Safety Management

Facility Decommissioning

A look at key SH&E considerations

By Bryan Bailey and Craig Galecka

BUILDING AN INDUSTRIAL EMPIRE is complicated and time-consuming. An idea is born. A process is designed. A factory is built. As demand increases, so must production and, with it, facilities. As technology advances, managers employ new processes, materials, chemicals and machinery; new product lines augment or replace the old ones. It takes power, raw materials, capital goods and infrastructure.

When a company decides to close its doors, its leaders can be faced with an unpleasant surprise: Shutting down an operation is nearly as complicated as building it. In truth, the proper decommissioning of facilities or parts of facilities is important to the success of an organization's plans for the site or property. The decision to close or substantially modify a facility involves significant planning and risk assessment. In addition, the SH&E issues involved in this process must be addressed. Failure to do so could have negative financial and legal consequences, and result in negative publicity. When a company or consulting firm approaches a decommissioning, it is well advised to consider SH&E throughout the four common phases of facility decommissioning: investigation, design, decontamination/demolition and closeout.

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Decommissioning Considerations

A decommissioning project is complicated in nature. Because of this, many organizations work with engineers and firms well versed in the intricacies of the process. Decommissioning requires an almost microscopic attention to detail, particularly those involving safety and health. Regulations and safety standards are in place to protect not just workers, but also the public and the environment. Applying these many recommendations and regulations can result in a safe and environmentally sound decommissioning process.

First, Build a Team

As an organization approaches a decommissioning, it should assemble a knowledgeable team with the skills and expertise needed to plan and execute the project in a way that serves the organization and all other stakeholders. Team members could include some or all of the following, depending on the project and type of facility:

- **Process or facilities engineer.** This individual, typically from inside the organization, will assess capital inventory and physical property.
- **Financial manager.** This person may be from inside or outside the organization. S/he will determine potential for reuse, sale or disposal of equipment, and evaluate the tax and financial implications of various closure options. This manager will also work with the process or facilities engineer to report the findings to the organization's decision makers and other team members.
- **Tax consultant.** This expert will help the company analyze the effects of its decommissioning decisions on tax responsibilities. This individual may be from inside or outside the organization. It should be noted that this aspect of decommissioning is often overlooked despite the fact that the financial impact of such an oversight can be considerable.
- **Environmental consultant.** Either from inside or outside the organization, this individual will conduct an environmental site assessment (Phase I ESA) to determine the potential for contamination of soil or groundwater. A Phase I ESA is conducted to determine whether any potential areas of hazardous waste contamination and/or environmental liabilities are associated with a property.

If necessary, the consultant will take samples to determine the extent of contamination (Phase II ESA). A Phase II ESA is conducted if recognized environmental conditions are identified during the Phase I ESA; it involves collecting and analyzing soil and/or groundwater samples to determine the extent of potential environmental contamination (see "Environmental Site Assessments" sidebar on p. 19).

The consultant will also evaluate process equipment for residual hazardous chemicals. If issues are identified, s/he will estimate the cost of cleanup,

either immediate or delayed, and assess whether the organization might be eligible for state or federal funds earmarked for environmental cleanup initiatives. This cost estimate is often a decision-making point for an organization. Sometimes, the company may find that it is more cost-effective to maintain some operations rather than clean up the facility for closure or sale.

• **Environmental engineer or geologist.** This expert will manage soil and/or groundwater remediation design if such remediation is found to be necessary.

• **Design-decommission contractors.** These contractors work in the manner of a design-build contractor, but with the opposite end in mind. The contractors design and carry out the decommission—including demolition and asbestos/hazardous materials removal. They also manage recycling, disposal or sale of waste materials.

• **Structural engineer.** This engineer, who may be from inside or outside the company, aids in the design of the building deconstruction, focusing on the structural elements.

• **Civil, structural or mechanical engineer.** Also from inside or outside the organization, this engineer will design the layout for any utilities that need to be moved or capped.

