CONSIDERATIONS FOR DEMOLITION OF POWER PLANTS

Through the Alliance between OSHA's National Office and National Demolition Association (NDA), NDA developed Considerations for Demolition of Power Plants for informational purposes only. It does not necessarily reflect the official views of OSHA or the U.S. Department of Labor. (September, 2023)

NATIONAL DEMOLITION ASSOCIATION

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Under the Occupational Safety and Health Act, employers are responsible (**https://www.osha.gov/workers/employer-responsibilities**) for providing a safe and healthy workplace and workers have rights (**https://www.osha.gov/workers**). OSHA can help answer questions or concerns from employers and workers. OSHA's On-Site Consultation Program (**www.osha.gov/consultation**) offers free and confidential advice to small and medium-sized businesses, with priority given to high-hazard worksites. For more information, contact your regional or area OSHA office (**https://www.osha.gov/contactus/bystate**), call 1-800-321-OSHA (6742), or visit **www.osha.gov**.

NATIONAL DEMOLITION ASSOCIATION

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Scope

This document was developed under the **National Demolition Association (NDA) and Occupational Safety and Health Administration (OSHA) Alliance** (Alliance) to provide awareness and information to all stakeholders involved in demolition of power generation plants. The objective is to help stakeholders such as owners, contractors, local authorities and engineers assess how their role helps with overall risk management of predictable hazards when preparing for and implementing power plant demolition.

Recent events involving human health and environmental risks including premature collapse, falling debris and environmental releases have encouraged the development of this document. The Alliance is interested in bringing awareness to procedures that have led to premature collapse, falling debris or unexpected environmental release during demolition of power plant structures. Additionally, it must be noted that this single document cannot provide sufficient information to prevent future incidents. Stakeholders engaging in the demolition of power plants need to have sufficient experience, information about the structures, professional planning and oversight, and engagement from all parties to identify and mitigate the risks associated with demolition of these structures. Active participation from all stakeholders during planning, review, oversight and implementation of power plant demolition is necessary to help prevent on-site safety and environmental incidents.

The requirements from regulating authorities, such as local municipalities and OSHA shall be understood and implemented. Additionally, supplemental information from nonregulatory entities such as the American National Standards Institute (ANSI), industry advocacy groups such as NDA and client site-specific procedures are also essential components in planning for demolition activities. Subsequently, statements in this document that use the words “shall,” “required” or “requirements” are included to let the reader know that these statements identify government regulations.

The scope of this document does not address contractual or legal issues but rather focuses on awareness around specific technical aspects of power plant demolition. The awareness and proper assessment of these technical issues could help with risk management when planning for and implementing demolition of complex power plant structures such as chimneys/stacks, silos, cooling towers, boilers, precipitators, transformers, conveyers, subsurface infrastructure, coal yards structures, intake structures or other similar industrial structures.

This document provides awareness of some complex, technical aspects of the work that may necessitate engineering and other professional support. The document may also be of assistance in providing reasonable expectations for owners in the stages of demolition planning and contractor selection.

NDA is not intending to set standards or requirements for its members or the industry based on other suggestions identified in this document. This document, which was developed by NDA in association with OSHA, is aimed at providing helpful guidance for owners, general contractors, subcontractors and others who may be involved in power plant decommissioning, dismantlement and demolition. It is advisory only and should be regarded as one of many tools that its user may or may not choose to follow, adopt, modify or reject.

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As part of the NDA Alliance Program with OSHA, contractors and the public have access to compliance assistance resources. This allows NDA members and the public access to resources and contact information of regulatory compliance staff in all 50 states and consult with them on a variety of rules and regulations affecting the industry. For more information, please visit the NDA Alliance webpage at osha.gov.

Preparatory Operations and Engineering Survey

General

Significant planning is required prior to commencing a power plant demolition project. It is important for the project team undertaking power plant demolition to understand the requirements and obtain a detailed understanding of the potential hazards, structural systems and environmental conditions that are presented to help select appropriate demolition methodologies. While a detailed understanding of the infrastructure and associated risks will help to plan for a safe delivery of the demolition work, demolition stakeholders need to recognize the potential for unforeseen conditions and the need for procedures and processes to communicate and manage changes identified during demolition.

