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Roadmap to Plant Retirement, Decommissioning, and Site Redevelopment

2020 TECHNICAL REPORT

Roadmap to Plant Retirement, Decommissioning, and Site Redevelopment

EPRI Project Manager
L. Millet

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

3420 Hillview Avenue
Palo Alto, CA 94304-1338
USA

PO Box 10412
Palo Alto, CA 94303-0813
USA

800.313.3774
650.855.2121

askepri@epri.com

www.epri.com

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The Electric Power Research Institute (EPRI) prepared this report:

Principal Investigators
L. Millet, P.G.
B. Delis, D.E.

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Abstract

Evolving economic and regulatory conditions continue to affect the viability and desirability of operating certain fossil-fuel generating assets. In response, plant owners worldwide have recently announced significant coal plant retirements to support the low carbon energy transition. The upcoming plant retirements present a number of new challenges, including their use of advanced equipment, the presence of coal combustion residual ponds and landfills, and the need to address legacy environmental issues and waste disposal areas.

Plant retirement does not occur on a single date in time. In reality, plant retirement and redevelopment is a multi-phase process executed over several years. This report describes the plant retirement, decommissioning, and site redevelopment process and key considerations to help prepare plant owners to undertake these projects in a strategic manner.

Keywords
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PRIMARY AUDIENCE: Utility executives and plant retirement and redevelopment team members.

SECONDARY AUDIENCE: Other stakeholders in the plant retirement and redevelopment process.

KEY RESEARCH QUESTION

The low-carbon transition requires retirement of significant coal assets over the next 15 to 20 years. Plant owners undertaking this process need a corporate strategy that addresses all phases of the pre-retirement, decommissioning, and site redevelopment process. This document provides an overview of the project phases, stakeholders, and tasks.

RESEARCH OVERVIEW

This document provides a roadmap to the plant retirement, decommissioning, and redevelopment process. It provides plant owners and team members with an overview of the process by highlighting key considerations that assist with developing and implementing a corporate strategy to execute the process.

KEY FINDINGS

- Plant retirement is not a single date in time. It is a process that involves multiple phases executed over several years.
- A corporate strategy that identifies the three phases of the process and quantifies corporate objectives is necessary to approach the process strategically.
- Upcoming plant retirements are more complex, impose more risk, and are subject to more environmental regulations than historical projects.
- Site redevelopment is now a necessity to support corporate, federal, state, and local goals to enable the low-carbon transition.
- Identification and engagement with stakeholders throughout the process is a key to successful retirement, decommissioning, and redevelopment.

WHY THIS MATTERS

The low carbon transition has focused worldwide attention on the power generation industry. Upcoming plant retirements are more complex, impose more risk, and are subject to more environmental regulations than historical closures. Plant owners are also facing increasing pressure to assist local communities by identifying new uses for properties that will replace the job and tax base that the generating assets historically provided. Development and execution of a corporate strategy that considers the three phases of the process, identifies and engages stakeholders, and mitigates risk is necessary to retire and redevelop these assets while maintaining a positive public perception of the company.

The potential benefits of implementing an effective process include the following:

- Achievement of plant owner/operator strategic goals
- Adherence to a project budget and schedule; avoided delays and cost overruns
- Responsiveness to all stakeholder interests
- Maintenance of plant owner/operator positive corporate reputation
- Attainment of ongoing operating value from the plant during its glidepath process
- Management of risk throughout the process
- Effective compliance with environmental and other regulations
- Selection of an optimal end use for the site that balances stakeholder goals

HOW TO APPLY RESULTS

This document provides a roadmap to the three phases of plant retirement, decommissioning, and site redevelopment. Plant owners can use the key considerations described for each phase to develop a corporate strategy that identifies objectives and mitigates risk through the process. Section 4 of the report provides abstracts from EPRI reports on related topics.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- This research is closely related to research under EPRI's pre-retirement project, "Glidepath to Closure: Optimizing Pre-Retirement Operations." Contact EPRI's Brandon Delis, P.E. (bdelis@epri.com) for more information.
- EPRI's Plant Decommissioning and Site Redevelopment Supplemental Program supports this research. Contact: Lea Millet, P.G. (lmillet@epri.com) for more information.

EPRI CONTACTS: Brandon Delis, P.E., Senior Program Manager, bdelis@epri.com; Lea Millet, P.G., Senior Technical Leader, lmillet@epri.com

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Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

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Section 1: Introduction

Evolving economic and regulatory conditions continue to change the viability and desirability of operating certain fossil-fuel generating assets. A significant number of older, smaller, and less-efficient fossil plants have already been retired over the last decade. Economic and regulatory pressure on the remaining fossil fleet is likely to decrease coal capacity throughout the next decade and beyond.

This report describes the multi-phase plant retirement process, typically executed over several years, as well as key considerations to aid plant owners.

Plant owners worldwide have recently announced significant coal plant retirements, with anticipated retirement dates over the next 15 years, to support the low carbon energy transition. This next round of plant retirements presents a number of new challenges. These plants are much larger, with average nameplate capacity retired of approximately 490 MW, compared to an average of 190 MW over the past 15 years. Increasing the scope of these retirements is their use of flue gas desulfurization (FGD) scrubbers, selective catalytic reduction (SCR) systems, other advanced equipment, coal combustion residual ponds and landfills, and legacy environmental issues and waste disposal areas.

Plant retirement does not occur on a single date in time. In reality, plant retirement is a multi-phase process executed over several years. This paper describes this process and key considerations to help prepare plant owners.

Retirement, Decommissioning, and Redevelopment Project Phases

Plant retirement and decommissioning includes the following three phases:

- The first phase of the decommissioning process, or glidepath, begins when the owner determines the retirement date.
- The second phase, or decommissioning, begins when plant operations cease.
- Redevelopment, or the process of identifying potential paths for future use of the assets and property, begins when a retirement date is determined and continues until all decommissioning activities are complete and the property is turned over to either the new owners or the internal group that will repower the plant.