• **SH&E manager.** In many cases, the SH&E manager is an employee of the demolition contractor. S/he will prepare site safety and health plans and procedures, and will review SH&E practices as the demolition occurs. A person with the CSP, CIH or certified hazardous materials manager (CHMM) designation will be knowledgeable and reliable in this role.

• **Other resources.** These include legal consultant, public relations, security, fire protection and real estate analyst.

Environmental Site Assessments: Phase I & Phase II

In a Phase I environmental site assessment (ESA), an engineer investigates documentation pertaining to a property in an effort to determine the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the its ground, groundwater or surface water. If the presence of such substances or products is evident or likely, a Phase II ESA is conducted.

In a Phase II ESA, an expert collects samples of air, soil, water and building materials for chemical analysis for hazardous substances or petroleum products to evaluate the recognized environmental conditions identified in the Phase I ESA or transaction screen process. The purpose is to describe the nature and extent of contamination to assist in making informed business decisions about the property and, where applicable, to provide the level of knowledge necessary to satisfy the innocent purchaser defense under CERCLA.

ASTM International has developed standards for conducting these assessments. For a Phase I standards, see ASTM E1527-05; for Phase II standards, see ASTM E1903-97(2002).

Abstract: *Using the decommissioning of a major automotive components manufacturer in the Midwest as an example, this article addresses SH&E issues found throughout the four phases of facility decommissioning: investigation, design, decontamination/demolition and closeout.*

Decommissioning requires an almost microscopic attention to detail. As an organization approaches a decommissioning, it should assemble a knowledgeable team with the skills and expertise needed to plan and execute the project

Regulatory Overlap

In most decommissioning situations, multiple agencies and governmental bodies have jurisdiction over some aspect of the closing of a single building. Given these often intentionally redundant regulations from multiple bureaucratic channels, any engineer in the business will volunteer that it is very easy to miss something. A simple oversight can be costly to the bottom line, but even worse, to a life. Leaving behind hazards to people, the infrastructure or the environment can be both dangerous and expensive.

While OSHA and EPA regulations apply as the minimum standard for any decommissioning in the U.S., owners also must comply with the regulations of local jurisdictions and state-level environmental agencies, many of which have more stringent requirements than federal OSHA and EPA.

For example, in Ohio, some closings are governed by a state-level EPA program that is called Cessation of Regulated Operations (CRO) (Ohio Administrative Code). The program was created in 1996 to prevent situations such as that which occurred after a 1987 break-in at a closed-down tire company. Vandals hoping to steal the copper components of transformer cores left on site after the closing caused the release of Askerol, a PCB-containing oil, into a nearby stream. This prompted a 3-year, publicly funded multimilliondollar cleanup.

To prevent such mishaps, the CRO program requires the owner or operator of a reporting facility that is ceasing regulated operations to do the following within 90 days of the cessation:

1) Submit the following information to the director of OhioEPA: a) the most recent emergency and hazardous chemical inventory form submitted to the State Emergency Response Commission (SERC); b) a current OSHA hazardous chemical list or MSDS for each chemical at the facility required to be on file with the SERC; and c) a list of every stationary tank, vat, electrical transformer and vessel which will remain at the facility that contains or is contaminated with a regulated substance prior to or at the time of cessation;

2) Drain and remove all regulated substances from each stationary tank, vat, electrical transformer and vessel and from all piping.

3) Lawfully dispose of, sell or transfer the regulated substances off site.

4) Lawfully transfer off-site all debris, nonstationary equipment, furnishings, containers, motor vehicles and rolling stock that contain or are contaminated with a regulated substance.

5) Certify to the director on a form prescribed that the actions required in the previous three items have been completed (OhioEPA, 2004).

Only after the equipment has been cleaned of lead dust, asbestos fibers, oils and chemical lubricants can it be scrapped, sold or transferred off-site. Switches, thermostats, fluorescent bulbs and other devices or controls containing mercury or other regulated substances also must be removed and recycled, sold or disposed of according to the applicable statutes.

