a document control system, data management system and data quality objectives, project health and safety considerations, contracting mechanisms, etc.

Deliverables

The deliverables from Stage 1 - Project Framing include:

- A list of the various project teams, team members, and roles and responsibilities;
- A project decision-making process, in flow chart or matrix form with supporting narrative;

- Project boundary description, including preliminary post-decommissioning land use objectives, and other components as described under Task 4 above;
- Directional estimates for different end use scenarios, if necessary; and,
- A project management system, including:
    - document control system,
    - data management system and data quality objectives, and
    - a project health and safety (H&S) plan.

Milestone 1

At the end of Stage 1, the PM and Communication and Consultation teams should agree on the project decision-making process, roles and responsibilities of key team members, project boundary description, post-decommissioning land use objectives, plant labor involvement (if applicable), and decommissioning scenarios. By agreeing on these project deliverables, Milestone 1 (Figure A-1) is reached, and the project can proceed to the next stage in the process, Site Characterization.

Stage 2 - Site Characterization

Site characterization is a critical step in the planning and implementation of the overall decommissioning process. The site characterization is a stepwise approach that provides the Owner / Operator an evaluation of environmental liabilities related to impacted surface and subsurface media. This information is used in end use determinations, funding, demolition planning, and long term management of properties.

The stepwise approach includes the following major phases:

- **Phase I Environmental Site Assessment** - A non-intrusive evaluation of potential areas of environmental concern.
- **Phase II Environmental Site Assessment** - Confirmation of presence or absence of impacted media related to findings of the Phase I ESA through physical sampling and analysis.
- **Phase III Environmental Site Assessment** - Further investigation of confirmed impacts designed to establish magnitude and extent of contaminants and to obtain data for remedial action planning.

A general description of the phased approach to site characterization is provided in this chapter.

Phase I Environmental Site Assessment

Objective

The purpose of the Phase I Environmental Site Assessment (ESA) is to evaluate the potential for impact to the environment as a result of past plant operations. For the purpose of this document "impact to the environment" relates to residual contaminants found in surface soil water, subsurface soil, sediments, and/or groundwater. The Phase I ESA is a non-intrusive study; no sampling or other physical characterizations are typically performed.

The *ASTM E1527 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* details the process of undertaking a Phase I ESA. In the United States, this ASTM standard is used as the regulatory-accepted method throughout the country. For ease of reference, only the main elements of this process are described herein.

Tasks

There are four components to a Phase I ESA: Records Review, Interviews, Site Reconnaissance, and Reporting.

Task 1. Phase I ESA Data Gathering

- Records Review: Compilation of available records that describe the past and current occupants and activities of the plant property and, if available, surrounding properties. Records to review can be of several categories, including: Operational Records, Plant Infrastructure Drawings, Public Historical Documents; Environmental Documents.

- Interviews: Interviews with relevant site personnel, including past and present owners, operators and occupants; and local government officials (if warranted).

- Site Reconnaissance: Detailed site visit and walkover to document current conditions of the plant property and surrounding properties (if accessible), with a focus on areas of concern noted during the records review and interviews.

Task 2. Evaluation and Reporting

Upon completion of data gathering, the information obtained should be evaluated to gain an overview prior to, or in parallel with, the report preparation. This allows the Owner Team or PM Team to evaluate the completeness of the data and to consider the need for additional data gathering as part of the Phase I assessment.

One important aspect of the Phase I ESA process is to help identify areas of the site that have similar operational history, or similar issues of environmental concern (e.g. coal handling areas, ash disposal areas, lay down areas, transformer yards, etc.). When decommissioning large facilities, it is very helpful to segment the property into smaller, more manageable areas. It can also help in the management of data, and in reporting.

Deliverables

There are two deliverables related to the Phase I ESA:

1. A Phase I Environmental Site Assessment Report, documenting the site history, site conditions, site use, and issues of environmental concern (or "recognized environmental conditions" as referred to in the ASTM standard); and

2. If warranted, a site diagram showing logical subdivisions or areas of the plant property that have common environmental issues, and that can be managed through the decommissioning process in a similar fashion.

> ***Quick Note - Phase I ESA Report:***
> *The Phase I ESA Report can sometimes be written by environmental consultants in a manner that is speculative. Although professional opinions from the consultant are part of the ASTM requirements, the findings should be fact-based and without conjecture. Should the Phase I ESA become public record, phrases such as "likely contaminated" or "threat to the environment" may negatively affect public perceptions when the issues identified in the report have not yet been confirmed through intrusive sampling and analysis.*

Upon completion of the Phase I Environmental Site Assessment, the Owner Team will evaluate the potential environmental liabilities, and discuss these liabilities in the context of long term land use determinations, demolition planning, etc. In the event that the liabilities require confirmation through physical sampling and analysis of potentially affected media, a "Phase II ESA" would be performed as discussed in the next section.

Phase II Environmental Site Assessment

Objectives

The objective of the Phase II Environmental Site Assessment (ESA) is to further confirm the presence or absence of impact related to the environmental issues identified during the Phase I ESA. This is done through physical sampling and analysis and other mechanisms. Evaluation of the environmental issues is completed through a process of conceptual site model development and site investigation. Guidance on Phase II site assessments can be found in *ASTM E 1903-97, Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process*. This standard process is summarized in the following tasks.

Tasks

Task 1. Development of Conceptual Site Models

> ***Quick Note - Smaller Projects:***
> *For smaller Phase II projects, Tasks 1 through 3 are easily done and not time consuming.*

The first task is to develop a conceptual understanding of the surface and subsurface environment related to issues of environmental concern (hereafter called Areas of Concern, or AOC) identified in the Phase I ESA, and for the plant property in general. The Conceptual Model describes the spatial relationships between contaminant and waste sources, surface and subsurface pathways (surface water bodies, soil and rock,

groundwater flow), and potential receptors (surface water bodies, water supply wells, groundwater discharge areas).

Development of a Conceptual Model allows the investigator to qualitatively assess relationships between contaminant sources and pathways, and to identify areas of uncertainty that will require further investigation. The Conceptual Model also allows the investigator to plan the site investigation program in a methodical and defensible manner.

Detailed discussion of Conceptual Model development is found in *ASTM E1689-95(2003) Standard Guide for Developing Conceptual Site Models for Contaminated Sites*.

Task 2. Selection of Environmental Assessment Criteria

A list of chemicals of concern is typically established during the Phase I ESA program. Once the Conceptual Model(s) has been developed, and the qualitative relationships between sources, pathways and receptors are understood, decisions can be made on the applicable soil, surface water and groundwater quality criteria to be used for assessment of environmental quality data. Decisions on applicable criteria should be made in consultation with the local regulatory agencies, if warranted.

Task 3. Development of Data Quality Objectives

The Data Quality Objectives process is a seven-step process used to plan the collection of data of suitable type and quality to meets the needs of the study. The first five steps of the process are focused on determining the qualitative study needs, such as the nature of the problem to be investigated, the decisions to be made based on the data, the types of data needed, and a logical definition of how the data will be used to draw conclusions.

Quick Note - Data Quality Objectives: *Establishing DQOs before implementing a sampling and analysis program helps to ensure a successful site investigation. By understanding the DQOs upfront, gratuitous sampling and analysis can be avoided; conversely, understanding DQOs also minimizes the potential for the analytical program to "miss" capturing the needed data, thereby avoiding additional mobilizations for incremental data collection.*

The sixth step involves definition of quantitative criteria on the quality and quantity of data to be collected. The seventh step is the design of the data collection program. The advantages of using the Data Quality Objectives process in study design include clear communication and documentation, defensible data collection, and logical decision structure.

Detailed guidance on application of the Data Quality Objectives Process is provided in *EPA/240/B-06/001 February 2006. Guidance on Systematic Planning using the Data Quality Objectives Process.*

Task 4. Design of Phase II Preliminary Site Investigations

Task 4 involves design of surface and subsurface site investigations based on the Areas of Concern identified during the Phase I ESA, and on the contaminant source and receptor relationships identified in the Conceptual Site Model(s). Objectives of the Phase II investigations can include:

- Identify the types of contaminants, the quantities, concentration ranges, and general locations;
- Identify potential off-site sources of contamination that may affect the project;
- Confirm soil, geological, hydrogeological and hydrological conditions of the Site and surrounding area;
- Provide the initial inputs to the identification of site remediation criteria.

The Phase II investigations may be specific to each AOC, but can also include data to support larger site-wide requirements. The deliverable from Task 4 is a Phase II Preliminary Site Investigation Work Plan that addresses each AOC or the entire site, if necessary.

Task 5. Development of Data Management System

An important aspect of the Phase II investigation process is to develop a system for managing all the chemical and physical data that will be gathered during the investigation phases. This can represent a significant amount of information, and should be handled and stored in an organized fashion to allow ongoing reference, and to provide quality and defensibility. Consideration should be given to developing and maintaining an electronic database for larger facility decommissioning programs.

Task 6. Development of Quality Assurance Project Plans

Task 6 involves the preparation of plans that summarizes the Data Quality Objectives for the Phase II investigations, and describes the quality assurance and quality control methods and measures to be implemented to meet the Data Quality Objectives. For smaller projects, this task may not be required as a stand-alone document but rather included in other planning documents.

Further discussion of Quality Assurance Project Plan format and content can be found in *EPA/240/R-02/009 Guidance for Quality Assurance Project Plans (G-5)*.

Task 7. Development of Health and Safety Plans

Health and safety plans should be developed for the Phase II site investigation works, consistent with corporate, state and federal occupational health and safety requirements.

Task 8. Implementation of Phase II Preliminary Site Investigations

Upon completion of the planning tasks associated with Phase II ESA, the investigations can be implemented.

Task 9. Compilation of Data into the Data Management System

Data returned from the Phase II ESA should be checked and validated as described in the Quality Assurance Project Plan, and compiled into the project Data Management System for subsequent analysis and comparison.

Task 10. Revision of Conceptual Site Models

Upon completion of the Phase II investigations, the Conceptual Model should be reassessed. As data is reviewed and the Conceptual Site Model is revised, there may be opportunity to revise or adapt the Phase II investigations to consider changing uncertainties and priorities.

Task 11. Preparation of Phase II ESA Reports

The Phase II ESA report will detail the nature and probable extent of chemical impacts, will identify data gaps, and will provide recommendations for additional investigation or assessment.

Deliverables

Deliverables for the Phase II ESA process are noted in the Task descriptions above.

Upon completion of the Phase II ESA, an evaluation will be made to determine if contamination has been sufficiently characterized. If not, additional decisions will be made to proceed with Phase III Detailed Site Investigations on part or all of the Site.

Phase III Environmental Site Assessment

Objectives

The objectives of the Phase III ESA are to:

- delineate the extent of contamination
- further define the physical and chemical conditions of the site to assess contaminant movement along various pathways
- collect structural and soil data required to clean, demolish, stabilize and isolate structures and deposits;
- provide more detailed data to assess the validity of the remediation criteria; and
- provide information necessary to assess the feasibility of various remediation and reclamation options.

The Phase III ESA is typically focused on confirmed areas of known impact, and a larger number of samples are collected from fewer locations. This may also include more specific testing and analysis requirements to further refine the Conceptual Site Model. For example, pumping tests may be conducted to identify aquifer parameters to further define a groundwater pathway, or sorption coefficient tests may be performed to determine sorption properties of various chemicals of concern in soil.

Tasks

The Phase III ESA sequence is similar in nature to the Phase II ESA, specifically as it pertains to development of planning deliverables, such as health and safety plans, QAPP documents, Data Quality Objectives, etc. For ease of reference, duplicative tasks have not been included in this section.

Task 1. Selection of Remediation Criteria for Land Use Scenarios

Based on the potential end land use objectives, appropriate remediation criteria (or chemical endpoints) can be established for the remediation program. Remediation criteria involve simply reviewing applicable State or Federally promulgated cleanup requirements (where present). This is important as the initial task because it allows the Phase III ESA to be designed to collect data that supports the remediation criteria requirements.

Task 2. Determination of Requirements for Environmental Simulations and Risk Assessments

At this stage of the project, there may be requirements to conduct environmental simulations such as groundwater transport modeling to predict chemical concentrations at receptors. Further, there may be requirements to conduct ecological or human health risk assessments to assess possible risks to receptors from known or predicted chemical concentrations.