Figure 1-1 shows the phases of the process and the overlap between project teams. Ownership of the project and the site changes throughout the process, moving from the glidepath team, to the decommissioning team, and to the redevelopment team until the final transfer to the new owner.

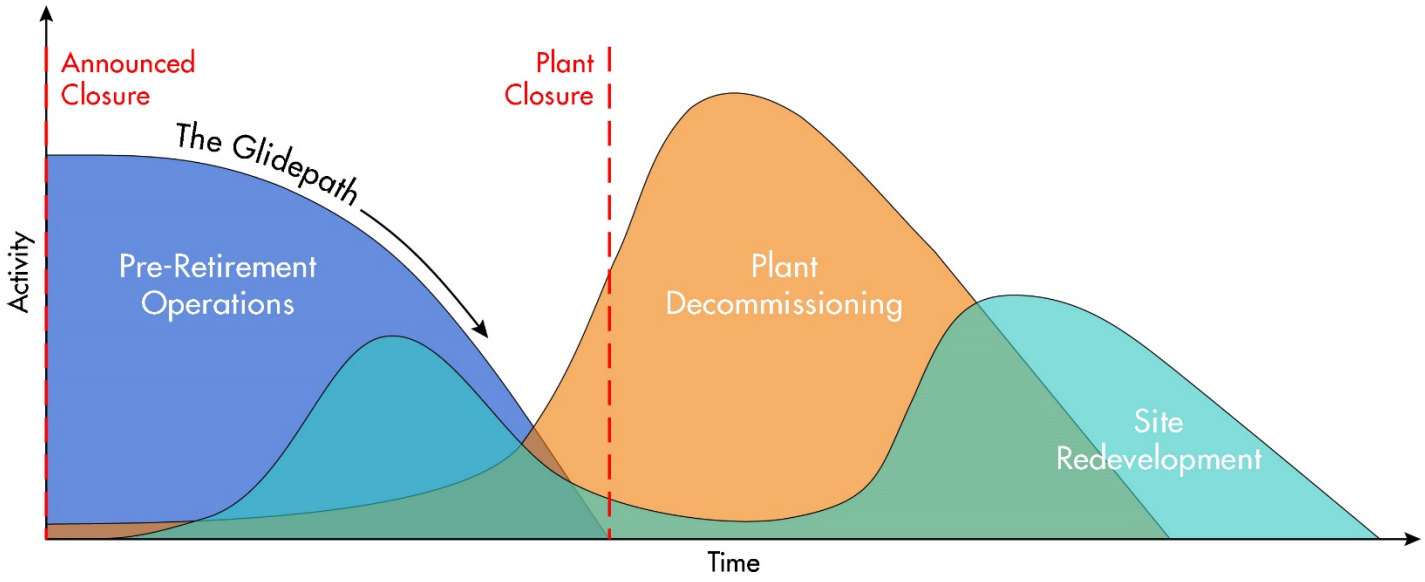

Figure 1-1
The phases of plant retirement, decommissioning, and redevelopment, and project team activity timing

The glidepath team consists primarily of the plant manager and plant staff. This team focuses on operating the plant to meet baseload generation requirements, while drawing down assets, staffing, and contractors, and minimizing operating costs. This phase engages primarily with internal stakeholders.

The plant decommissioning team consists of a dedicated group of individuals, usually engineers and/or construction managers, who are supported by subject matter experts throughout the company. The team is responsible for planning and executing the physical and environmental decommissioning of the plant. They frame the project, characterize the site, plan for reclamation, remediation, and demolition, then implement the plans. This phase engages with internal stakeholders and end-use stakeholders when an end use has been selected.

This report describes the multi-phase plant retirement process, typically executed over several years, as well as key considerations to aid plant owners.

The redevelopment team is composed of a dedicated group of individuals, generally with real estate and legal backgrounds, who are supported by subject matter experts throughout the company. This group is responsible for identifying potential site end uses and developing opportunities for property sale or reuse. This team creates a site attributes and assets summary, analyzes local and regional markets, identifies potential end uses, and then identifies opportunities for redevelopment. This phase engages extensively with both internal and external stakeholders to characterize the site and identify and implement end-use opportunities.

Beginning at project initiation, each team accesses resources and knowledge from throughout the corporate organization by working with subject matter experts from legal, accounting, environmental, engineering, and other departments to ensure that the project is properly planned and executed. Examples include:

- The glidepath team works with the decommissioning team to identify and tag salvageable and saleable equipment and scrap metal.
- The decommissioning team works with the site redevelopment team to perform a site characterization and evaluate potential end uses.
- The redevelopment team works with the decommissioning team to identify and protect assets, such as buildings and utility infrastructure, that will be retained for redevelopment.

Corporate Strategy

Safe, efficient, and cost-effective plant retirement and repowering or redevelopment requires a corporate strategy that promotes collaboration and balances many parallel priorities.

The path to safe, efficient, and cost-effective retirement and repowering or redevelopment is complex and requires a corporate strategy that promotes collaboration between the teams managing each phase of the process. Balancing the many parallel priorities of safety, staffing transitions, operational and maintenance expectations, and asset management, maintains baseload generation of the plant without incurring excess risks or costs. At the same time, the process identifies a path for plant repowering or redevelopment and then plant decommissioning. This process requires a corporate strategy that is comprehensive, flexible, and allows development of a site-specific playbook that:

- Establishes corporate objectives for retirement, decommissioning, and redevelopment
- Establishes achievable goals with realistic schedules for each project phase and the entire process

Fully implementing the corporate strategy and achieving the objectives requires an experienced, competent leader of each team, and the full support of executive management. All three components—executable strategy, experienced leaders, and executive support—are needed to avoid adverse safety, schedule, budget, or public perception impacts (see Figure 1-2).