Engineering Survey

Prior to starting all demolition operations, the OSHA Standard in the Code of Federal Regulation (CFR), 29 CFR 1926.850(a), requires that an engineering survey of the structure must be conducted by a competent person. The standards in 29 CFR 1926.850(a) say “The employer shall have in writing evidence that such a survey has been performed.” An OSHA "competent person" is defined as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them." [29 CFR 1926.32(f)]. According to OSHA 29 CFR 1926.850(a), "The purpose of this survey is to determine the condition of the framing, floors, and walls and possibility of unplanned collapse of any portion of the structure.” Due to the nature of demolition activities, site conditions are constantly changing, which may substantively affect site conditions hazardous to employees. This may necessitate a frequent reevaluation of site conditions by competent persons, including support from professional engineers. For completeness and contractual protection, adjacent buildings or infrastructure that could be impacted by the demolition shall also be included in the survey since OSHA requirements include a statement that “Any adjacent structure where employees may be exposed shall also be similarly checked.” Refer to OSHA letter of interpretation for more on the requirements of engineering survey: **https://www.osha.gov/laws-regs/standardinterpretations/1994-01-27-0**

Additionally, if the structure to be demolished has been damaged by fire, flood, explosion or some other cause, appropriate measures, including bracing and shoring of walls and floors, shall be taken to protect workers and any adjacent structures. The safety of all workers on the job site shall be a prime consideration. During the

preparation of the engineering survey, the survey team shall identify potential hazards, such as those that may cause fires, cave-ins and injuries; and implement strategies to prevent, control or mitigate these.

Some of the general requirements to be addressed in the engineering survey are as follows:

- Review of existing architectural structural and as-built drawings for completeness and accuracy and/or development of as built sketches as deemed necessary by the engineer;
- Identification of building materials, substances and wastes that will be generated by the demolition and associated proper handling techniques;
- Identification of personnel with sufficient plant knowledge, such as the maintenance manager and/or environmental manager of the facility, who can provide relevant information regarding the plant operation and history that may impact the methodology. (This could include information such as specific maintenance procedures, fire events or spills that may indicate the presence of chemicals in the facility.);
- Identification of confined spaces, exposed edges, voids or underground tanks and structures;
- Identification of hazardous chemicals, gases, explosives, flammable materials or similar dangerous substances that may have been used or stored on the site. (When the presence of any such substances is apparent or suspected, testing and purging shall be performed and the hazard eliminated before demolition is started. If the nature of a substance cannot be easily determined, samples shall be taken and analyzed by a qualified person prior to demolition based on OSHA 29 CFR 1926.850(e).);
- Instances where historical events could have damaged and weakened the structure (e.g., past boiler explosions);
- Presence of ongoing underground services that may impact equipment selection or protection requirements;
- Presence of connections between power plant infrastructure to be demolished and other on-site power plants or infrastructure that may require extra precautions or grounding;
- Identification of accident prevention in accordance with OSHA 29 CFR 1926.20(b) and 1926.20(b)(1);
- Testing of mechanical properties of structural materials;
- Utilities as covered under OSHA 29 CFR 1926.850(c) and 1926.850 (d). (Some utilities may need to be maintained during demolition operations.);
- Possible fall protection hazards caused by wall openings and floor holes;
- Possible hazards related to fragmentation;
- Storage of demolition debris;
- Access/egress for employees; and
- Working during inclement weather.

3D Laser Scans or BIM Models

In addition to review of existing as built drawings, additional tools are available to evaluate the structure and prepare design drawings for the demolition method. There are several methods that can be applied to create structural drawings, including use of an engineering firm to prepare drawings or provide a three dimensional laser scan or imaging of the structure and develop a geometric model for the structure. The laser scanning or imaging can be done from multiple fixed points on and around the structure or using drone technology depending on structure accessibility.