Data requirements for environmental simulations and risk assessments should be determined during this task, so that data collection can be included as part of the Phase III ESA.

This task is not always needed; the decision is based on the complexity of the site conditions and contaminants.

Task 3. Design of Phase III ESA

Upon completion of Tasks 1 and 2, the Phase III ESA can be scoped and planned accordingly.

Task 4. Implementation of Phase III ESA

Upon completion of the planning tasks associated with this phase, the investigations can be implemented.

Data returned from the Phase III ESA should be checked and validated as described in the Quality Assurance Project Plan, and compiled into the project Data Management System for subsequent analysis and comparison.

Quick Note - Regulatory Agency Involvement:
As part of the site characterization process, the Owner / Operator should consider engaging the appropriate regulating agency before or after the Phase III ESA. Depending on the nature of confirmed environmental impacts, there may be a requirement to notify the agency. Regardless, engaging the agency is often useful in that agency representatives can become integrated in the planning of future investigations or remedial actions, thus helping to expedite remedial action acceptance in the long term.

Task 5. Revision of Conceptual Site Models

As with the Phase II ESA, the Conceptual Model should be reassessed upon completion of the Phase III ESA. Revision or adaptation of the Phase III ESA can be made during the investigation program in response to changing uncertainties and priorities.

Task 6. Preparation of Phase III ESA Reports

Task 6 involves preparation of the Phase III ESA reports that detail the extent and magnitude of contamination, a summary of environmental simulations, risk assessments, and remediation objectives, as well as identification of data needed to further develop remediation and reclamation options.

Deliverables

The deliverables associated with the Phase III Detailed Site Investigation include:

- The revised Conceptual Site Model
- The Data Quality Objectives for the Phase III investigations
- The Phase III ESA Work Plan
- The Phase III ESA Quality Assurance Project Plan
- A Data Management System updated with the Phase III data;
- Health and Safety Plans; and
- The Phase III ESA Reports.

Milestone 2

This Decision Milestone is reached upon completion of Stage 2 – Site Characterization. Site conditions should be sufficiently understood at this point to determine if the site can be remediated and reclaimed in a way that meets the requirements of the intended post-decommissioning land use. If the site cannot be remediated or reclaimed in this manner, then the project team must discuss the possibility of revising the post-decommissioning land use objectives. If the site can be remediated or reclaimed in a manner that meets the post-decommissioning land use objectives, then the overall decommissioning process can advance to Stage 3, Remediation and Reclamation Planning.

Stage 3 - Remediation and Reclamation Planning

Preparation of Conceptual Plans

Objectives

The objectives of the Conceptual Remediation and Reclamation Plan serve two distinct yet linked tasks: 1) remediation of surface and subsurface media, and 2) the physical abatement and demolition of the site structures.

- For Objective 1 above, the conceptual plan will identify potential subsurface remediation and reclamation options for the site, evaluate those options in terms of selection criteria such as engineering feasibility, stakeholder acceptance, schedule and cost, and select preferred remediation and reclamation options that will meet the requirements of post-decommissioning land use.
- For Objective 2 above, the conceptual plan will allow the Owner and PM to effectively scope the physical removal of the site structures in a manner that achieves Owner contracting and risk requirements, and the land use goals.

Preparation of Remediation and Reclamation Plans

Tasks to be undertaken in preparation of the Conceptual Remediation and Reclamation Plan include:

- Literature review of Remediation and Reclamation Options, and selection of options for further assessment;
- Design and implementation of bench-scale testing and computer simulations to support remediation and reclamation options feasibility assessment;
- Implementation of risk assessment and risk analysis to support remediation and reclamation options feasibility assessment (as necessary);
- Estimation of costs and schedules for Remediation and Reclamation Management Options;
- Selection of Preferred Remediation and Reclamation Management Options for each Area of Concern; and
- Preparation of a Conceptual Remediation and Reclamation Plan for review by the Owner and/or other teams.

The level of detail for the conceptual plans can be broad (matrix / graphic-based) or more detailed (including narrative descriptions and options summaries). The decision on the level of detail is a project-specific decision.

Preparation of Scope and Contract Documents - Abatement and Demolition

In this step of the decommissioning process, scope and contract documents are developed that will be used to guide the contractor bidding and work implementation. The documents are the next step in the progression of this process, created from the conceptual plans described above.

The major tasks to be completed include:

1. Deciding the best contracting mechanism for delivery of the project(s);
2. Planning for the control of environmental issues during the project
3. Planning for the control of health and safety issues during the project
4. Developing the detailed scope-of-work, project sequencing, and contract documents.

The main role-players in this step are the Owner's Project Management (PM) Team and the Technical Team comprised of both environmental and infrastructure consultants. The responsibility of the PM team is to:

- provide guidance to ensure that Owner requirements are met (e.g. financial, schedule, regulatory);
- provide guidance regarding site-specific operational, environmental or health and safety aspects that must be addressed during execution of the work; and,
- review and ensure that the contract documents reflect the Owner's overall objectives and requirements and minimize Owner risk for unnecessary cost overruns and other liabilities.

The responsibility of the Technical Team is to:

- provide technical expertise to the PM team during the planning phase of each task; and,
- produce high-quality documents that will facilitate completion of the project and meet the Owner's contracting and risk objectives.

The deliverable documents to be produced include:

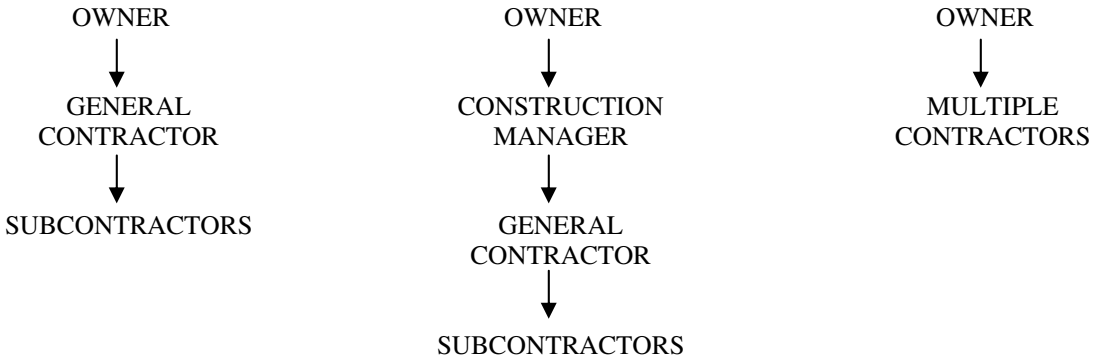
- Environmental Control Plan (ECP)
- Health and Safety Plan (HASP)
- Overall Project Schedule
- Pre-Demolition Survey (regulated materials, infrastructures)
- Project Manual / Contract Documents

Task 1. Contracting

The Owner's PM team in conjunction with the Owner's purchasing department (if applicable) will decide on the preferred contracting mechanism for the project. There are several options available for administering the contracts, as presented below. Regardless of the contractual arrangement, the Owner should consider retaining an engineer and/or environmental consultant

to act as the Owner's representative for reviewing and monitoring the work being conducted to ensure compliance with the contract requirements and applicable regulations.

Examples of Contract Administration Setup:



Typical pricing options include: stipulated fixed price, time-and-materials, Cost Plus with Fee, or a combination that might include unit-pricing for some aspects of the work. Use of the fixed price option places the risk for overruns on the Contractor. Use of the other options places the risk of overruns on the Owner.

> ***Quick Note - Fixed Price Contracts:*** *Experience shows that the best way to achieve cost containment on a building demolition project is to administer a fixed price contract. A good way to minimize contingencies a contractor builds into his/her costs is to be thorough in the pre-demolition phase: conduct a thorough hazards survey with quantities, provide plant structural and mechanical drawings for reference, provide old permits and reports; etc. The more information - and time - provided to a contractor during the bid process will result in a lower cost for a fixed price contract.*

The contract administration setup selected is dependent upon the experience, availability and ability of the Owner's staff to manage the project and the level of involvement in the day-to-day decisions that the Owner would like to have and also upon the Owner's tolerance or acceptance of variance in the ultimate cost of the project compared to projected costs at the onset of the project.

Task 2. Control of Environmental Issues

The Owner's PM team in conjunction with the Technical team identifies the environmental aspects of the project, and collectively set forth responsibilities for addressing these issues. Environmental aspects of the project could include (but are not limited to): air emissions, storm water discharges/control, sanitary discharges, spills of regulated materials, solid waste control, and use and management of regulated materials. Use of the pre-decommissioning environmental survey (prepared in Stage 2) is a valuable tool for identifying environmental aspects.

The site work responsibility to address these aspects is generally assigned to the Contractors hired to execute the project; however, monitoring to ensure that the aspects are being addressed would be the responsibility of the PM team (such as the Environmental Consultant or Program Manager, as applicable).

A listing of the environmental aspects and parties responsible for addressing them is captured in the contract documents as a high-level Environmental Control Plan (ECP). A detailed ECP is a required submittal from the Contractor prior to the start of the project. This detailed ECP would be reviewed by the PM and Technical teams for consistency with the Owner's requirements contained in the high-level ECP.

Pre-Decommissioning Environmental Survey

A critical step in the planning and scoping of a successful abatement and demolition project is the pre-demolition environmental and infrastructure survey, or "Pre-Demolition Survey" for short. This survey provides a wealth of information that is later used during the bidding and implementation of the abatement and demolition project, such as

- An identification of building and process materials that require removal, handling, and special disposal as "regulated wastes" prior to, or during the demolition project. Without removing - or "abating" - these materials prior to demolition, the resultant demolition debris can become environmentally impacted, thereby rendering the debris as a contaminated waste stream and causing significant costs and undue cradle-to-grave liability (if applicable) to the Owner or other designated generator of the wastes.
- An identification of the infrastructures that serve the plant, including utilities, sub-slab pits and vaults, foundations of former structures, hidden slabs and abandoned piping, and other such items. It is very important to research and understand infrastructures, because any such items can delay a project considerably if not known or suspected up front.

> ***Quick Note - Pre-Decommissioning Infrastructure Surveys:***
> *A good mechanism for capturing the historical environmental and infrastructure information that is critical to an efficient demolition project is through a "Site Use History". The SUH process enables the Team member(s) to locate and evaluate current and historic information, such as previous reports, design and as-built drawings, permits, utility diagrams, past processes and operations, etc., and compile the salient information into one report for future reference by the Owner's Teams, contractors, and planners, as necessary.*

The Pre-Decommissioning Survey can be performed in parallel with the site characterization efforts, and should be completed prior to scoping the project to maximize the information used to develop the conceptual plans. An environmental consultant experienced with facility decommissioning projects should be retained.

Task 3. Health and Safety

The Owner's PM team in conjunction with the Technical Team identify the health and safety aspects of the project, and responsibility matrices for addressing those aspects. Health and safety aspects of the project could include (but are not limited to): site-specific health and safety procedures or Owner requirements, notifications to operational groups within the site that will remain active during the project, industrial hygiene type issues including use of personal protective equipment, disruption of utilities being used by active portions of the site, housekeeping at the project site, traffic, heavy equipment, excavations, confined spaces and burning and welding. The responsibility for addressing these aspects, as well as being in compliance with Federal, State, Provincial Occupational Health and Safety laws, is generally

assigned to the Contractors hired to execute the project. However, monitoring to ensure that the aspects are being addressed would be the responsibility of the PM team (including the Environmental Consultant or Program Manager, as applicable).

The health and safety aspects identified by the PM and Technical team are captured in the Project Manual as a listing of the health and safety performance requirements that the Contractors will be required to follow. Detailed HASPs are a required submittal from the Contractor prior to start of the project. The submitted HASPs would be reviewed by the PM and Technical teams for consistency with the Owner's requirements.