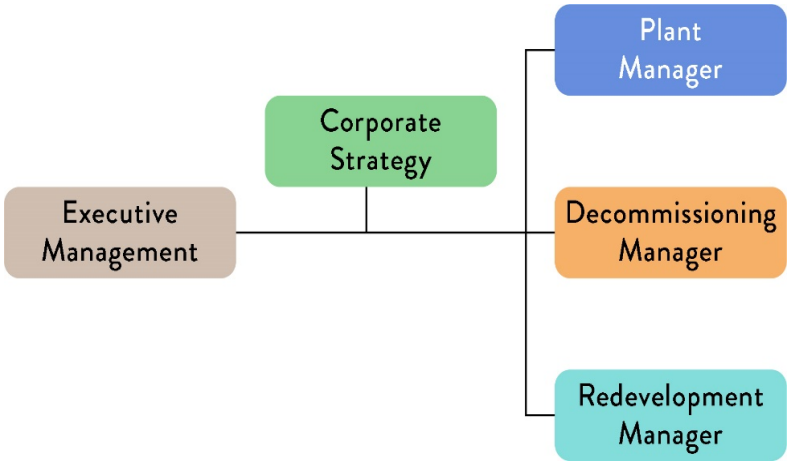

Figure 1-2
Essential project components in the plant retirement, decommissioning, and redevelopment process

Risk Identification and Management

Once corporate risk limits are established, project teams can use them to continually anticipate, monitor, and mitigate risk across the three project phases—plant retirement, decommissioning, and redevelopment.

Throughout the process, a critical aspect of project planning and execution is risk management. An understanding of risk tolerance, risk capacity, and risk appetite establishes the amount of risk the company is willing to incur (see Figure 1-3). Identifying and respecting these limits enables goal setting to meet overall project objectives, such as safety, cost management and control, schedule, regulatory compliance, operations, and reputation. If the owner does not establish risk limits at the corporate level as part of the retirement strategy, project teams or individual project managers may set limits that are unacceptably conservative or aggressive compared to the true corporate limits. Once the corporate risk limits are established, project teams can use them to continually anticipate, monitor, and mitigate risk across the three project phases.

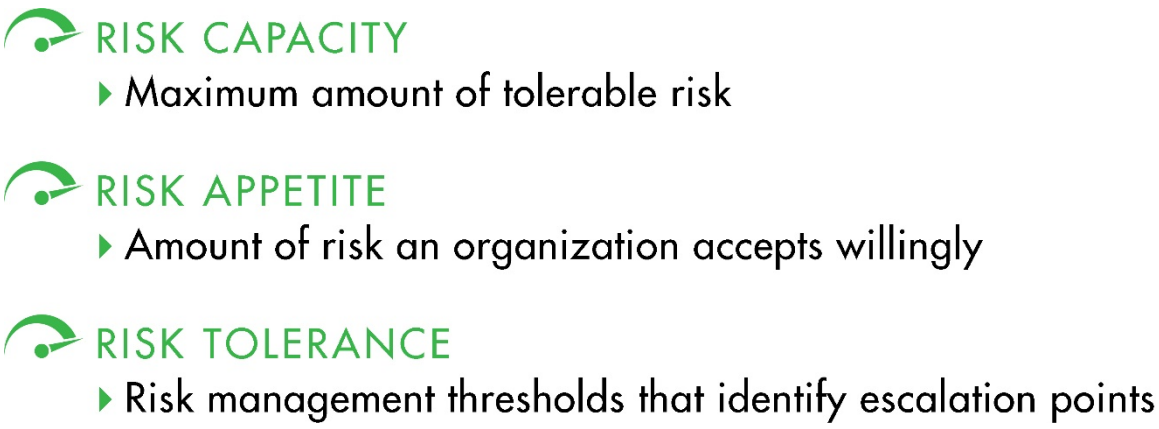

Figure 1-3
Risk management begins with establishing acceptable risk limits (adapted from EPRI, 2018)

Plant Retirement and Site Redevelopment Approaches

Plant decommissioning projects implemented from approximately 1995 to 2015 typically used one of the following approaches:

- **Plant layup** included maintaining the plant in its present condition, with minimal activities designed to maintain environmental and safety compliance. In some cases, the plant continued to provide seasonal or peaking operations.
- **Partial dismantlement** included minimal dismantlement and demolition performed with minimal ongoing activities that were designed to maintain environmental and safety compliance.
- **Full demolition** included removal of all equipment and infrastructure, remediation of environmental conditions, and plant restoration or repurposing.

During this period, the following factors influenced the choice of strategy:

- Projected cost of decommissioning and environmental remediation
- Peaking operational needs
- Third-party interest in acquiring and redeveloping the property (for plants on waterfronts or in urban centers)

Corporations, in addition to local, state, and federal government agencies, are placing an increased emphasis on redeveloping properties during the low carbon transition.

Historically, little thought was given to site redevelopment. Today, allowing a property site to remain idle is no longer an option. Local, state, and federal governments, municipalities, non-governmental organizations, development commissions, and environmental justice advocates are increasingly calling for industrial facilities at redevelopment sites to assist with the transition from an operating power plant to site redevelopment. The goal is to replace the taxes, jobs, and community support that are lost during the retirement. In the United States, this has become a federal priority in 2021. The U.S. Congress and U.S. Environmental Protection Agency are taking actions to encourage transition of closed or closing power plants and the industries that support coal-fired electricity generation.

Based on these expectations for companies that are decommissioning plants, the new approaches to decommissioning will likely include the following:

- **Plant layup** includes maintaining the plant in present condition for peaking operation while it is repowered with a new energy source, at which time the unutilized coal generation infrastructure is demolished.
- **Partial dismantlement** includes removing and closing portions of the plant not needed for the intended end use, while protecting and maintaining portions of the plant incorporated into the repowering or redevelopment plan.
- **Full demolition** includes fully demolishing the plant and performing environmental remediation to remove limiting environmental conditions, while preparing the site for an end use that does not include power generation.
- **Site sale prior to demolition** includes ceasing operations and selling the plant as-is to a developer, who performs demolition, environmental remediation, and site redevelopment.