Ducts for heating, ventilation and air con-

Regulations to Review

Safety & Health

- Respiratory Protection Part 451 and 29 CFR 1919.134 and 1919.103
- Noise Part 380 and 29 CFR 1910.95
- Hazard Communication Part 92 and 29 CFR 1910.1200
- Confined Space Entry Part 90 and 29 CFR 1910.146
- Control of Hazardous Energy Part 85 and 29 CFR 1910.147
- Trenching and Excavation (29 CFR 1926)
- Eye Protection (29 CFR 1910.5)
- Spills and Releases 29 CFR 1910.12 and 40 CFR 311
- Fall Protection 29 CFR 1910.66 and 29 CFR 1926.500
- OSHA Asbestos Regulations (29 CFR 1910.1001, general industry, and 1926.1101, construction industry)

Environmental

- Hazardous Waste (40 CFR 260-265)
- Land Disposal Restrictions (40 CFR 268)
- Clean Air Act
- Clean Water Act
- Asbestos (40 CFR 61 Subpart M; 40 CFR 763 Subpart E)
- Underground Storage Tanks (40 CFR 280)

ditioning—all potential harbors for environmental safety hazards—should be cleaned and/or removed. Refrigeration equipment for air conditioning or cooling processes must be removed, and all refrigeration gases in any machines—transformers, for example—must be recycled or disposed of as well. Underground and aboveground storage tanks often have entire agencies dedicated to their removal and closure.

Financial Options

After a complete capital asset inventory, which documents the value of all assets in a facility, a decommissioning contractor often will work with a tax consultant, who can evaluate the tax implications of actions such as failing to liquidate inventory that has not fully depreciated. Fully depreciated inventory, such as machinery in a tool room, can be a tax deduction. However, if it still has appreciable value, a company cannot simply dispose of it—and keeping it can mean a big tax hit.

Procedural Matters

When actual decommissioning begins, the project manager must be aware of procedural requirements for each task. For example, in some jurisdictions, asbestos abatement requires 10 days' notice to the local or state air pollution control agency. Such a requirement cannot be overlooked. The repercussions of doing so could be more than fines—someone could end up in prison because of it.

"Out of sight, out of mind" does not apply when it comes to disposal of potentially hazardous chemicals. If a drum of solvent or other regulated substance is discovered some 10 years in the future to have been disposed of at a nonregulated facility, authorities will want to find out exactly who was—or might have been—responsible and collect damages. Any business owners which sent material to the landfill will have to prove that the substance did not come from their decommissioning projects. In other words, follow all the rules and choose the right landfill. Unlined construction and demolition landfills are not good choices.

Good Corporate Citizenship

If a company wants to leave a building, it is recommended that it be a "good and responsible environmental citizen" in the interest of the environment, workers and the future site owner.

One particularly good environmental citizen was an electric and hybrid gas/electric battery research and development facility in Michigan. The business owner, who had been leasing the facility, asked a facility decommissioning contractor to collect and analyze surface wipe samples from floors and rafters to ensure that the space was clean enough to turn over to the next occupant.

Owners have several options to illustrate this good citizenship. If redevelopment and reuse are likely, it is considered the right thing to do to conduct Phase I and Phase II ESAs, even taking soil samples to identify issues that might affect the property's desirability. The objective is to identify the potential for contamination—any of which would eventually be discovered by potential buyers in assessments required for financial lending.

Case Study: The Importance of Planning & Cooperation

In the case of a major automotive components manufacturer in the Midwest, a comprehensive decommissioning plan developed with guidance from qualified consultants not only made a complicated, arduous shutdown process manageable, it also protected workers, nearby residents and the environment.

Once the company decided to shutter its facility, it acknowledged that various SH&E hazards would require attention. These issues included underground and aboveground storage tanks; asbestos-containing materials; asbestos manufacturing equipment; PCBs; ozone-depleting substances; refrigerants; lead; mercury; batteries; light bulbs; a wastewater treatment plant and its accompanying sludge and chemicals; a powerhouse; a host of manufacturing lines; a spectrum of utility systems; and dozens of applicable local, state and federal regulations.

Shutting the factory's doors proved to be anything but simple. The process does, however, illustrate well the myriad SH&E implications of a building decommissioning in its common four phases: investigation, design, decontamination/demolition and closeout.