Task 4. Scope of Work and Schedule

The Technical Team, with input from the PM team prepares a formal scoping document that will be used to describe the scope of the project, specify the Owner's requirements, and obtain firm pricing from potential Contractors (i.e. Bidders). This document essentially evolves into the "Project Manual", which can be defined as a merging of the reference, bid, and contract documents necessary to procure a contractor(s) and implement a project of this nature. The Project Manual should include the following elements:

- Pre-decommissioning survey reports (regulated materials survey, site use history)
- Contract drawings
- Site environmental investigation report
- The scope-of-work (SOW) for the project
- The project schedule milestones
- Specifications of how to execute the project
- Contract documents, general conditions, Owner requirements, and other reference materials.

Project Manual

The first three elements listed above are included to provide the bidding contractors with a detailed description of the current conditions of the site which they will use to complete their due diligence and prepare methods and costs. The pre-decommissioning survey reports are very important to identify the location, the nature and the quantity of regulated materials requiring disposal. Historical drawings (which are included as part of the site use history) are important because they will give the bidding contractors insight into:

- assessing how the site buildings were constructed and conversely how they may be demolished,
- estimating quantities of recyclable material,
- requesting additional analysis of samples of regulated materials during the bid cycle,
- locating underground utilities to be capped and abandoned, re-routed, or protected.

The site environmental investigation report would be provided to describe the nature and extent of impacted soil and/or groundwater and gives context to the remedial designs provided in the SOW section.

The SOW provides a detailed list of tasks to be accomplished by the selected Contractor(s) in order to complete the entire abatement and demolition project. The SOW would include the design of the selected remedial option to be installed and any engineering designs for restoration of structures that may remain, and for abandonment or re-routing of utility infrastructures. The project schedule would show progress milestones that the Owner requires to be met and may show the general sequencing of the overall project should the Owner have logistical constraints that would govern sequencing of the work.

Quick Note - Performance-Based Contract Documents:
For most abatement and demolition projects, it is best to prepare a scope of work and technical specification document that is "performance based". This style of contract document provides the end requirements for the specific work tasks, with boundaries within which a contractor must work to ensure compliance with regulations and other stipulations of the contract. The actual means and methods are determined by the contractor and reviewed by the Owner team for compliance (see Stage 4 - Implementation). By not prescribing means and methods, the Owner minimizes its liability in the event that a contractor fails to perform the work in accordance with applicable regulations and safety requirements.

The specifications section provides a description of how the project should be executed. Ideally, the goal of the specification section is to be specific enough to set the boundaries of acceptable means and methods (e.g. prohibit the use of explosive techniques) but to be flexible enough to be able to best utilize the expertise of the selected Contractor to execute the project safely and in a cost-effective manner. The contract style of the specifications can vary from very prescriptive (i.e. describing means and methods) to very general (i.e. describing only the end result to be achieved) - see note on this page regarding "Performance-Based Contract Documents". It is recommended that a construction/demolition industry standardized format, such as Construction Specifications Institute (CSI), be used. The requirements of the environmental control plan and the health and safety plan requirements are presented in the specification section.

The list of individual specifications that are included in the project manual are unique to each project; however, the following general categories of specifications are common to all projects.

General Conditions to complete the work. Aspects in this category would include but are not limited to: site security, temporary utilities, traffic control, temporary office space, sanitation facilities for project personnel, and communications.

Regulatory/Environmental Controls. Aspects in this category would include, but are not limited to: the Owner's ECP (refer to Task 2), regulated material management, waste transport and disposal, recycling, permitting, storm water control, air emissions, sanitary discharges, noise control, and vibration control.

Health and Safety Controls. Aspects in this category would include, but are not limited to the Owner's health and safety requirements for working on the site (refer to Task 3), emergency procedures, and compliance with applicable regulations.

Technical / Performance Specifications. Aspects in this category would include, but are not limited to: descriptions of acceptable techniques to accomplish the SOW, prohibition of certain techniques, quality of materials used to construct new installations, performance requirements of installed systems, or building components or earthwork, and clean-up criteria or remediation goals.

Submittals / Communication / Planning. These sections describe the process by which the Owner and the Contractor communicate planning and execution issues. Aspects in this category would include, but are not limited to: permitting, method statements, designs, progress schedules, progress meetings, and Owner review and acceptance procedures. Typical planning-type submittals include, but are not limited to: Health and Safety Plan, Environmental Control Plan, Dust Control Plan, Noise and Vibration Control Plan, Construction Storm Water Control Plan, Emergency Response Plan, and Site Grading Plan. A good practice is to require submittal of detailed method statements covering activities that have critical safety or environmental aspects so the PM/Technical teams can assure the Owner that the appropriate level of pre-planning has occurred to minimize the potential for incidents.

Bidding Documents. The Bidding Documents are comprised of elements that address the commercial aspects of the project. These elements include, but are not limited to: terms and conditions, insurance requirements, bonding (if required), invoicing and payment terms, warranties, handling of revenue generated by scrap or other equipment and materials sold for re-use, and the bid form. The Contractor should also be required to provide: a general approach and description of the methodologies to be used, and a proposed schedule with milestones.

Bid Form. The objective of the bid form is not only to obtain pricing, but also to understand in a general sense how each bidding contractor intends to approach the project (in terms of level of effort) so that valid comparisons of the bids can be made. Preparation of the bid form may vary, depending on the Owner's needs and the type of contract (fixed price vs. time-and-materials), in terms of the level of detail of pricing requested from the bidding contractors. Having the bidders submit their proposed schedule with milestones is a useful tool for understanding how they will approach the project. Because the value of the revenue generated from scrap metal recycling is significant with respect to the value of the entire project, the methods for computing, accounting and receiving the value of the scrap metal should be clearly presented.

Quick Note - Retain or Waive Recycle Rights?
An Owner may retain or waive rights to recycle or sell assets from a structure. Assets include metallic scrap, equipment and furnishings, unused product, and aggregate (concrete, brick) generated during the project. Experience has shown that although it is contractually more efficient to waive rights to a contractor, it can be more lucrative for an Owner to retain rights to metallic steel and equipment and arrange a separate contract with a recycler or equipment divestment broker. Recycling or sale of aggregates (e.g., concrete crushed onsite) can be problematic with respect to the environmental condition of the material and long-term liability associated with its reuse in commerce. The Owner's team should evaluate this issue during the conceptual planning phase of the project.

A good practice regardless of the type of contract is to ask for pricing detail for the major elements of work such as: utility infrastructure abandonment, environmental decommissioning, asbestos abatement, demolition, waste disposal, recycling revenue, site work for environmental remediation, and site restoration. Having this minimum level of pricing detail facilitates interrogation of the Bidders during the post-bid Contractor evaluation phase and a better comparison of the bids received. Additionally, the Bidders should be encouraged to propose

"voluntary alternates" for elements of work where they believe that they can provide better value (e.g. time savings, cost savings, enhanced safety) to the Owner if alternate methods are used from those described in the specifications. In this manner, the Owner could benefit from unique expertise held by any one of the bidding firms.

Milestone 3

At the completion of the project manual and bidding documents, qualified firms must be selected and invited to bid on the project. The Owner's PM team, with consultation from the Purchasing Department and the Technical Team would select the firms qualified to bid on the project.

Stage 4 - Implementation

The objective of Stage 4 is to implement the solutions developed in Stage 3 (i.e., decommissioning, demolition, remediation, restoration) as the means to accomplish the project objectives (i.e. the envisioned end land use) developed in Stage 1. The main tasks to be accomplished are: environmental decommissioning of the site buildings, demolition of the site buildings, remediation of impacted soil and/or groundwater, closure of on-site waste management units, and site restoration. The major steps for each of these tasks will be further categorized as *whole project*, *buildings and infrastructure*, *environmental site work*, and *site restoration* and presented in time sequential order. However, to the extent that the *building and infrastructure* and *environmental site work* categories of activities do not occupy the same physical space on the property, they could be conducted as parallel activities.

The responsibility to implement the solutions is shared between the Owner's PM team and the Technical Team. The PM team's main role is high-level oversight of the project activities and progress and to act as the interface between Management and the Contractor when input is needed to solve technical or logistical issues. The Technical Team's main role is to help coordinate the Contractor's activities with those of the Owner, to provide detailed monitoring of the Contractor's activities to ensure compliance with the project manual and to ensure that the project activities are being conducted in accordance with all applicable Regulatory requirements.

Contractor Evaluation and Procurement

The Contractor evaluation and procurement process begins when the Project Manual/Bidding Documents are delivered to the qualified bidders. The following steps are critical to the success of this process.

Pre-Bid Meeting. The objective is to meet the bidders and to briefly explain, from the Owner's perspective, the scope of the project, the format of the bid form, commercial terms, and to outline the due diligence process. The participation of the PM and Technical Team in this meeting as well as a representative from the Purchasing Department, if applicable.

Bid Cycle Due Diligence. The objective of this step is for the bidder's to thoroughly familiarize themselves with the conditions and aspects of the project. Depending on the complexity of the

project, this step could take weeks or months. The bidders should be given access to inspect all facilities and they should be encouraged to request additional samples of potential waste streams so that they can accurately verify quantities of waste for pricing purposes. The objective from the Owner's standpoint is to have the bidders know enough about the site conditions and the scope-of-work that they can submit bids that are complete with minimal assumptions (or qualifications/caveats). The more qualifications/caveats that accompany a bid price, the more opportunity there is for the Contractor to submit change requests as the project progress, resulting in an escalation of cost.

The Technical team is primarily responsible for conducting the Bid Cycle activities which includes: escorting bidders during site inspections, collecting and analyzing all samples requested by the bidders, answering technical or commercial questions (with help from PM team), and providing all supplemental data and technical/commercial answers to all bidders in the form of addenda to the project manual.

Evaluation of Bids. The objective of this step is for the PM and Technical teams to analyze the pricing, schedule, qualifications/caveats, and the methods and schedule submittals contained within each bid in an effort to understand the approach and pricing provided by each bidder. In this manner the PM / Technical teams can compare the bids on an equivalent (i.e. "apples-to-apples") basis. An important element to this process is the post-bid interrogation. Each bidder is invited to discuss their approach and pricing assumptions and to answer other technical or commercial questions posed by the PM/Technical team. At the end of the evaluation process, the PM team recommends to the Purchasing Department the firm that presents the best opportunity for successful completion of the project.

Milestone 4

If the bid pricing is containable within the established project budget, then proceed to awarding the contract. If the pricing exceeds the established budget, then the PM and Technical teams should re-evaluate the scope-of work and the envisioned end land use and reconvene with the Management team to evaluate options for moving forward.

Contract Award and Finalization of Schedule. The Purchasing Department is responsible for notifying the successful bidder and awarding the contract. The schedule of activities should be finalized by the successful bidder, in conjunction with the PM and Technical teams, soon after award of the contract.

Implementation - Entire Project

This and the following sections describe major tasks that comprise the decommissioning process. The tasks are presented in sequential order. The duration of each task may vary on a case-by-case basis, but the typical sequencing is shown on the stage chart (Appendix A).

Quick Note - Finalizing Project Schedules:
Owner acceptance of the Contractor's project schedule immediately after project award is critical for protecting against schedule creep and subsequent claims for increased general conditions costs.

Permitting. Application for all applicable permits should be the

first step in the process because the timing for receiving the permits may be variable depending on the governing agency (Federal, State, Provincial, Local). Much of the physical work (e.g. asbestos abatement, demolition) may not be allowed to proceed until the appropriate permits are issued depending on local regulations. The PM team and the Contractor would be responsible to prepare and submit permits.

Community / Regulatory Notifications. If additional notifications to regulatory agencies or the community-at-large are required, then this task should be accomplished early in the process. Depending on the sensitivity of the project or the interest taken by the community, there is the potential to spend several weeks of effort (or more) to accomplish this task.

Review and Acceptance of Submittals. Prior to the start of work, the Contractor should prepare and submit, for review and acceptance by the PM/Technical Team, all contractor submittals (work plans, safety plans, etc.) listed in the Project Manual. The purpose of this submittal and review process is to verify that the appropriate levels of pre-planning have been done to ensure that the project is executed without safety or environmental incidents occurring. This process also serves to notify the management structure of operationally active portions of the plant site (if any) of the types of activities that will be occurring. In this manner, coordination issues can be identified and resolved prior to the onset of decommissioning and demolition activities. Depending upon the ability of the Contractor to communicate effectively, the level of complexity of the project, and the workload of the PM team, this task could take several weeks.