These new approaches to decommissioning are more complex, more costly, and carry more risk than previous plant retirements. New regulations have resulted in:

- Closed coal combustion facilities, for which many owners will retain ownership and liability
- Stricter environmental remediation requirements for legacy contaminants
- Stricter rules that complicate maintaining or transferring environmental and operating permits, or impede a new owner's ability to gain the permits required for site reuse

Current owners now need corporate strategies that are comprehensive, flexible, and allow identification of end uses that may vary across the site, rather than redeveloping the entire site for a single use.

Retirement, Decommissioning, and Redevelopment Stakeholders

Another challenge for the retirement process is the identification and engagement of stakeholders. Plant retirement affects a significant range of internal and external stakeholders (see Figure 1-4).

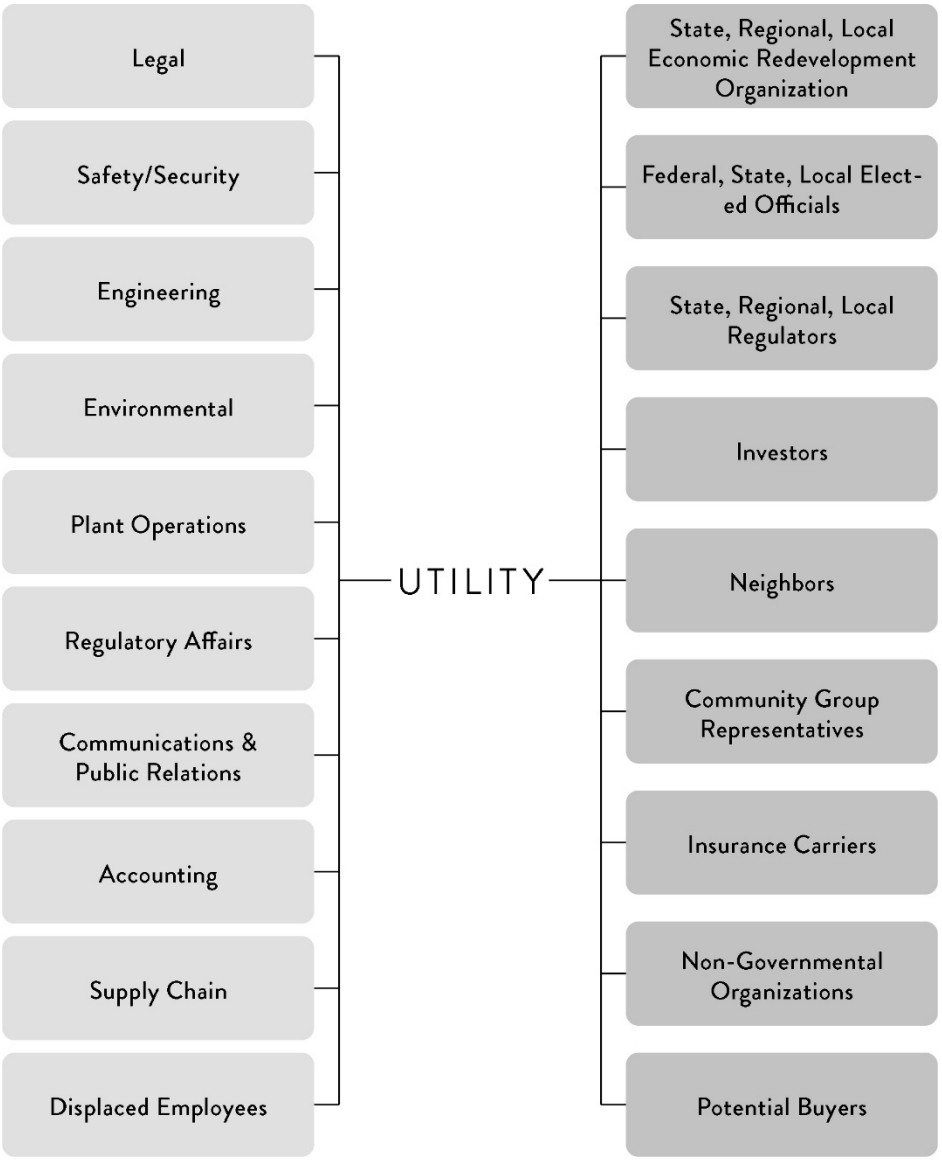

Figure 1-4
Potential internal and external Stakeholders for plant retirement, decommissioning, and redevelopment projects

A successful project requires inclusion of all stakeholders to gain access to the most useful and beneficial knowledge, ideas, lessons learned, and path forward. Identification of all critical stakeholders and effective stakeholder engagement is needed to avoid:

- Miscommunication or inadequate communication
- Missed opportunities to benefit from lessons learned during previous plant retirement and redevelopment projects
- Uninvestigated potentially beneficial paths to redevelopment

In each case, benefits include avoided costs, schedule delays, or lost redevelopment opportunities. Engaging key stakeholders early in the process can enable development of post-closure land use plans. These can ultimately lead to preservation of structures and utilities, as well as environmental remediation to the level required for the planned use, potentially providing cost and schedule savings. This approach can also avoid costly unexpected outcomes by identifying potential historical environmental liabilities, undocumented plant changes, and other knowledge of the long-time plant staff.

Section 2: Retirement, Decommissioning, and Redevelopment

Overview

Many companies have performed a plant decommissioning project within the past 20 to 25 years, and some companies have decommissioned multiple plants during this period. This has enabled companies to build a large internal knowledge base for best practices and lessons learned with regard to plant decommissioning. This, in turn, has resulted in cost and time savings because staff members could apply these practices to multiple projects. For example, this knowledge can help manage the project budget and schedule. Knowledge of the location and composition of regulated building materials for a certain type of building construction typical to the company enables the team to identify and remove materials as part of the initial plan, rather than as a change order. This process can also improve project outcomes, for instance, by improving demolition safety planning and expectations.