Investigation

During the investigation phase, assessing current facility conditions is vital in determining the most cost-effective and efficient manner to exit the property. This investigation focuses primarily on the

Areas to Evaluate

- asbestos
- PCBs
- refrigerants
- lead
- mercury
- batteries/lights
- manufacturing processes
- wastewater treatment plant
- powerhouse
- noise control
- materials containing heavy metals
- fugitive dust
- erosion control
- waste management
- fire protection
- notifications to regulatory agencies
- emergency planning
- site-specific safety and health planning

site's environmental conditions and the impact they have on the required scope of work.

For example, soil and groundwater remediation may be required. The site disposition options may include "cold/warm hold"; decontamination and demolition to slab; complete decontamination and demolition with site restoration; or no action based on the findings of this phase (see "Shutdown Scenarios" sidebar below). Additionally, when considering the scope of the project, it is important to identify applicable local, state and federal regulations.

To address the current environmental conditions, the organization could use an ESA (e.g., Phase I, Phase II); a building decommissioning assessment; an asbestos survey; a physical property assessment (e.g., capital equipment); and utility analysis (see Financial Options section on p. 21). These assessments allow the organization to understand the impact of the current conditions and effectively conduct a final site disposition analysis.

In addition, the Sarbanes-Oxley Act requires publicly owned companies to account for environmental cleanup liabilities. These potential high costs may have a significant impact on the final site disposition (FASB, 2005).

In this case, this investigation helped the company assess its best options, as well as the best options for the environment and the community. The 47-acre site had nearly 1.2 million sq ft of building space, three different plants, a wastewater treatment plant, a wellfield, a powerhouse, an administrative building and a pedestrian/vehicle/utility tunnel connecting the plants.

At the time of the investigation, production included stamping, resistance welding, machining, assembly using gluing and bonding, alkaline washing, oil-quench heat treating and chemical formulation. Previous production activity included copper/nickel powdered metal part forming, known as sintering; oil recycling; solvent degreasing; and several plating processes using zinc phosphate, zinc dichromate, tin and chrome, as well as lead-tin-copper triplating. Some volatile organic compounds had been detected in the production wells from which the plant drew water for potable and industrial use. A river flowing as close as 240 ft from the site received stormwater from the site's sewers.

Using data from the investigation, costs were estimated for engineering, environmental cleanup, removal of asbestos and hazardous materials, demolition, and utility cuts and caps. Company management and consultants also evaluated assets that would not be sold at a site auction and estimated the value of recyclable materials.

Based on the results, management decided to demolish two of the three plants—a total of 29 buildings constructed from 1906 to 1974, including the powerhouse and the wastewater treatment plant.

Shutdown Scenarios

Once all of the assessments, inventories and evaluations have been completed, various options may be recommended. They include the following:

- **Cold hold.** Essentially, this equates to shutting off the lights and locking the doors. Although it may be the easiest and least expensive option, it is seldom a legal option (especially in light of Sarbanes-Oxley). Any asbestos in the facility will deteriorate over time, making a future cleanup likely. Fire protection systems are not operational, so fire departments and insurance companies do not advocate this strategy. Because electricity is off, no lighting is available, leaving fall hazards, open pits and structural hazards to pose grave risks to any unauthorized occupant. Even with barriers around the facility, safety hazards can remain. A company that takes the cold-hold option must consider whether it is doing all it can to protect people—authorized to be in the facility or not—from hazards.
- **Warm hold.** In this approach, a facility's water and heat are minimally supplied to keep pipes from bursting and to maintain fire protection systems.
- **Selective demolition/decommissioning.** If this option is selected, interior walls are demolished, leaving just the facility shell and utilities. Process equipment is removed and hazards are eliminated. Barriers to the site are required or recommended, and a competent person should walk the site periodically to satisfy insurance and fire protection requirements.
- **Tear down to slab.** This approach is just as its name implies. It requires consideration of major safety and health hazards, most notably for workers performing the deconstruction. Hazards are hard to identify until teardown begins. Separating materials, for example, can expose workers to even more potentially severe injuries than a construction project.
- **Removal of all components to soil level.** Once the site is cleared, including any contaminated subsurface soil, the site is secured and left until other plans call for its reuse.