> ***Quick Note - Contractor Submittals:***
> *This process can become tedious but perseverance by the PM/Tech teams in completing this process in a robust manner is critical for ensuring project safety and protecting against change order requests.*

Implementation - Buildings and Infrastructure

Disconnect plant from the distribution power grid. This work could be contracted to a specialty Contractor or included in the project manual with the general decommissioning and demolition work.

Remove surplus fuel. Surplus fuel should be removed and transported for: (a) re-use by the Owner elsewhere, (b) re-sale to third-parties, or (c) disposal.

Disposal of assets. If the Owner wants to recover monetary value from assets (furniture, non-process equipment, process equipment, or other material) and/or retire the asset from the book value of the property through re-deployment or sale for re-use, this activity is best done early in the decommissioning process because it could be a lengthy process. Assets to be re-deployed in another facility (operated by the same Owner) could either be removed by the Owner's forces or included in the Contractor's work scope. A third-party broker or liquidator could be used to dispose assets that are to be re-sold for reuse under a separate contract with the Owner. Alternatively, the contract for the decommissioning and demolition work could contain incentives for the Contractor to sell assets for re-use (including a revenue-sharing arrangement with the Owner). In any case, the asset may require some level of environmental decommissioning prior to shipment in accordance with governing Department of Transportation regulations.

The time frame for undertaking the asset disposal process and the scope of the effort should be defined by the Owner in the project manual so that the decommissioning and demolition work doesn't get delayed by the asset disposal task.

> ***Quick Note - Asset Disposition:***
> *It is easy to pass the point of diminishing returns when disposing assets. In general, if the value to be received for the intact asset is less than the scrap value plus the cost to remove it and ship it, then re-deploying or selling the asset is not worth the effort.*

Environmental decommissioning and utility disconnection. The regulated building materials should be removed from the plant buildings/structures to the extent required for demolition of the structures. Depending upon the work methods utilized and local regulations, not all regulated material needs to be completely removed prior to demolition. As an example, non-friable asbestos- containing roofing material may, in some cases, be left intact as the roof is demolished providing that adequate engineering controls are implemented to prevent release to the environment. Underground process piping should have residual material removed during this step and any floor penetrations covered to prevent demolition debris from collecting in the previously cleaned pipes.

It is recommended that sewer connections are plugged prior to commencement of the environmental decommissioning to eliminate the potential for discharges to the storm or sanitary systems. However, it would be beneficial if utilities such as electricity and potable water remain active as long as possible to facilitate the work inside the buildings and structures (for example asbestos abatement or residual chemical removal). At some point; however, the utilities need to be disconnected so that the building is isolated and completely de-energized. Following complete disconnection of the remaining utilities, regulated materials that are a part of the electrical systems (e.g. PCB-containing oil) and water distribution system would be removed.

At the completion of the environmental decommissioning activities, the Owner's environmental consultant would verify the level of cleanliness attained and that the building/structure has been adequately prepared for demolition.

Protection of Existing Utility Infrastructure. If there are utilities within the demolition zone that are active and need to remain so, they should be temporarily re-routed or protected prior to beginning demolition. Verification that the buildings/structures to be demolished are isolated and de-energized from utility feeds should be performed.

Demolition. Demolition of the above-ground buildings and structures can proceed after verification that all applicable permits have been received. The buildings/structures can then be demolished to grade level in whatever sequence is the most expedient as described in the Contractor's method statement submittal. The resulting debris would be disposed or recycled as appropriate.

Removal of Slabs and Foundations. Following removal of the building debris, removal of the floor slabs and foundations can commence. Typically, foundations are removed to a depth of 36-inches below the existing grade so that any remaining structures do not interfere with re-development activities. However, this depth can be modified depending on the re-development plans. The location and depth of the remaining foundations should be surveyed and tied into the vertical and horizontal control system and added to the post-demolition site conditions record drawing (a.k.a. "as-built" drawing).

Removal of Underground Process Piping or Abandoned Utility Lines. If underground process piping or abandoned utilities occur at a depth shallower than 36-inches below grade, they would typically be removed to prevent interference with re-development activities. If these infrastructures will remain because they occur at a depth that will not interfere with re-development, they can be abandoned in-place or filled with grout. Filling with grout is recommended for pipe diameters greater than 12-inches to minimize future settlement issues caused by pipe decay and collapse. Piping segments that remain in the ground and disconnection points from the utilities feeding the site should be surveyed and added to the post-demolition site conditions record drawing.

Implementation - Environmental Site Work

The following major tasks comprise the remediation and closure process and are presented in sequential order. The duration of each task may vary on a case-by-case basis; typical sequencing is shown on the stage chart (Appendix A). As previously stated, these activities could occur in parallel with the building decommissioning work as long as they are not located in the building demolition zone. If so, it is recommended that demolition occur prior to remediation so that any installed components of the remedial solution are not damaged.

Preparation of Area for Remedial Action. On-site waste management or disposal units and raw material storage areas may have surficial control features and structures associated with their operation. For example, ash lagoons or coal storage areas may have water discharge conduits/features that should be abandoned and plugged to prevent inappropriate discharges during remedial activities. New control features or systems should be installed to control, capture and discharge storm water that accumulates in the areas during remedial activities in accordance with applicable regulations.

Execution of Remedial Actions. Following site preparation and installation of the appropriate controls, remedial actions are undertaken in accordance with the designs and work plans included in the Project Manual. The range of remedial actions includes: gross material removal and disposal, in-situ treatment, isolation by capping, or some combination of all three.

Verification of Remediation or Verification of Performance. The effectiveness of the remedial actions to attain project goals is documented through various testing methods. Chemical laboratory analysis is used to document the attainment of soil and groundwater clean-up goals. Geotechnical testing or other physical testing procedures are used to document the attainment of performance goals for installed remedial solutions (e.g. caps, liners, extraction systems, barriers). Depending upon the ability to use field methods to verify attainment of remedial goals, the verification process may require several iterations of testing and further remedial action, so the duration of this task may require several weeks or months. In the case of in-situ remediation, attainment of remediation goals may require several years; however, the performance of the remediation system compared to the design specifications can be documented at the conclusion of installation.

Hand-Over Of Installed Remedial Systems to Owner. Once it has been verified that the performance of any installed remedial systems match the design criteria, the installation contractor “hands-over” responsibility for the system to the Owner. It is important for the Owner

that the hand-over process be well documented and that, at a minimum, the following information be received from the Contractor: equipment operating manuals, warranties and/or service plans; and an operation and maintenance (O&M) plan. In addition, the Contractor could be requested to provide hands-on training sessions to the Owner's employees/subcontractors who will be responsible for operating and maintaining the system. At the conclusion of the hand-over process, the Owner may notify their insurance carrier of the presence and operating functions of the installed system.

Implementation - Site Restoration

Following completion of the slab and foundation removal, the piping and infrastructure removal, and the environmental site remediation, site restoration activities can begin in the disturbed portions of the site. Pits or deep depressions can be filled with inert, structurally stable fill material and compacted to meet the requirements of the re-development activities. Then the site is graded to the final contours shown on the site grading plan. If there will be a significant time-lag between completion of site decommissioning and site re-development activities, it is likely that the governing regulatory agency will require that disturbed portions of the site be stabilized by seeding for vegetative growth to prevent erosion. Contouring and grading of the site should take into account effective, non-erosive drainage of storm water across the site.

Milestone 5

Completion of the previously listed tasks constitutes completion of the Implementation stage and a transition into the Closure stage of the project.

Stage 5 - Closure

This stage of the decommissioning process includes those tasks that establish: (a) that the remediation and reclamation of the site has been successfully completed, (b) the site meets the post-decommissioning land use objectives established at the onset of the project, and (c) that the participating stakeholders agree that the completed project conforms to the pre-determined requirements. Closure also prepares the site for ownership transfer, and/or redevelopment consistent with the post-decommissioning land use objectives. Finally, long-term risk management controls (e.g. property deed restrictions, institutional access controls, environmental monitoring programs) are put into place during this stage of the process.

The responsibility to drive the closure process to conclusion is shared between the Owner's PM team and the Technical Team. The PM Team's main role is to prepare and file the legal documentation required to accomplish the post-decommissioning land use objective. The Technical Team's main role is to obtain or produce the "record" documentation needed by the Owner to manage their residual long-term environmental risk from having owned or operated the site.

Record of Site Conditions

Preparation of accurate records concerning the physical and environmental condition of the site at the conclusion of the decommissioning process is critical for managing long-term environmental risk and, or for successful redevelopment of the site.

Record drawings that document the remaining physical conditions of the site, often referred to as "As-built" drawings, provide information regarding:

- The location and elevation of cut and capped service utility feed lines,
- The location and elevation of infrastructure elements (e.g. decommissioned piping, foundations, etc) that were abandoned in-place,
- The location and elevation of installed remedial solutions (i.e. caps, liners, extraction system piping, groundwater wells, engineered barriers, etc), and
- The shape and elevation of the ground surface.

This type of information is especially useful to developers when planning for and re-developing the site.

Documents that record the environmental condition of the site, may be referred to as project completion reports or remedial action reports. These documents provide information regarding:

- Subsurface geological and hydrogeological conditions at the site,
- Attainment of cleanup criteria,
- Soil quality at the site and the lateral and vertical extent of remediated areas,
- Groundwater quality at the site,
- Installed remedial measures that mitigate future impact to the environment and exposure to human or other ecological receptors,
- Environmental monitoring program requirements,
- Institutional or engineering controls that form the basis for the closure and re-use strategy for the site.

The project completion report is typically the document upon which obtaining regulatory closure of the site is based. Upon review and acceptance of the project completion report, the regulating authority should issue to the Owner written confirmation that the closure of the site is accepted (e.g. No Further Action Letter, Covenant Not To Sue, etc.). Obtaining regulatory closure of environmental issues may not be necessary for property redevelopment by the existing Owner, but it is critical to moving forward with sale of the site.

Waste Management Records

Documentation that provides evidence of how decommissioning and demolition derived waste streams were disposed or recycled should be collected into a report and kept by the Owner to address potential future questions related to waste management issues. Documentation to be retained includes but it not limited to:

- Waste stream characterization data and waste profiling documents,
- Owner-generated shipping documents,
- Manifests (State, Federal, Provincial)
- Truck receipts from the accepting facility
- Certificates of destruction.

Depending upon the location of the project, there may be Local requirements to report waste disposal or recycling activities; therefore, organization of the waste management information into a clear, concise report facilitates ease of transmitting information to regulatory agencies.

Contract Closeout

Part of the overall closure process includes the closeout of all contracts related to the remediation, reclamation, abatement, and demolition work performed. This should be done in accordance with an Owner / Operator standard corporate contracting terms, and can be implemented by the PM Team. Elements to consider for ensuring contracts are closed out include:

- Receipt of waste management records as described above
- Final waivers of lien and invoices have been submitted by contractors
- Permits required for the site work have been closed out, if necessary
- Appropriate agency notifications of completion have been issued
- Final site inspections have been completed to the satisfaction of the PM Team
- Deed notices or other items related to the property have been filed, as necessary.

Deed Restrictions or Institutional Controls

Deed restrictions and institutional controls are land use control mechanisms that may be a part of the site closure strategy (e.g. areas requiring permanent, impervious cover, or digging prohibitions, etc). These mechanisms are typically in-place prior to obtaining final Regulatory closure and are described in the project completion report. Formal registration of land use controls / restrictions will ensure that future owners do not inadvertently cause damage to installed remedial measures or cause exposure to subsurface media that are inconsistent with the conditions under which Regulatory closure was obtained. Land use controls shall be registered

on the property title in a manner that satisfies the requirements of Federal, State, Provincial, and Local governing authorities.

Establish Long-Term Monitoring Program (if required)

An environmental monitoring program may be an important part of the closure or re-development strategy for the site. If so, the Owner's PM Team should establish a plan for coordinating the monitoring program with the future activities planned for the site and then manage the process to ensure compliance with applicable environmental regulations. If ownership of the site will be transferred to a third party, the requirements for environmental monitoring should be clearly presented to the potential buyer and should be addressed in the property sale agreement.