Decommissioning of the larger and more complex plants in the next 20 years will require plant owners to build a new set of best practices while incorporating historical lessons learned.

All companies entering the current phase of decommissioning need to determine whether their internal knowledge base remains or is accessible to the new teams undertaking these larger, costlier, and more risky decommissioning projects. The normal process of staff turnover includes retirements, downsizing, departmental transfers, position promotions, and staff leaving the company. This can result in loss of acquired knowledge base if more than 3-5 years pass between decommissioning or redevelopment projects. If the project knowledge and lessons learned are not captured during the project close-out, or if they are not recorded in a digital format that remains accessible, valuable information can be lost, and companies may enter decommissioning projects without the benefit of historical knowledge.

Another consideration for the decommissioning scheduled in the next 20 years is the size and complexity of the plants. These plants incorporate new types of equipment, generate more process chemicals and wastes, are subject to new environmental regulations, and must adhere to stricter safety regulations than were common in previous decommissioning projects. This means that no historical knowledge base exists for certain aspects of the upcoming plant retirements, or historical knowledge of team members is incorrect or no longer applicable to the current situation. Companies may need to build a new set of best practices and lessons learned to accommodate the changes in both the physical plants and the regulations applicable to retirements.

The remainder of this section examines the glidepath, decommissioning, and redevelopment project phases.

Glidepath

The glidepath is the period between the committed retirement announcement to the plant's actual retirement and eventual decommissioning. During this time, plant staff members are challenged with increasing resource constraints and flexible operations, complicating unit operation as it nears the planned retirement. Until decommissioning, units remain important for serving load during their glidepath—especially for seasonal production or until new units are brought online. This highlights the importance of continued operations, maintenance, and investment decisions.

Through proper planning and guidance, plants undergoing retirement can continue to provide value during the "glidepath" period.

Similar to flexible operations, a committed retirement announcement represents a change in mission for these coal plants. Prior to the commitment, plant operational strategy was based on an extended operational period (i.e., 20 years or more). Reduction of the plant operational period fundamentally changes how this plant is operated and maintained. Long-term investments are eliminated, resources continue to decrease, and the plant staff begins a phasing-out process.

Through proper planning and guidance, these plants can continue to deliver value. A prudent, risk-informed, and technically-sound strategy can enable plant staff to limit costs, achieve required reliability and production targets, and maximize the value from these assets leading up to and after retirement.

Identify and Mitigate High Consequence Risks

Annual generation targets usually decrease during the glidepath period, but these units remain important during peak summer and winter periods. As demonstrated in Texas during the winter of 2021, coal units continue to provide a key role in peak seasons. Identification and development of mitigation strategies for high consequence risks helps ensure that these units deliver value while on their glidepath.

Identification and mitigation of low-frequency, high-consequence risks early in the process is critical to glidepath success.

Operational risk begins to increase as the planned retirement date approaches and resources become less available. Hence, decreasing resources need to be used effectively to manage risk and meet operational targets.

High consequence events are a threat to the safe and effective operations of these facilities. Although safety cannot be compromised, reduced resources and staffing increase the risk of an incident. This is also true for environmental compliance. Major equipment failures due to age or reduced maintenance can significantly shorten the unit's remaining life if the event results in repair costs exceeding the remaining value of continued operations.

Development of Remaining Life Resource Plans

With lower overall utilization factors, the resource plans for these plants should not require high reliability at all times. The plan should focus on peak periods and increasing plant flexibility to ensure it can respond quickly to opportunities in the market to enhance value. Plant staff should also consider relaxing plant operating conditions to preserve plant life and retain the ability to respond quickly. The focus for the preretirement phase is to establish and communicate a new risk-reward balance of operations to obtain increased value from the plant during its decreasing operational period.

Determine the most effective deployment and highest ROI of limited resources to maximize glidepath operations.

A recommended "calibrated" resource plan establishes an optimum strategy for the management of assets and helps deliver the unit's glidepath mission. It ensures that investment in the physical assets helps directly and optimally deliver value. The asset plan should establish priorities and optimize cost, risk, and performance. This strategy is a significant departure from plant operations prior to the announced retirement, due to the shorter defined remaining plant life expectancy.

Staff and Stakeholder Management

The next round of retirements differs from the retirements over the last 15 years in many ways. One significant difference is that plant owners are committing and announcing these planned retirements in advance of decommissioning and redevelopment. These commitments increase the certainty of the plant's future, enabling the human resource side of the transition to begin sooner and over a longer period of time.

Ensure safe, reliable operation through the glidepath period, while managing stakeholder engagement.

The impending plant retirement requires a significant shift in the plant's mission and culture, requiring the full support and cooperation of the staff. Staff member activities and responses are an important part of success during the glidepath period. The impending plant retirement means staff will individually consider their long-term future, and depending on their personal circumstances, some might decide to leave the plant. This calls for corporate and plant management to establish a strategy and plan for personnel staffing that provides the sustainable skills, qualifications, and experience required to support the asset until retirement.

In addition to the company and the staff, a range of other parties have vested interests in the power plant and much to gain or lose from its retirement. The plant owner needs to ensure these groups remain aware of the process and supportive. Contractors and suppliers, in particular, will see the potential for reduced earnings, so the plant owner should keep them informed of significant developments. Regulatory authorities—especially those involved in environmental requirements—will take an active interest in a power plant that is nearing its end of life. Local community interest in the plant will increase as they contemplate the demise of a large local employer and source of local spending.

Decommissioning

Decommissioning is a process that starts long before the plant ceases power generation. A successful decommissioning project builds a qualified team, develops a thorough plan in conjunction with the redevelopment efforts, and manages risks throughout the process. The decommissioning team works closely with the operations team to ensure a thorough understanding of the plant and its systems. They also work closely with the redevelopment team throughout the process to ensure that structures, utilities, and other assets in the redevelopment plan are preserved and protected, and that necessary environmental remediation and site restoration are achieved. The remainder of this subsection describes the five primary steps to developing and implementing a decommissioning project.