Design

Once the scope of the project has been decided with information provided in the final site disposition analysis, the design phase begins. In this phase, the organization plans how the work will be conducted. The planning results in job specifications that identify the following:

- proper cleanup standards and methodologies;
- local, state and federal site-specific requirements;
- waste removal and disposal requirements;
- safety and health requirements.

The enhanced planning and research conducted in this phase will help minimize costs and risks related to SH&E issues.

For the automotive components manufacturer, the design called for leveling all 29 structures to the slab. To do this, the company received a special exemption from a city code that required the removal of all substructures. Because the potential for groundwater contamination could not be determined with certainty, the city permitted the slabs to remain so that they could serve as a cap, protecting the aquifer from remedial groundwater contamination.

Basements, trenches and sumps were to be filled to the level of the slabs, with special care taken not to fracture the floors or walls of pits or basements. Steel frame buildings would be removed as scrap, along with masonry block, wood structures, walls and all machinery. All mechanical and electrical systems would be removed as scrap as well, along with ductwork, lights, fans, pipes, conduits, guard posts, railings and other materials. City water lines would be cut and capped at four locations.

Decontamination/Demolition

The preliminary work conducted in the prior

Decommissioning Standards & Resources

Standards

- ANSI/ASSE A10.6-1990 (R1998): Safety Requirements for Demolition Operations
- ANSI/ASSE A10.8-2001: Safety Requirements for Scaffolding
- ANSI/ASSE A10.12-1998: Safety Requirements for Excavation
- ANSI/ASSE A10.13-2001: Safety Requirements for Steel Erection
- ANSI/ASSE A10.18-2007: Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations
- ANSI/ASSE A10.32-2004: Fall Protection Systems for Construction and Demolition Operations
- ANSI/ASSE A10.33-1998: Safety and Health Program Requirements for Multi-Employer Projects
- ANSI/ASSE A10.44-2006: Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations
- ANSI/ASSE A10.46-2007: Hearing Loss Prevention in Construction and Demolition Workers
- ASTM E1908-03: Standard Guide for Sample Selection of Debris Waste from a Building Renovation or Lead Abatement Project for Toxicity Characteristic Leaching Procedure Testing for Leachable Lead
- ASTM E2356-04e1: Standard Practice for Comprehensive Building Asbestos Surveys
- ASTM E2308-05: Standard Guide for Limited Asbestos Screens of Buildings
- ASTM E1527-05: Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process
- ASTM E1528-06: Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process
- ASTM E1903-97(2002): Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process
- NFPA 241: Standard for Safeguarding Construction, Alteration and Demolition Operations (2004 ed.)

Resources

- *Characterization of Building-Related Construction and Demolition Debris in the United States.* EPA. www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf.
- U.S. publications for construction and demolition materials. EPA. www.epa.gov/epaoswer/non-hw/debris-new/pubs.htm.
- *Building Savings: Strategies for Waste Reduction of Construction and Demolition Debris from Buildings.* EPA. www.ilsr.org/recycling/buildingdebris.pdf.
- Demolition Debris Resources. State of Washington. www.ecy.wa.gov/programs/hwtr/demodebris.
- *Minimizing Construction and Demolition Waste* (4th ed.). Hawaii Department of Health. http://hawaii.gov/health/environmental/waste/sw/pdf/constdem.pdf.
- Rethinking Debris: Construction and Demolition Industry Waste Reduction and Recycling Tips. Wisconsin Department of Natural Resources. http://dnr.wi.gov/org/caer/cea/publications/pubs/section3/ie211.pdf.
- Construction and Demolition Waste Recovery: Processing, Recycling, Burning and Transport. Wisconsin Department of Natural Resources. http://dnr.wi.gov/air/compenf/asbestos/asbes6.htm.
- Demolition Permits for Commercial and Residential Structures. King County (WA) Department of Development and Environmental Services. www.metrokc.gov/ddes/acrobat/cib/3.pdf.
- Integrated Waste Management Disaster Plan, Chapter 9 Building Demolition Program. California Integrated Waste Management Board. www.ciwmb.ca.gov/Disaster/DisasterPlan/chp9.htm.
- Green Construction and Demolition. Michigan Department of Environmental Quality. www.michigan.gov/documents/deq/deq-ess-p2-anlrptadd-greenconstruction_234796_7.pdf.
- Decommissioning of Nuclear Facilities. U.S. Nuclear Regulatory Commission. www.nrc.gov/about-nrc/regulatory/decommissioning.html.
- 29 CFR 1926 Subpart T, Demolition
- Demolition Hazards and Possible Solutions. OSHA. www.osha.gov/SLTC/constructiondemolition/recognition.html.
- Demolition. OSHA. www.osha.gov/doc/outreachtraining/htmlfiles/demolit.html.
- Excerpts from Federal Policy Ideas for Community Revitalization. Northeast-Midwest Institute. www.nemw.org/BrownfieldChapterSurdna1Rpt072106.pdf.
- Airing Out "Mothballed" Facilities. CFO.com. www.cfo.com/article.cfm/3325357/c_3214842?f=singlepage.