Statement of Intent for Redevelopment

Should the Owner also be the party responsible for re-development at the site, Local governing authorities may require that a formal notification or statement of the Owner's intent to redevelop the site be filed in the public record. This statement would serve to transition the property from the decommissioning phase to the development phase. Again, depending upon the Local jurisdiction, a public comment period may be necessary prior to beginning re-development activities.

Ownership Transfer

Transference of ownership is an important milestone in the history of a piece of industrial property and brings several future risk management issues, the importance of which cannot be over emphasized. The property sales agreement will likely address issues such as: future liability for past activities, indemnifications to cover previous or future activities, and restrictions on future land use. It is important that the closure phase of the decommissioning process be well documented so that future liability issues are addressed properly in the sales agreement documents. The Record of Site Conditions documents will be used to set a "baseline" condition at the time of ownership transfer and serves as a basis for identifying the responsibilities of the previous owner from those of the current owner for any environmental or property use issues that may arise in the future.

Milestone 6

The Closure stage is complete when all record documents have been received by the Owner, and closure of environmental issues is obtained from the governing Regulatory authority.

A
CHARTS: STAGES, TASKS AND RESPONSIBILITIES

The following charts provide an overview of all the stages (Figure A-1, emphasizing milestones) and the tasks and responsibilities within each stage (remaining figures).

Entire Process: Milestones

Figure A-1. Milestones Associated with Each Stage in the Decommissioning of Fossil-Fueled Power Generating Plants

Stage 1: Project Framing

Figure A-2.Tasks and Team Responsibilities Associated with Stage 1 in the Decommissioning of Fossil Fueled Power Generating Plants

Stage 2: Site Characterization

Figure A-3. Tasks and Team Responsibilities Associated with Stage 2, Phase I in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-4. Tasks and Team Responsibilities Associated with Stage 2, Phase II in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-5. Tasks and Team Responsibilities Associated with Stage 2, Phase III in the Decommissioning of Fossil-Fueled Power Generating Plants

Stage 3: Remediation and Reclamation Planning

Figure A-6. Tasks and Team Responsibilities Associated with Stage 3 (Conceptual Remediation and Reclamation Plan) in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-7. Tasks and Team Responsibilities Associated with Stage 3 (Detailed Remediation and Reclamation Workplans) in the Decommissioning of Fossil-Fueled Power Generating Plants

Stage 4: Implementation

Figure A-8. Tasks and Team Responsibilities Associated with Stage 4 (Contractor Evaluation and Procurement) in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-9. Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Whole Project) in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-10. Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Buildings and Infrastructure) in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-11.Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Environmental Site Work) in the Decommissioning of Fossil-Fueled Power Generating Plants

Figure A-12. Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Site Reclamation) in the Decommissioning of Fossil-Fueled Power Generating Plants

Stage 5: Closure

Figure A-13. Tasks and Team Responsibilities Associated with Stage 5 in the Decommissioning of Fossil-Fueled Power Generating Plants

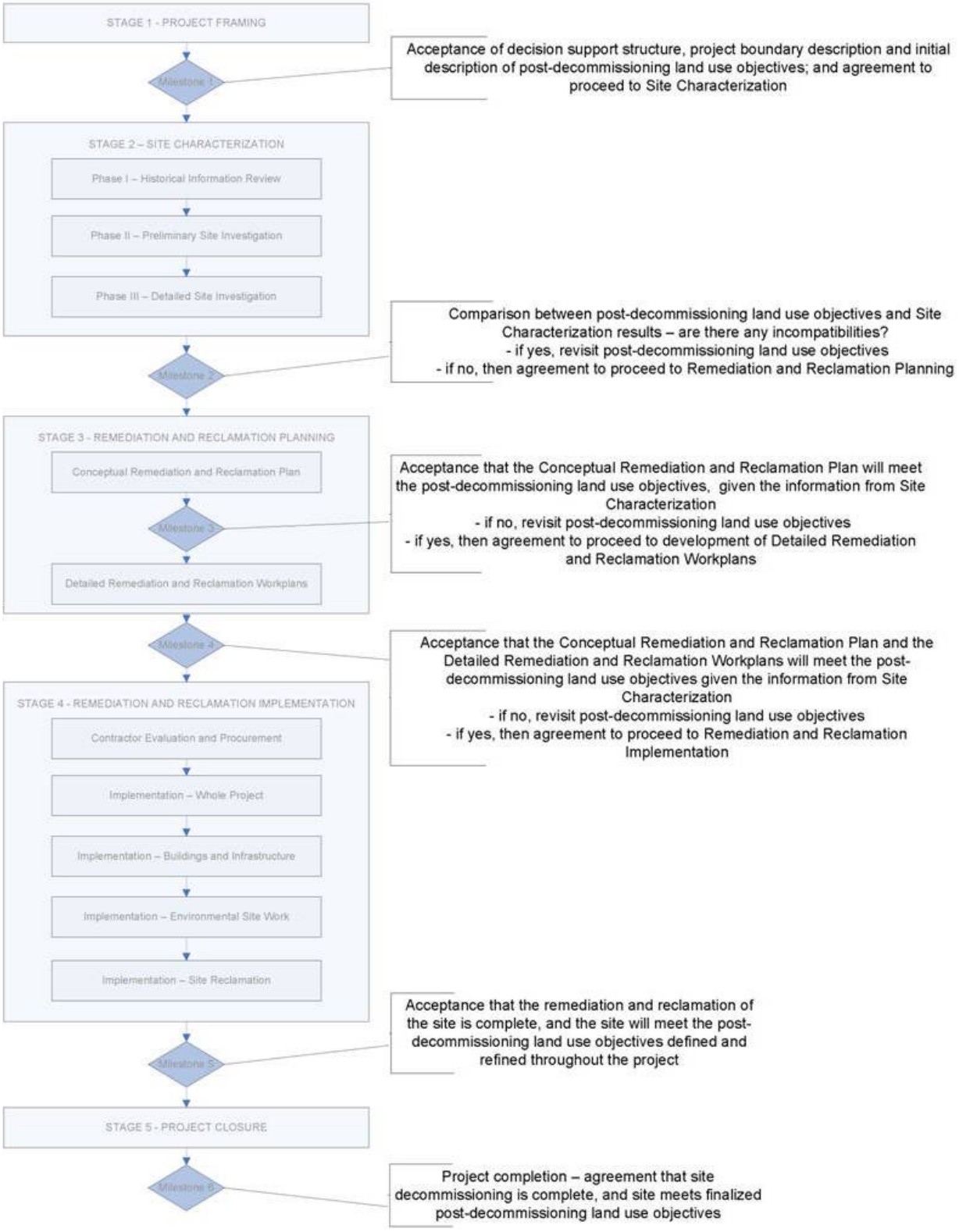


Figure A-1
Milestones Associated with Each Stage in the Decommissioning of Fossil-Fueled Power Generating Plants

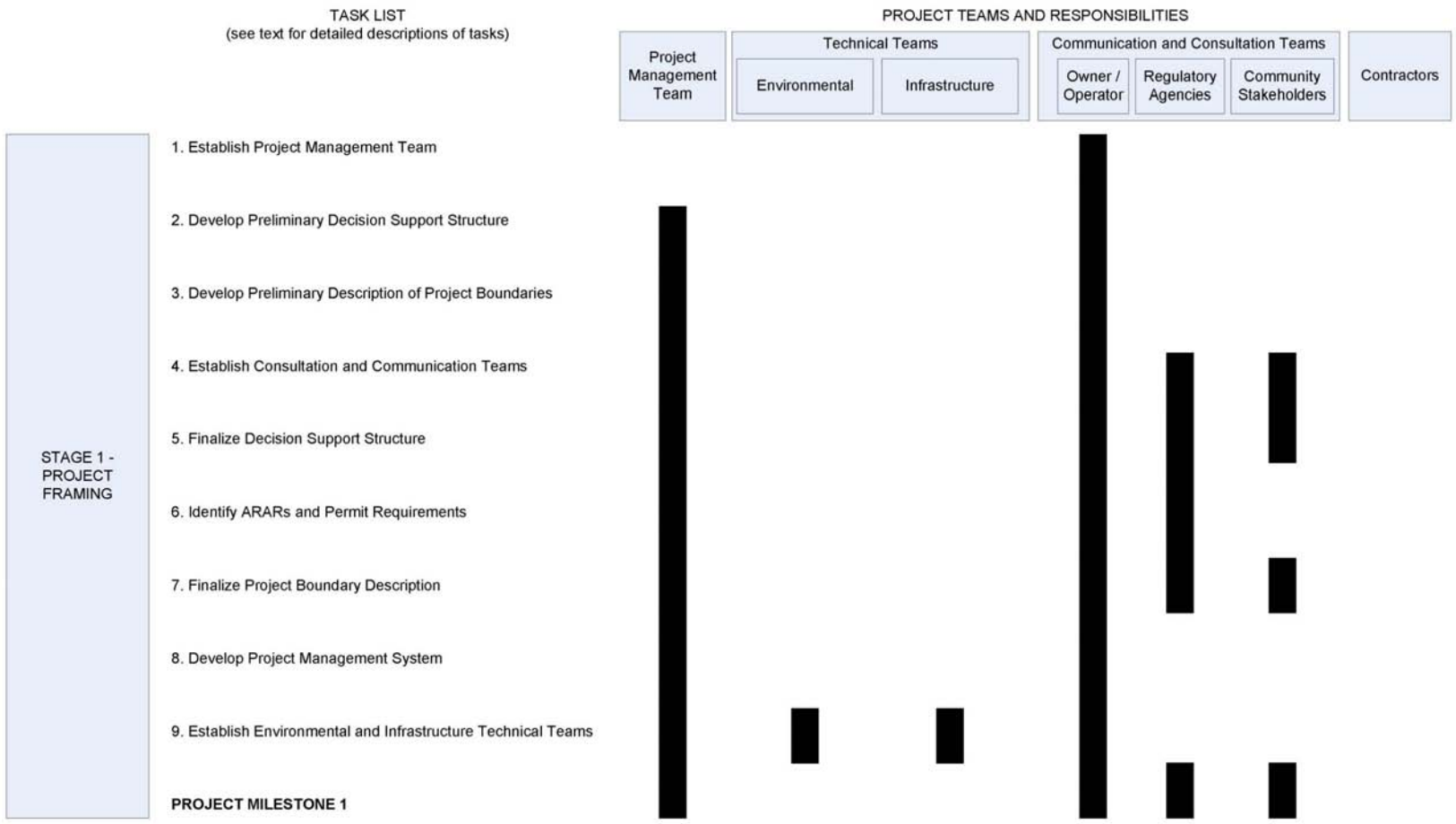


Figure A-2
Tasks and Team Responsibilities Associated with Stage 1 in the Decommissioning of Fossil Fueled Power Generating Plants

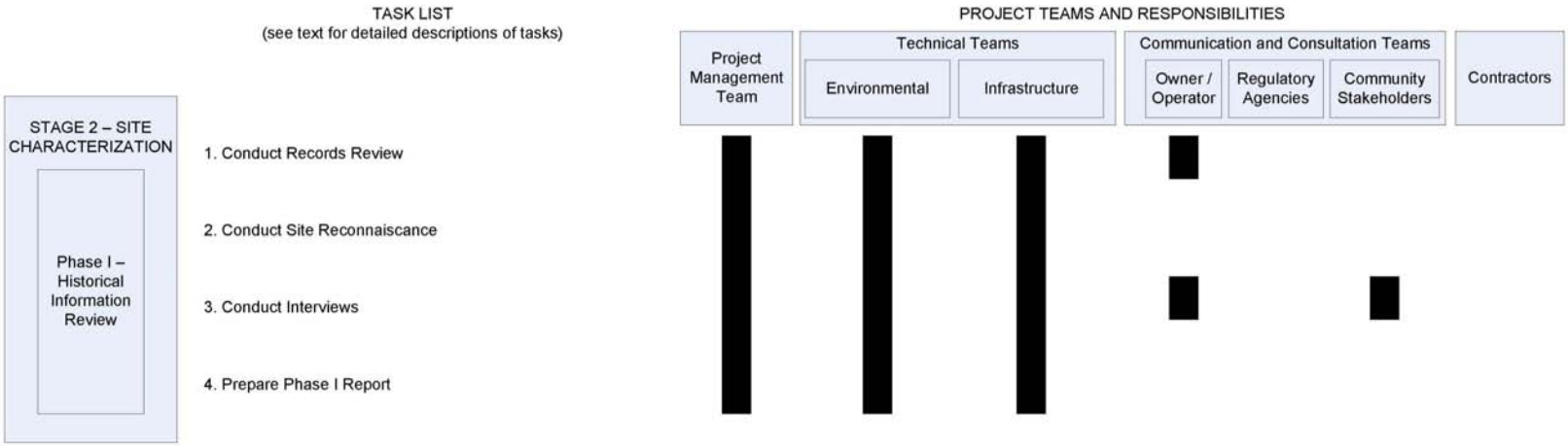


Figure A-3
Tasks and Team Responsibilities Associated with Stage 2, Phase I in the Decommissioning of Fossil-Fueled Power Generating Plants