Frame the Project

Project framing begins with the corporate decommissioning strategy and builds a site-specific playbook that encompasses all aspects of the project. This document is typically reviewed with internal stakeholders to identify missing information or steps that could impact the budget or schedule. Certain aspects of the plan may be reviewed with external stakeholders where the property will be redeveloped. Items that are typically covered include:

- Objectives
  - Safety, budget, schedule
- Expectations
  - Owner/operator
  - Regulatory
  - Stakeholder
- Project management systems
- Project decision-making processes
- Project team roles and responsibilities
- Schedule
- Budget
- Communications
- Environmental conditions and risks
- Retirement plan

Characterize the Site

Site characterization begins at the time of the plant retirement announcement. It improves understanding of the assets, obligations, liabilities, and limitations for decommissioning and redevelopment. This information is used to determine the necessary amount of environmental remediation and to evaluate potential end

uses for the land. By starting during glidepath operations, staff with historical knowledge of plant operations will be available to assist with the effort. The final environmental characterization will not be possible until the boilers have completely cooled and can be accessed for regulated materials inspections. However, much of the site characterization can be completed during glidepath operations. Figure 2-1 lists typical considerations for this step.

Figure 2-1
Examples of site characterization consideration for determining assets, liabilities, and limitations

Plan for Remediation and Reclamation

The remediation and reclamation planning process uses information gained during the site characterization and redevelopment planning process to identify abatement, demolition, and environmental remediation that will take place during decommissioning. This planning also includes working with state and/or federal environmental regulators and other stakeholders to set cleanup goals for regulated building materials (if structures will be left in place) and other potentially contaminated areas. Detailed schedules and cost estimates are finalized during this step, and the plans are reviewed with internal and external stakeholders to promote agreement and identify missing information that may affect the project. The redevelopment team works closely with the decommissioning team to ensure that assets needed for the redevelopment phase will be protected and retained during decommissioning. Major tasks executed during remediation and reclamation planning include:

- Select contracting mechanisms
- Plan for control of environmental issues during execution
- Plan for control of health and safety during execution
- Develop detailed scope, sequencing, and contract documents

- Develop engineering feasibility evaluations
- Evaluate reclamation markets and material values
- Develop site staffing plans

Implementation

The implementation phase begins with contractor selection, during which a large pool of candidate companies is narrowed to a small number of highly qualified bidders for each aspect of the third-party work. When candidates and their qualified subcontractors are selected, the schedule is finalized and mobilization begins. The site-specific playbook developed during the planning process guides the activities through initiation, remediation, and restoration. The decommissioning team continues to work closely with the redevelopment team and redevelopment stakeholders to ensure that the final physical and environmental disposition will meet redevelopment requirements. Figure 2-2 lists typical activities executed during project implementation.

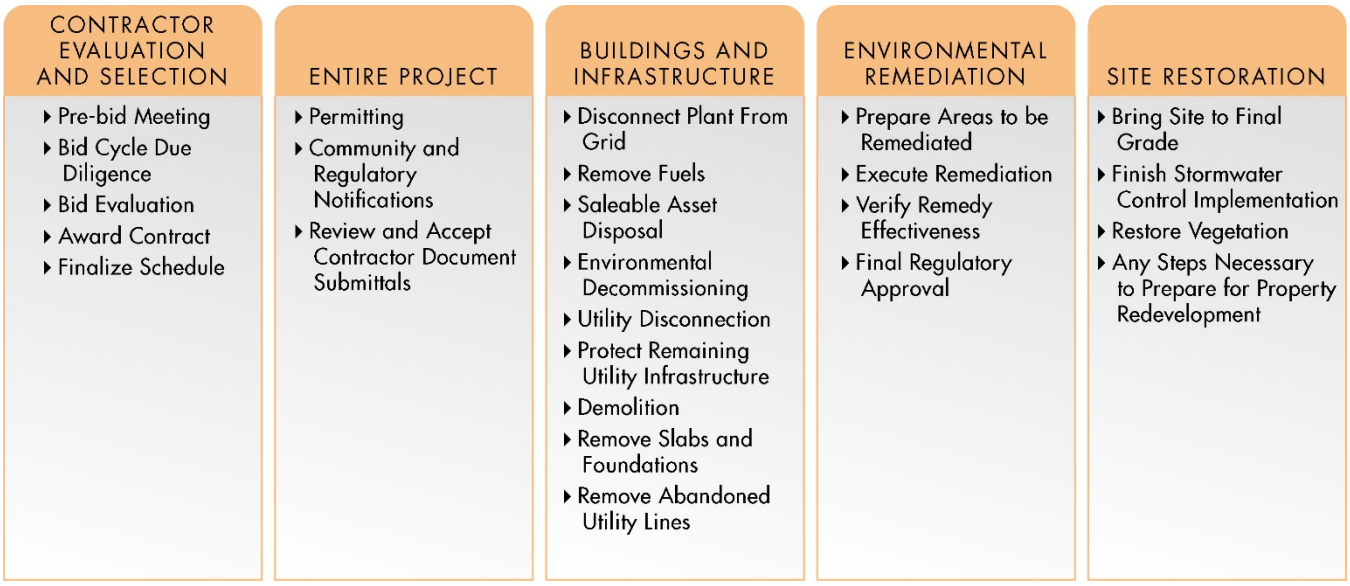

Figure 2-2
Typical site decommissioning implementation activities

Decommissioning Project Closure

As site restoration is completed, the decommissioning team performs several final tasks to complete the project and release the property for redevelopment. These include:

- Verify that remediation and reclamation are complete
- Verify that the site meets redevelopment requirements
- Confirm that stakeholders agree that the project is completed and has met the objectives

- Implement long-term risk management controls
- Finalize and file project documents
- Identify project successes and capture lessons learned

Redevelopment

Plant redevelopment activities are most successful when they begin far enough in advance of plant retirement to allow time for a thorough examination of assets, liabilities, obligations, and limitations to identify potential end uses.