3D laser scans of the structures can provide an accurate representation of the facilities, which can be used to help manage the planning process and reduce the risk involved with the project. Completing a 3D laser scan may be appropriate where the existing drawing set is inaccurate, incomplete or difficult to read. There may also have been undocumented changes to the structures during the operational life of the facility. Having a complete 3D model results in a more accurate representation of the structure for planning, analysis, visualization and stakeholder engagement. 3D scans are particularly relevant for the more complex structures such as the boiler house.

Having a complete Building Information Model (BIM) data set allows for:

- Quantity take-offs and volume assessments for waste and recyclable materials, etc.
- Dimensions and geometric properties, which, in turn, provide better information for the selection of equipment and planning of work areas
- Improved accuracy on structural analysis and assessment
- Improved planning efficiency
- Better understanding of the facility and, therefore, reduced unknown conditions or modifications
- Information to assist with comparing actual structural behavior to calculated behavior

A BIM survey does not replace the need for site inspections, condition assessments or other preplanning activities. While the BIM can provide information regarding member sizes, it does not provide information on corroded or overstressed members. Stakeholders who elect to perform a BIM survey could consider the level of effort to provide a usable data set:

- Collect a high density of data points to create a point cloud data set that has sufficient information to help identify structural member sizes.
- Define the time that the modeling company will need to convert the point cloud data to a complete 3D model and include that time frame in the overall project-planning schedule.
- Plan to combine photogrammetry with the BIM survey to improve the visual representation of the structure.

Types of Chemicals Used in Power Plants

Throughout the operation of the power plant, chemicals may have been used as part of the process and may have been in contact with building materials. Regulated building material inspections are performed to understand

the chemicals that may be present in the power plant. This can be done by reviewing all Safety Data Sheets (SDS) to understand the chemicals used and stored on-site. Inspections, inventories and sampling will typically include asbestos, silica, lead, fluids, residues, lighting, radiation sources, batteries and wastes in addition to any specific regulated materials identified by the owner. The inspections should also consider operational process, maintenance practices and any historical events such as fires that may have used chemicals in the management of the event.

According to OSHA 29 CFR 1926.850(e), “It shall also be determined if any type of hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances have been used in any pipes, tanks, or other equipment on the property. When the presence of any such substances is apparent or suspected, testing and purging shall be performed and the hazard eliminated before demolition is started.”

Examples of hazardous materials that can be found in power plants are:

- Firefighting foams that could contain polyfluoroalkyl substances (PFAS) and perfluorooctanoic acid (PFOA) and which may have been used on site for training purposes or to manage a fire.
- Chemicals that may have been used in the production components such as fabric filter bags as well as polychlorinated biphenyl (PCB) spills from PCB containing oils or in building material paints and caulks and flue gas desulfurization (FGD) wastes.
- Oils and solvents used in equipment and maintenance areas that may have come in contact with horizontal concrete surfaces.
- Residues where process chemicals may have come in contact with the building materials.

Environmental Inspections and Sampling

Environmental inspections are completed and abatement and materials management plans are prepared to address worker exposure, define handling and disposal of regulated materials, specify actions that will be implemented for spill prevention and control, and confirm that evaluations performed incorporate the duties of building and facility owners to determine where these materials may be present.

Duties of building and facility owners with respect to asbestos are provided in OSHA 29 CFR 1926.1101. In particular, 29 CFR 1926.1101(k)(2)(i) states,“Before work subject to this standard is begun, building and facility owners shall determine the presence, location, and quantity of asbestos containing materials (ACM) and/or Presumed ACM at the work site pursuant to paragraph (k)(1)(i) of this section.”

An investigation of ACM by a registered asbestos consultant is required to produce an asbestos register and management plan suitable for demolition. This plan will provide guidance on industrial hygiene requirements, handling and disposal.