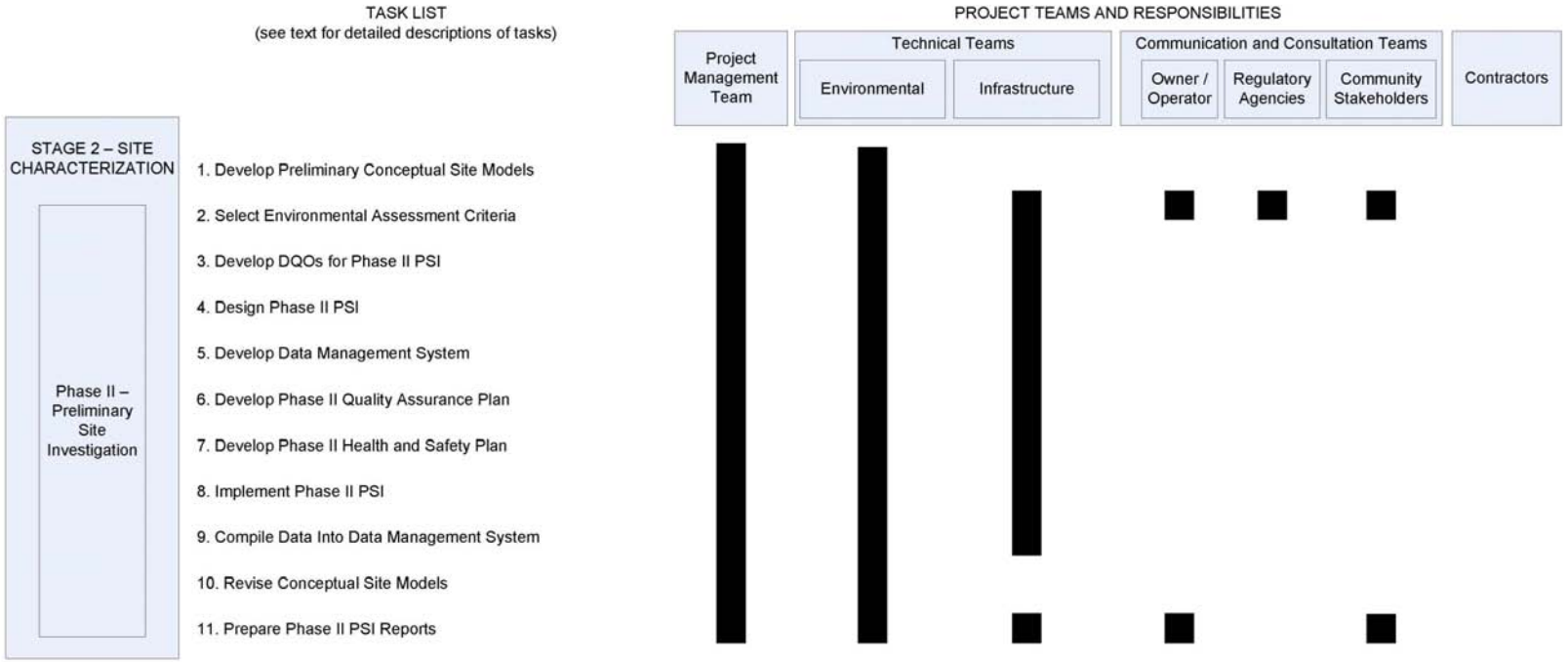


Figure A-4
Tasks and Team Responsibilities Associated with Stage 2, Phase II in the Decommissioning of Fossil-Fueled Power Generating Plants

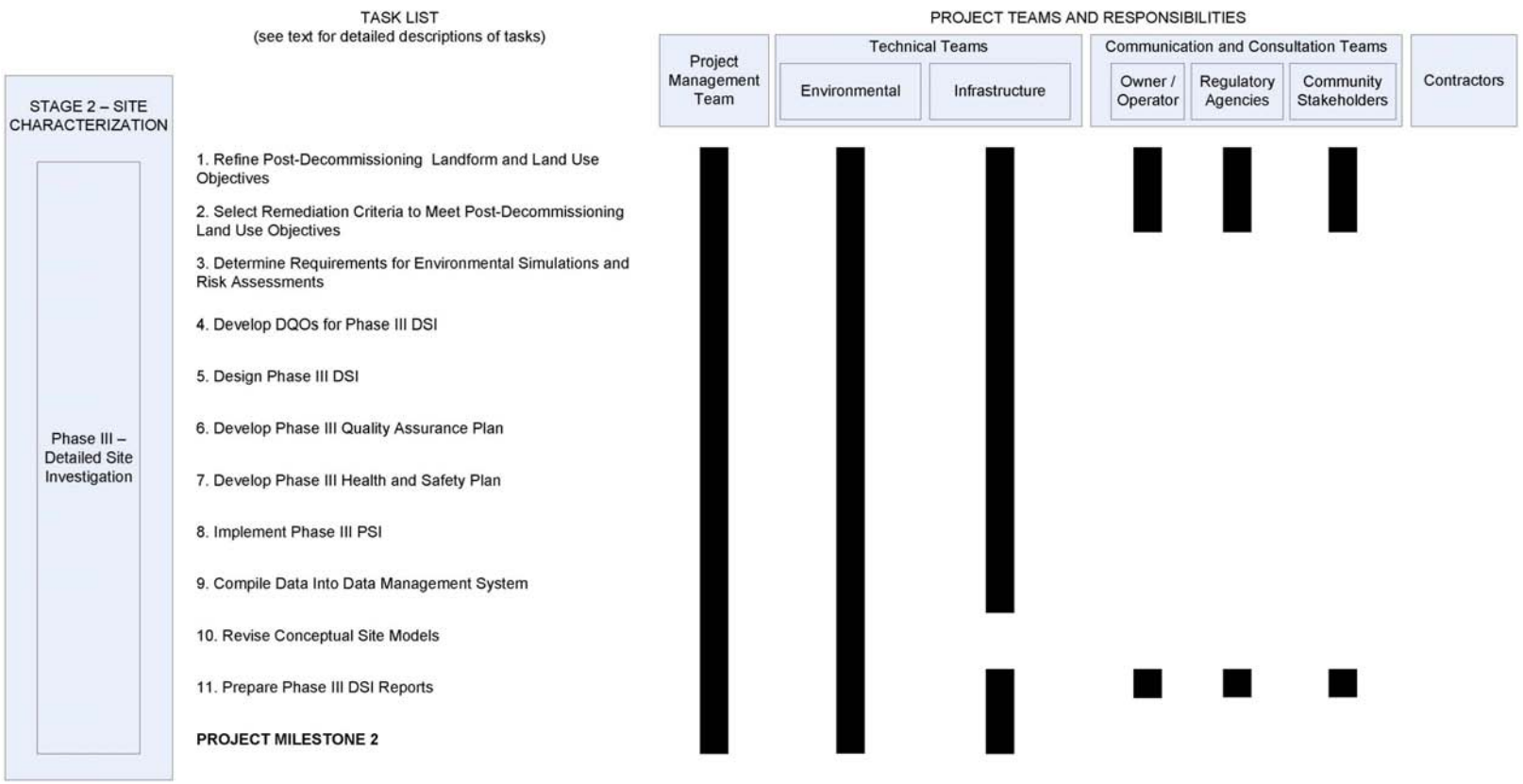


Figure A-5
Tasks and Team Responsibilities Associated with Stage 2, Phase III in the Decommissioning of Fossil-Fueled Power Generating Plants

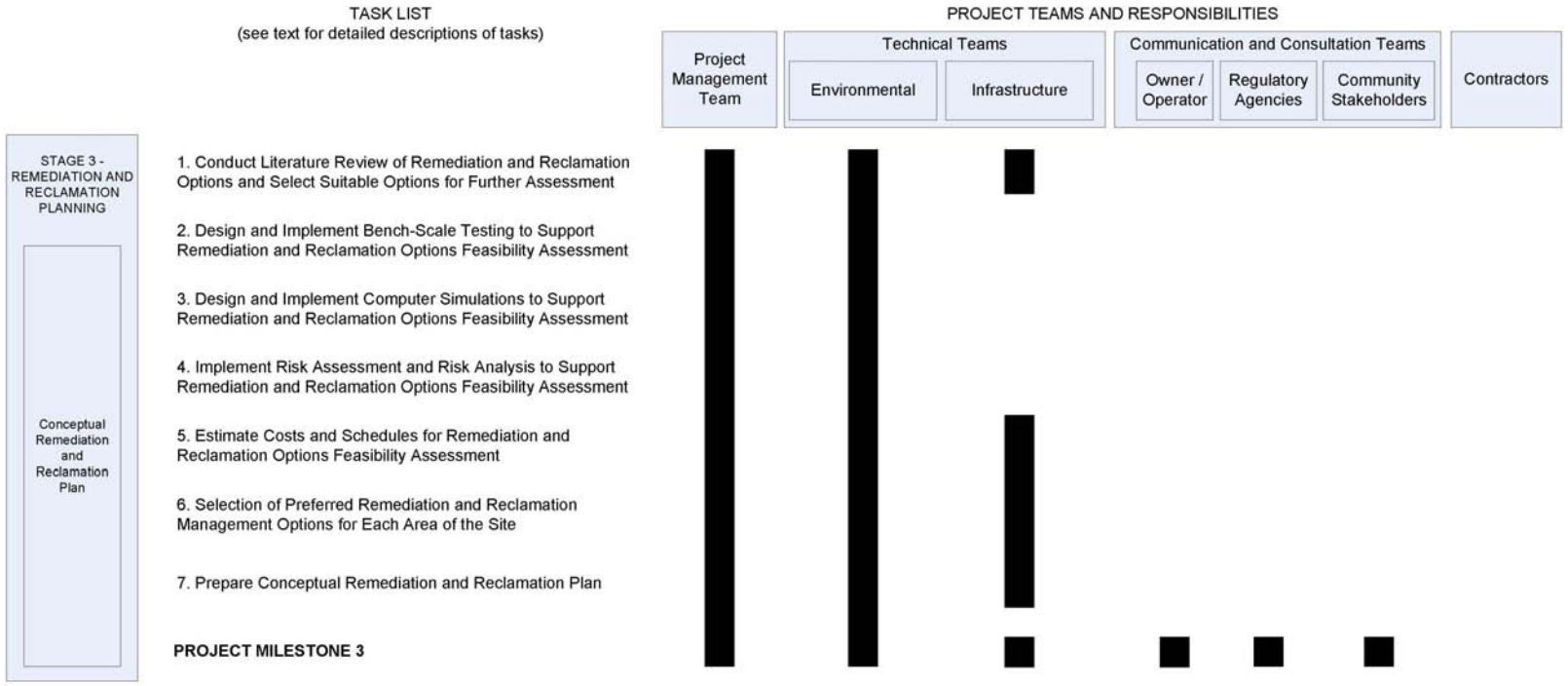


Figure A-6
Tasks and Team Responsibilities Associated with Stage 3 (Conceptual Remediation and Reclamation Plan) in the Decommissioning of Fossil-Fueled Power Generating Plants