Plant redevelopment activities are most successful when they begin far enough in advance of plant retirement to allow time for a thorough examination of assets, liabilities, obligations, and limitations to identify potential end uses. The redevelopment team works closely with internal and external stakeholders to identify and objectively evaluate potential end uses. This team then continues to work with the decommissioning team throughout the retirement process to ensure that structures, utilities, and other assets required for redevelopment are protected and maintained. This team identifies and engages with many external stakeholders to identify a viable redevelopment plan that considers the liabilities and limitations of the site, while taking full advantage of site, local, and regional assets. Working closely with external stakeholders allows the owner to identify opportunities that are beneficial for both the site and the surrounding community.

Build on the Internal Site Characterization to Develop a Full Picture

The redevelopment team works with the decommissioning team to develop an accurate site characterization, then expands the characterization to include local and regional factors. This involves working with internal and external stakeholders to identify assets and limitations for many factors and taking into consideration any local or regional mid-range to long-term plans for growth.

This step develops an initial list of potential end uses for the property. Figure 2-3 lists examples of the factors considered during this step.

Figure 2-3
Types of factors considered for end-use identification

Screen Potential End Uses

End-use identification and selection is an iterative process that requires input and support from multiple stakeholders

When the plant characterization has been expanded to include the factors discussed above and a list of potential end uses has been developed, the redevelopment team works with internal and external stakeholders to evaluate the potential end uses. This consists of an iterative process that considers all aspects of the potential end use, including but not limited to an evaluation of cost, engineering feasibility, environmental obligations, and stakeholder agreement. This process may be repeated many times, before the end use most likely to result in a successful outcome is identified (see Figure 2-4). One important consideration during this process is that the entire property may not be suited for any particular end use, and that the overall project may benefit from dividing the property into multiple end uses. Ultimately, a final end use may not be determined prior to the start of site decommissioning, in which case the site can be adapted to the most likely future use.

Figure 2-4
End-use identification and selection is an iterative process

Identify Opportunities for Sale or Reuse of the Property

Using the list of potential acceptable end uses, the redevelopment team engages with internal and external stakeholders to identify opportunities for site redevelopment. This may be part of a larger corporate strategy that involves repowering to take advantage of existing interconnections, operating, and environmental permits, transmission and utility infrastructure, and other site assets. Alternatively, this process may involve working with developers, local and regional development authorities, or others to attract potential buyers to the site. The redevelopment team works through all available opportunities until a final one is selected, at which point the team begins working on the legal and practical requirements of the property transfer.

Facilitate the Transition to the New Use

The redevelopment team works closely with the decommissioning team to ensure that planning and implementation of the site retirement playbook accounts for the requirements of the final land use. Throughout the decommissioning process, the team facilitates contact between the decommissioning team and the new owner (or internal new users, if the property is not sold) to ensure stakeholder

satisfaction and agreement that the site will be left in the desired condition, with the agreed-upon modifications completed. The redevelopment team also assists with the legal and real estate aspects of project documentation, including records such as site condition, institutional environmental controls, access agreements, and ownership transfer.

Section 3: Conclusion and Next Steps

The process of fossil-plant retirement, decommissioning, and site redevelopment poses challenges for a broad range of interested stakeholders, including the plant owner/operator, local community, plant employees and contractors, suppliers, redevelopment and regulatory agencies, and others (see Figure 1-4). An effective process includes the following elements:

- Careful appointment of key personnel to lead various transition teams
- Definition of the roles and responsibilities of team members
- Collaboration across teams to achieve common goals and benefits
- High level plant owner/operator corporate commitment to an effective, open process
- Open, early, ongoing, and consistent communication between all stakeholders throughout the process
- Application of best practices and lessons learned from previous projects

The potential benefits of implementing an effective process include the following:

- Achievement of plant owner/operator strategic goals
- Adherence to a project budget and schedule; avoided delays and cost overruns
- Responsiveness to all stakeholder interests
- Maintenance of plant owner/operator positive corporate reputation
- Attainment of ongoing operating value from the plant during its glidepath process
- Management of risk throughout the process
- Effective compliance with environmental and other regulations
- Selection of an optimal end use for the site that balances stakeholder goals

As plant owners and operators move into the glidepath, decommissioning, and redevelopment process, EPRI continues to provide value with research that supports the teams executing the process. Members can take advantage of the supplemental project *Glidepath to Closure: Optimizing Pre-Retirement Operations* (3002020797) and the *Plant Decommissioning and Site Redevelopment Supplemental Project* (3002019714). These supplemental projects are designed to

provide a collaborative environment where companies can gain value from research dedicated to specific aspects of each project phase while sharing best practices and lessons learned. The projects provide access to expertise within EPRI, the utility industry, and consultants and contractors throughout the world.

Section 4: For More Information: Abstracts of EPRI-Related Reports

EPRI has supported members by researching topics related to the plant retirement, decommissioning, and redevelopment process. This section summarizes key references that may be useful to members as they develop and execute upcoming plant retirements.

Strategies for Maintaining Fossil Assets Designated for Retirement - 1021786

New economic and regulatory conditions have changed the viability of continuing to operate certain fossil-fuel generating assets. Several interconnected inputs contribute to a decision that determines whether a unit will continue to operate or be placed into retirement and, ultimately, be decommissioned. These inputs can include unit efficiency, ability to meet emissions and waste regulations, necessary plant modifications, aging critical equipment, changing load demands, unit economics, and a host of other factors. Retirement of these fossil-fuel generating assets is becoming more prevalent in the industry. When this decision is made, the strategy for maintaining the unit changes significantly. This report investigates best practices for maintaining fossil-fuel generating assets after a retirement date has been designated. Specific emphasis is placed on guidelines for ensuring that these assets remain safe and reliable during this transition phase. This report draws on the knowledge gained from experiences in Europe with plant retirements based on legislation enacted to date. It provides a high-level framework for key considerations after an asset has been designated for retirement.