For the automotive components manufacturer, the design called for leveling all 29 structures.

phases allows the decontamination/demolition phase to be set into action. Before work begins on the site, the organization must review the contractors' safe operating procedures, environmental procedures, and safety and health procedures. These plans should include noise, fugitive dust, erosion control, emergency response, safety and health, a project work plan, waste management and fire protection.

The decontamination work exposes employees and the environment to many safety and health risks and can result in adverse financial and legal issues, such as from the mishandling of wastes or improper cleanup methods. This phase requires the removal and disposal of regulated materials, and verification that all regulations for facility closure have been followed. Before demolition, the owner must inspect the site and its buildings and verify that regulated materials and essential physical assets have been removed.

The demolition portion of this phase requires significant coordination between entities to reduce the risk of injury to those on site. In addition to building demolition, metals and other materials deemed to have monetary value are recycled during this phase. At the end of the demolition phase, the site should be what the organization envisioned during the initial planning phase.

During this phase, the owner or consultant must conduct thorough due diligence of disposal costs. High resale values on reclaimed materials make demolition a profitable business, and contractors bid competitively for jobs with high potential for recycling. However, a company might benefit from contracting separately with a recycling contractor because a significantly higher bid can help offset costs in other areas.

For the automotive components manufacturer, the demolition process went rapidly. The contract was awarded in mid-May 2002; the equipment auction took place in early July; asbestos remediation, environmental cleanup and wastewater treatment plant cleanup took place from August to late October; and utilities were capped and cut as the demolition progressed. Demolition was completed by Nov. 1.

Closeout

The closeout phase ensures that the site will be maintained according to all applicable requirements and regulations. During this phase, it is prudent to alleviate potential risks as best as possible. Thus, it is important to determine site security needs, evaluate remaining structures and utilities, maintain the site to predecommissioning standards and ensure proper regulatory reporting. At the automotive components manufacturer, these considerations were taken diligently, and postdemolition remedial site investigations are ongoing.

Conclusion

If planned and executed with guidance from qualified professionals, in cooperation with local agencies, and according to the recommendations, regulations and best practices of OSHA, EPA, ANSI, ASTM and other organizations, the closure and/or demolition of a facility or operation can be completed in a way that is safe for workers, the community and the environment and that will allow the facility owner to make the best possible choice for the future of the facility.

Taking a less diligent approach can lead to dire circumstances. Consider the case of the defunct tire manufacturer mentioned earlier. If fishermen had not seen the toxic PCB oil slick at the building's outflow, the environmental and public health effects could have been much worse than just the costly cleanup—an $8 million bill paid by taxpayers. Had the contamination been given time to spread, the waterway and the river it fed into would still be being dredged, and the environmental impact could have been catastrophic.

Catastrophe is almost always avoidable. With the proper considerations and adherence to applicable regulations, a facility decommissioning can be completed in a manner that is safe for both people and the environment. ■

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