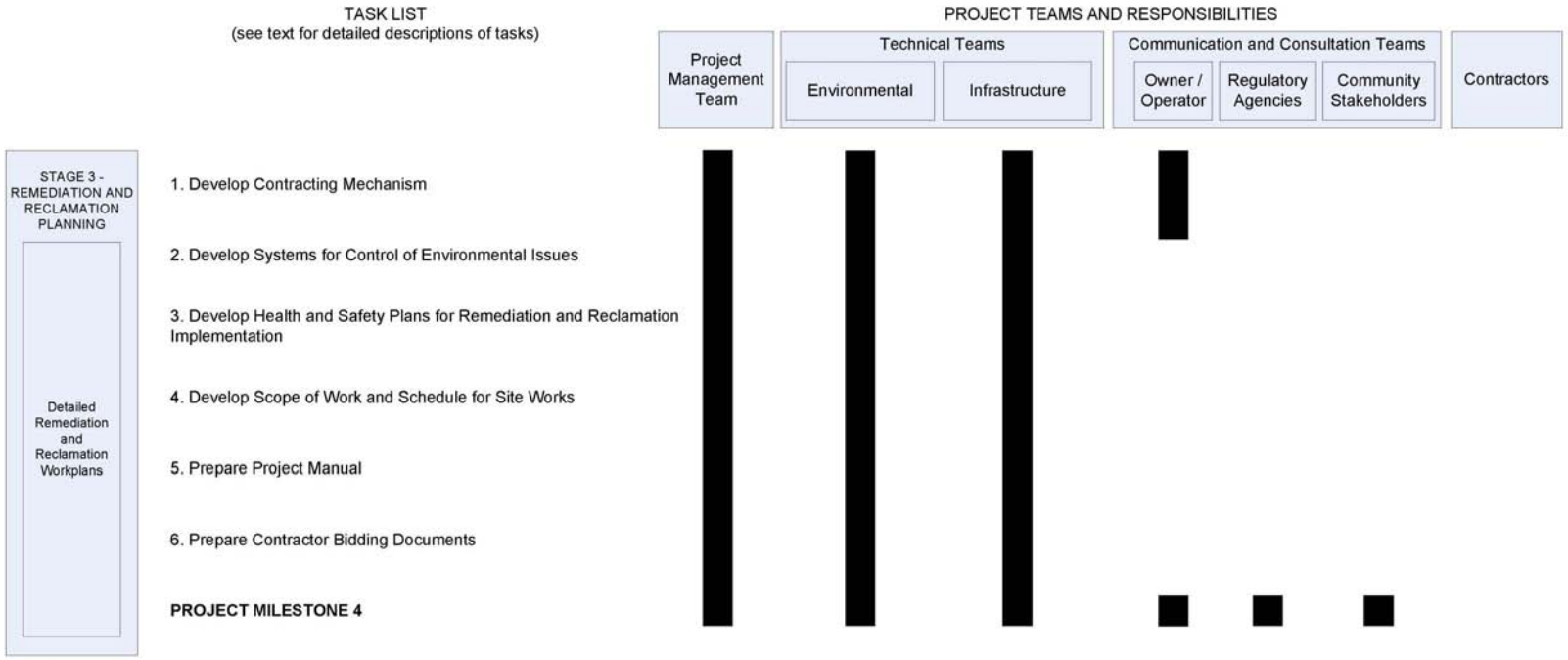


Figure A-7
Tasks and Team Responsibilities Associated with Stage 3 (Detailed Remediation and Reclamation Workplans) in the Decommissioning of Fossil-Fueled Power Generating Plants

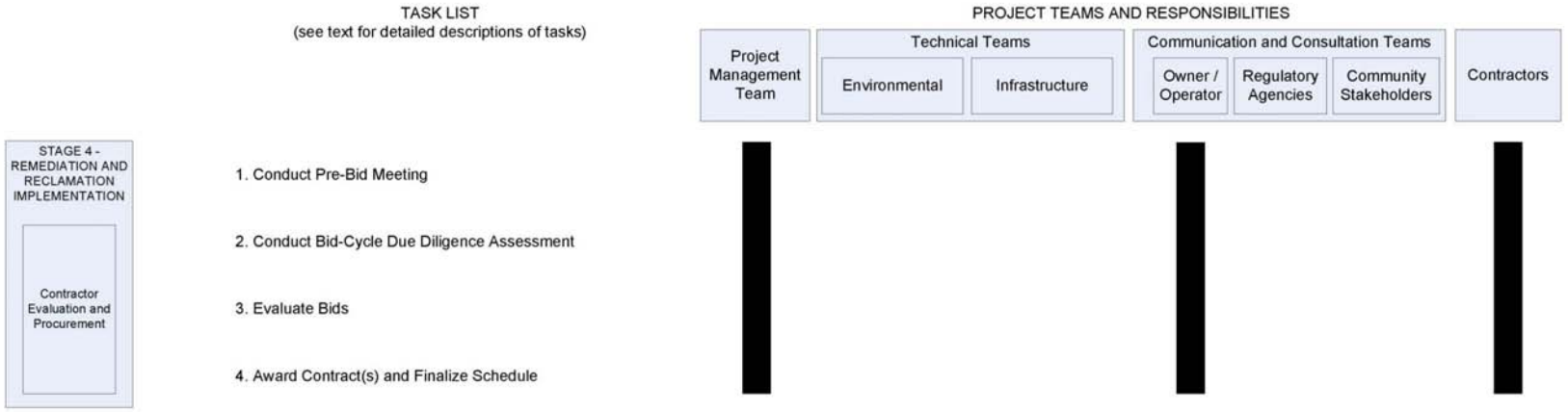


Figure A-8
Tasks and Team Responsibilities Associated with Stage 4 (Contractor Evaluation and Procurement) in the Decommissioning of Fossil-Fueled Power Generating Plants

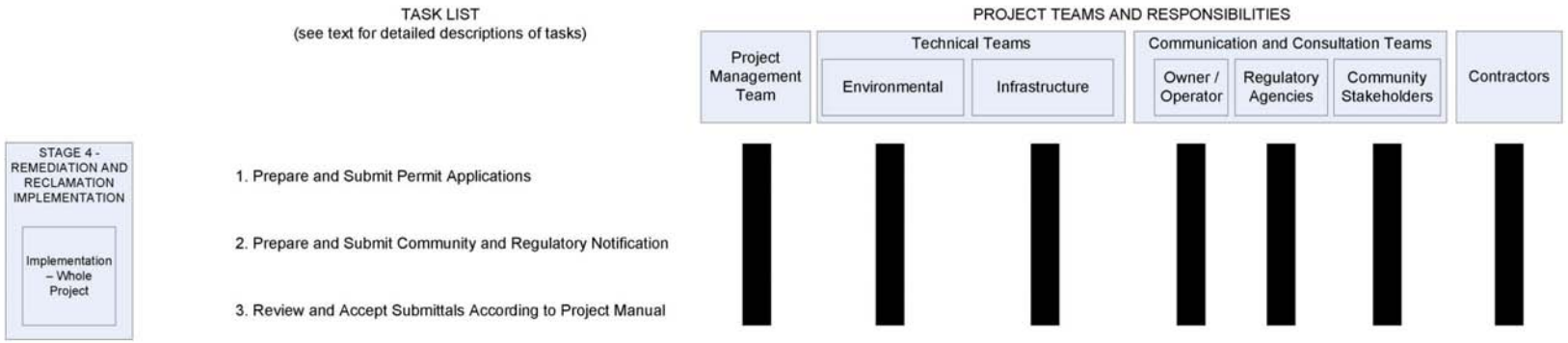


Figure A-9
Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Whole Project) in the Decommissioning of Fossil-Fueled Power Generating Plants

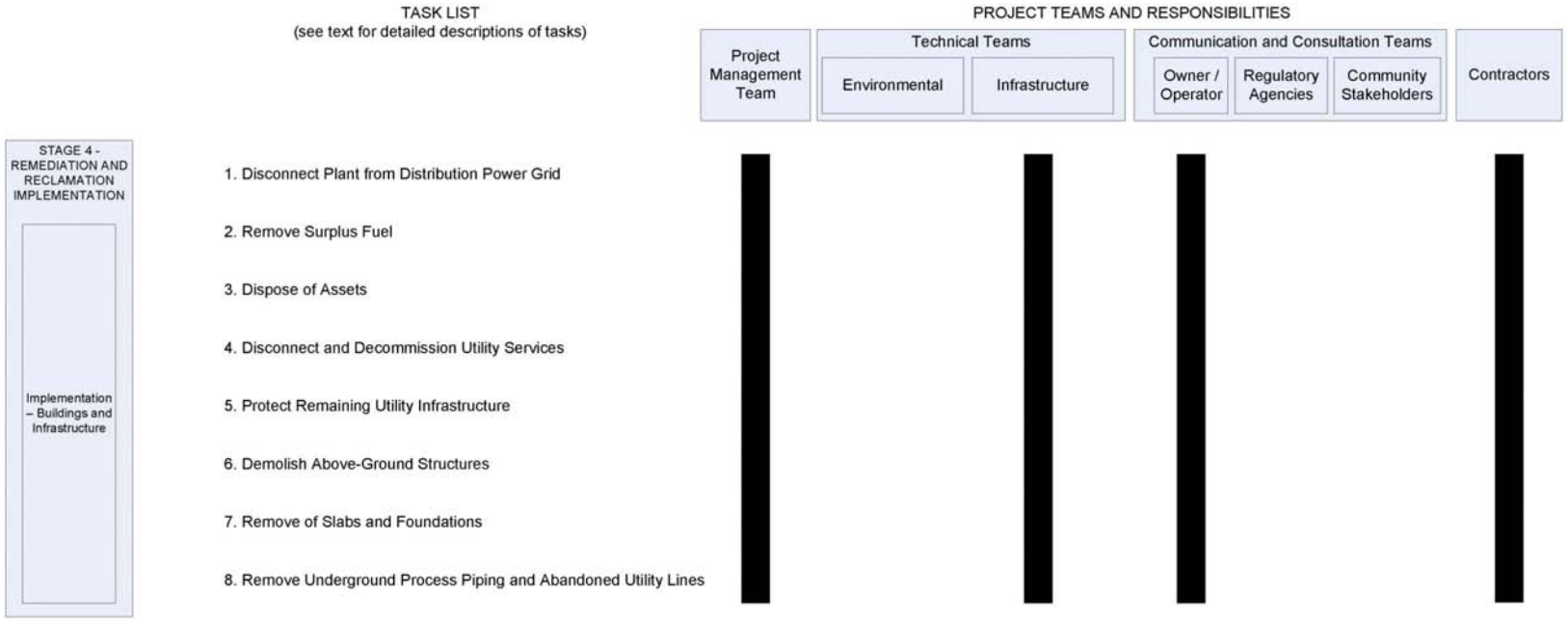


Figure A-10
Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Buildings and Infrastructure) in the Decommissioning of Fossil-Fueled Power Generating Plants

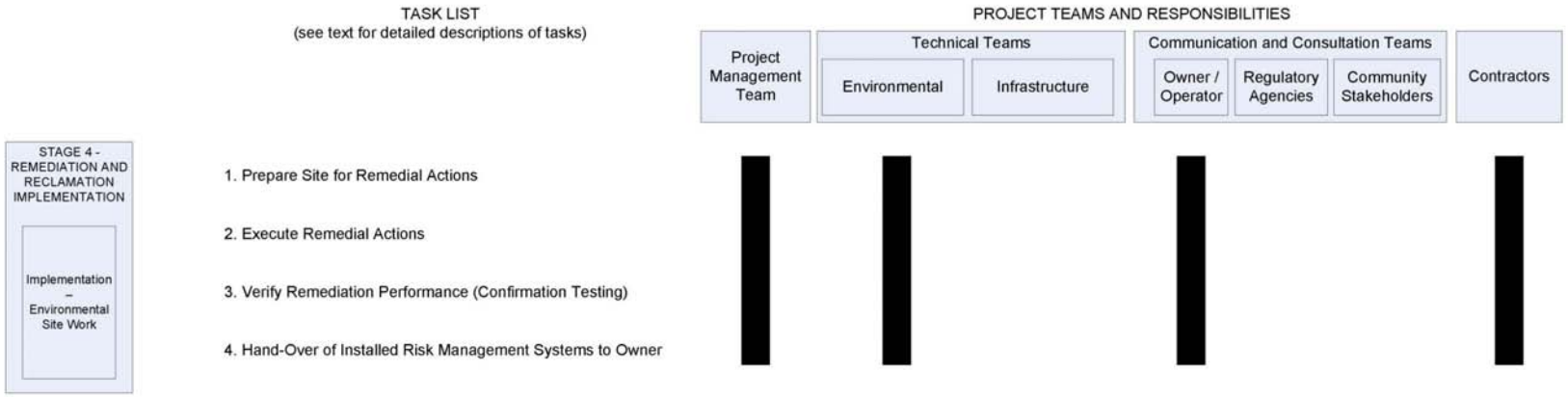


Figure A-11
Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Environmental Site Work) in the Decommissioning of Fossil-Fueled Power Generating Plants