Decommissioning Handbook for Coal-Fired Power Plants - 1011220

This handbook describes the steps necessary to fully decommission a coal-fired power plant. The handbook includes ways to handle permitting, environmental cleanup, plant dismantlement, and site remediation, as well as discusses overall decommissioning costs. It is based on three actual case studies of coal plants recently decommissioned: the Arkwright coal-fired plant of Georgia Power, the Watts Bar coal-fired plant of the Tennessee Valley Authority, and the Port Washington coal-fired plant of Wisconsin Electric Power.

Decommissioning Process for Fossil- Fueled Power Plants - 1020652

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; partial scenarios (i.e., partial dismantling, remediation, and reclamation of the plant site); and mothballing (i.e., layup of a plant in operable condition).

Power Plant Closure Guidebook – 1022263

This report details the many components of decommissioning an aged power plant and discusses the various alternative solutions to the problems that will likely arise. It draws on the experiences of utilities, vendors, brokers, and contractors that have addressed such issues. Since each decommissioning project is unique, this report attempts to enumerate the many facets of the problems that can affect the outcome of the effort. A carefully planned, well-executed project can save hundreds of thousands of dollars and months of reduced schedule time, compared to a project that is poorly planned and executed.

A Comprehensive Approach to Repurposing Retired Coal Power Plant Sites Transforming Liabilities to Assets – 3002016691

EPRI is seeking to assist its members in their efforts to repurpose decommissioned/retired power plant sites across the US. While past efforts of utility owners and communities have typically focused on the environmental remediation aspects of repurposing these sites, a more holistic approach to redevelopment planning has the potential to yield more accelerated and positive outcomes. Accordingly, this technical update provides an overview of decommissioned/retired power plant sites across the US and internationally and describes a comprehensive process for advancing repurposing efforts.

Risk Management Guidebook for the Demolition of Coal Fired Power Plants – 3002014768

Fossil fuel-based power generation continues to face increasing social, economic, and regulatory pressures related to the operation and maintenance of coal-fired power plants. These pressures are forcing power plant owners to reconsider the operation of coal-fired power plants and will likely result in the continued deactivation and demolition of these plants. However, demolition poses myriad safety, regulatory compliance, construction change orders, and asset recovery challenges, which represent significant liabilities for plant owners. In order to adequately manage the risks of coal-fired power plant demolition, plant owners need a clear understanding of the potential risks and how to actively manage them. This guidebook explores potential liabilities coal-fired power plant demolition and identifies options to manage the liabilities. This helps EPRI

members make informed business decisions related to risk management. This report presents potential techniques and best practices for identifying and proactively managing risk during a project's lifecycle.

Environmental Site Assessment Guidebook for Fossil Fuel Plant Sites – 3002003337

With the evolving U.S. regulatory climate, power supply infrastructure and facility aging, and introduction of other power supply sources, fossil-fuel plants (particularly coal-fired power plants) have been subject to retirement and decommissioning. As part of the decommissioning efforts, environmental investigation and remediation of these sites may be necessary. This Guidebook helps utility engineers conduct environmental site assessments (ESAs) during the facility decommissioning phase at former fossil-fuel power plant sites. The guidebook offers a generalized sequential process for evaluating these sites for environmental impacts. The guidebook is not an all-inclusive compilation of the techniques that can be employed during a site investigation. Rather, it serves as an introductory guidance document to familiarize EPRI members with the basic terms, concepts, types of environmental impacts that may be encountered at fossil fuel plant sites, methods for identifying and investigating potential impacts, and potential ESA outcomes.

Grand Lake Generating Station Decommissioning Experience Report – 3002001344

This report details the experience of the New Brunswick Power Corporation in the decommissioning of its coal-fired Grand Lake Generating Station in Newcastle Creek, New Brunswick, Canada. The objective of the report is to document the work completed and the lessons learned over a five-year period to convert a 96-acre (39-hectare) power generating site on the shores of Grand Lake to a safe, passive green space available for public use. The project team assembled the information in the report through site inspections, interviews with members of the decommissioning team, and an extensive review of project records. The Grand Lake team successfully addressed many issues that are common to fossil-fired generating plant retirements and some issues that were unique to this particular site. Although the planning and execution of the decommissioning were conducted under the environmental, safety, and health regulations of Canada and the Province of New Brunswick, the required standards were similar to those in the US. Therefore, organizations that are contemplating, planning, or in the midst of a plant decommissioning project can benefit from the information and experiences captured in this report.

Significance of Naturally Occurring Radioactive Materials on Thermal Plant Decommissioning – 3002006939

The purpose of this technical update is to provide information on the significance of naturally occurring radioactive materials (NORM) to the utility staff conducting thermal power plant decommissioning. Topics include typical thermal power plant commodities and materials that contain NORM or other radionuclides; a summary of regulations and regulatory guidance concerning the identification, control and disposition of materials containing NORM; and

recommendations for minimizing the impact of radioactive materials on fossil plant decommissioning.

Utility Brownfields Resource Guide – TR-111784

As deregulation changes the electric utility industry, utilities are seeking ways to redefine their role in the communities they serve. Many utilities have found that active participation in community redevelopment not only revitalizes their service territories, but also helps to project a positive, proactive image for the company, particularly in cities with a legacy of abandoned industrial plants and languishing commercial real estate. These properties, known as "brownfields," represent lost tax revenue, lost jobs, and a deterrent to attracting new energy customers. Redevelopment offers utilities the opportunity to participate in how the redevelopment is implemented. In this way, utilities can assume a leadership role on community development. Effective participation requires understanding of the complex web of technical, legal, and social issues that surround brownfield redevelopment projects.

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI members represent 90% of the electricity generated and delivered in the United States with international participation extending to nearly 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; Dallas, Texas; Lenox, Mass.; and Washington, D.C.

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Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com