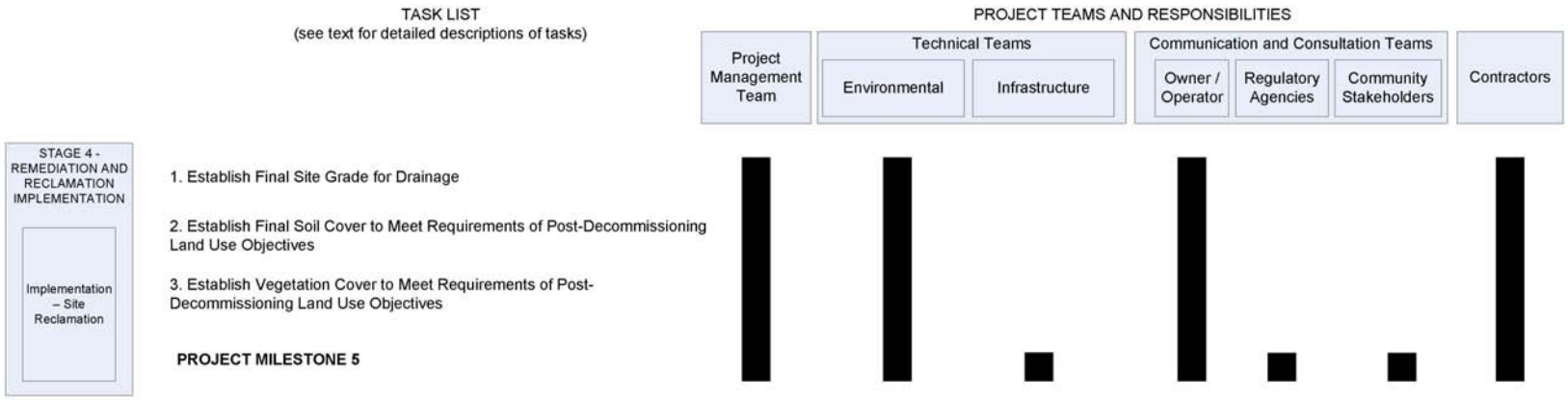


Figure A-12
Tasks and Team Responsibilities Associated with Stage 4 (Implementation – Site Reclamation) in the Decommissioning of Fossil-Fueled Power Generating Plants

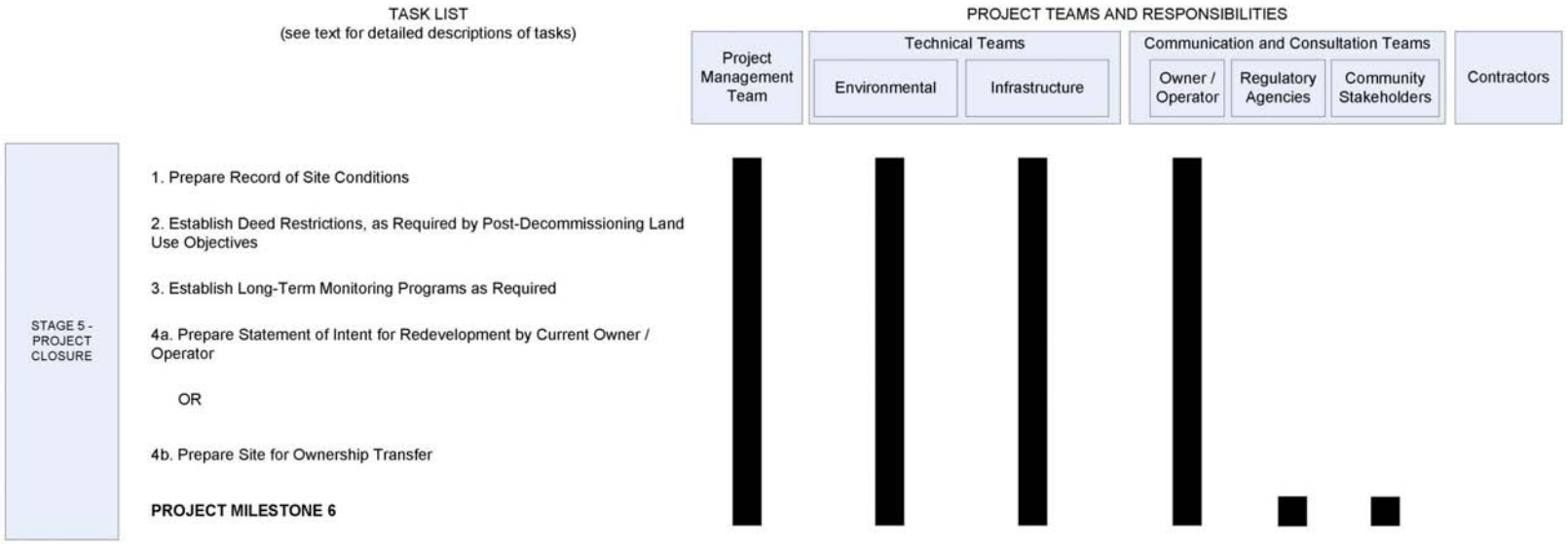


Figure A-13
Tasks and Team Responsibilities Associated with Stage 5 in the Decommissioning of Fossil-Fueled Power Generating Plants

B
DECOMMISSIONING PROJECT IMPLEMENTATION CHECKLIST

This document is intended to serve as a high-level roadmap to guide a project manager through the successful implementation of a decommissioning project. The items listed below assume that implementation of a decommissioning project has been approved.

Stage 1 – Project Framing

- ❑ **Establish the project team** and identify internal stakeholders that will have input into the final objectives and work scope for the project.
- ❑ **Develop end-use scenarios** for the subject property/facility with input from appropriate stakeholders.
- ❑ **Obtain directional, budgetary cost estimates** for each of the end-use scenarios.
- ❑ Review scenarios and cost estimates with decision-makers and **make final selection of the desired end use scenario** to be implemented. < Go – No Go decision >
- ❑ **Establish funding** for the decommissioning project.
- ❑ Establish project control structure by engaging Purchasing Department and other internal support functions as necessary (e.g. Legal, Engineering, Environmental Health & Safety, Real Estate, etc).

Stage 2 – Site Characterization

- ❑ Conduct a **Phase I environmental site assessment** and compile operational site use history information.
- ❑ Conduct a **Phase II environmental site assessment** (intrusive surface and subsurface sampling and analysis) if a real estate transaction or a significant change in land-use is being contemplated.
- ❑ Conduct a **Phase III environmental site assessment** if remediation of surface or subsurface materials is required to complete the real estate transaction or significant change in land-use being contemplated.
- ❑ Review the results of the environmental site assessment to **confirm that the planned end-use scenario is viable** from a technical and financial standpoint.

Stage 3 – Remediation and Reclamation Planning

- ❑ Conduct a regulated building materials survey (a.k.a. **pre-demolition survey**) and sampling program for the structures to be decommissioned/demolished.
- ❑ **Compile historic and current facility construction drawings** that are applicable to the buildings and infrastructures affected by the decommissioning project.
- ❑ Prepare **environmental remediation plan** and work scope for impacted surface and subsurface materials if required to complete the real estate transaction or significant change in land-use.

- ❑ Identify the **contract administration mechanism** and pricing option to be used (e.g. construction management involvement, fixed price vs. unit price, etc.) to deliver the completed project.
- ❑ Identify critical **health and safety and environmental** aspects of the project so that control mechanisms can be built into the project scope of work and technical specifications.
- ❑ Identify **critical sequencing and scheduling** aspects of the project so that important project milestones are included in the project scope of work requirements.
- ❑ Prepare the project scope of work, **technical specifications and contracting documents** (a.k.a. Project Manual or Tender Documents) which will be used to obtain bids and to administer the project during implementation.

Stage 4 – Implementation

- ❑ Identify, invite and **obtain price quotations** from qualified bidders for the work described in the Project Manual / Tender Documents.
- ❑ Evaluate the bids received to identify the contractor offering the highest value bid. **Award the project** and issue purchase orders and contracting documents to the winning contractor.
- ❑ Conduct the **pre-work submittal phase** of the project to ensure that applicable permits are obtained, that community and regulatory notices (if required) have been submitted, and that Contractor has sufficiently pre-planned the site work to address schedule, health and safety, and environmental aspects of the project.
- ❑ Establish mechanism for Owner's representative to **monitor on-site activities**; establish project control procedures; establish project communication plan.
- ❑ Contractor mobilization and **implementation of the physical site work** in accordance with the Project Manual.
- ❑ **Contractor de-mobilization** from the site and establishment of post-project security measures (if required).

Stage 5 – Closure

- ❑ Ensure that contractor has **closed-out all open permits** and made final regulatory notifications that are applicable to the project.
- ❑ Obtain **record of current site conditions** documentation from the contractor.
- ❑ Obtain all **waste management records** from the contractor and verify completeness.
- ❑ Obtain all commercial documents required by the contract; make final payment to the contractor and **close-out the contract**.
- ❑ **Complete internal requirements** regarding the change in operational status of the property/facility and engage appropriate internal functions (e.g. real estate, property accounting, tax, insurance, security, etc).

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BEST PRACTICE – PRELIMINARY PROJECT ESTIMATING

Preliminary project estimating is a critical process for converting a "conceptual course of action" into a viable project that achieves the Owner's business objectives. The information obtained from the preliminary estimating process is used for:

- **strategic decision-making** including: property end-use decisions; strategies for maximizing asset value; and project Go – No Go decisions

- **establishing corporate funding** or reserves/provisions to cover execution of the project.

The goal for preliminary estimating is to obtain a realistically conservative estimate (within 20% or so) of the cost of a project to facilitate good decision making. The more information that is made available to those providing the estimate, the more realistic the estimate will be.

Steps – see next page

Steps

- **Identify viable end-use scenarios for the property.**

  Identifies range of end-uses that achieve corporate business objectives. Identify high value options; eliminate low value options.

- **Determine general scope-of-work action statements from owner to achieve each end-use scenario**

  Identifies work elements needed to achieve objectives. Facilitates cross-functional review and input by other corporate stakeholders. Minimizes surprises and scope changes later in project when they are more difficult to address.

- **Develop Owner timing requirements for each end use scenario.**

  Timing of project initiation affects holding cost. Schedule constraints impact project scenario cost estimates.

- **Visit property to inspect physical layout of facilities and property; obtain basic drawings and environmental data, if available.**

  Conduct site inspection and facility review to "sanity check" the conceptual end-use scenarios and work scopes. Identify discrepancies or site-specific features to address in final project planning.

- **Prepare written scope-of-work in outline form for each scenario (e.g., bullet list).**

  Provides a structured format for preliminary cost estimating that ensures all the work elements and implementation strategies of the entire project are included in the estimate.

- **Obtain preliminary cost estimate from internal or external sources for each scenario.**

  To attain the required accuracy in the cost estimate, the Owner's estimating department or a full service environmental / engineering consulting firm experienced in decommissioning / demolition projects reviews the work scope scenarios and provides cost estimates. Additional site visit may be required.

- **Provide output documents for use in further planning actions.**

  Prepare documents in a format easy to communicate to, and be understood by, the corporate decision-makers.

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