Exposure to chemicals and materials, including inhalation, ingestion, skin absorption or contact with dust or any material or substance at a concentration above those specified in the “Threshold Limit Values of Airborne Contaminants for 1970” of the American Conference of Governmental Industrial Hygienists, OSHA Standards under 29 CFR 1926 Subpart: D, “Occupational Health and Environmental Controls” and Subpart Z “Toxic and Hazrdous Substances” shall be avoided.

If hazardous or toxic materials such aslead or cadmium are identified, there are specific OSHA standards that need to be followed. Refer to OSHA Standard Number 29 CFR 1926.62 for lead and 29 CFR 1926.1127 for cadmium for those requirements. OSHA also provides a publication for Lead in Construction that provides a useful overview of lead standards-related topics (OSHA 3142-12R).

Special Consideration for Complex Chimneys and Stacks

Chimneys (or stacks) and the internal flues (liners) have a unique set of considerations that could impact their demolition and have special considerations in addition to all the requirements of the Engineering Survey. These conditions include construction materials, geometry and third-party installations. With regard to construction materials, additional considerations should include the properties of the stack and liner material. Documents reviewed should include design drawings and historical stack inspections.

Specifically, thereview of historical documents should minimally consider:

- Steel and concrete properties as well as the annulus space and connectivity between inner flues and outer reinforced concrete wind screens
- The location of support for liners or flues and connection to the foundations or the outer stack
- Exterior cracks or spalling for the stack or masonry liner

Masonry liner material should also be assessed for contact with process chemicals, regulated building materials and residues.

The presence of breach openings, windows or doors in both the stack and the liner should be documented and compared to original drawings to identify any changes that have been introduced after completion of initial construction. This information will be essential for cases where 3D structural modeling is necessary.

Stacks frequently have navigation lighting and markings on them that may have to be maintained until it is demolished; therefore, consultation with Federal Aviation Administration (FAA) and Federal Communications Commission (FCC) authorities may be required depending on the size and location of the stacks.

Utility Location

Coordination with local utilities is needed in order to obtain demolition permits. Disconnection of these utilities shall be completed with the utilities and confirmed to be air gapped prior to the start of demolition for all incoming utilities or coordinated for inspection after disconnection for outgoing sewer connections. According to OSHA standard 29 CFR 1926.850(c), “All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped, or otherwise controlled, outside the building line before demolition work is started. In each case, any utility company which is involved shall be notified in advance.”

- Disused or redundant utility lines shall be shut off, capped or otherwise controlled before demolition work is started. Affected utility companies shall be notified in advance and shall perform disconnections. Consideration regarding allowable limits of impact forces and vibrations for utility lines should be coordinated with the utility company.

- The location of all affected overhead power sources shall be determined, as they can result in a hazardous condition during demolition. All workers shall be informed of the location of any existing or relocated utility service.

Medical Services and First Aid

Prior to starting work, provisions shall be made for prompt medical attention in case of injury. The telephone numbers of the local police, ambulance and fire departments should be available at each job site. Setting up meetings with local emergency services is necessary as planning progresses.

Noise limitations

Prior to starting work, limitations governing noise should be identified. If no stricter limits are identified by local authorities, protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table D-2 of OSHA Standard Number 29 CFR 1926.52(d)(1) “Safety and Health Regulations for Construction Subpart: D.” In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered.

Navigable Waterways

Communication with Coast Guard, Corps of Engineers and/or the Environmental Protection Agency may be required as applicable if working in or near water or sensitive waterways, as defined by state and federal regulation. Their review of work plans may consider environmental controls or impacts to the operation and navigation of channels (e.g., lighting that may impact shipping).

Demolition Analysis and Planning

The need for engineering analysis and supervision vary for different projects depending on the contractor’s method to raze the structure, jurisdiction and complexity of the infrastructure.

Choice of Contractors and Method for Demolition

Safe demolition is a team effort including owners, contractors and professional engineers. Contractors must be adequately vetted for these complex demolition projects based on experience and other qualifications. Determining the appropriate demolition method requires consideration of many criteria. Safety of workers and community is the most important criteria. There are several methods that can be used to demolish complex structures. Safe implementation is founded in well-planned demolition activities. Contractors offering to implement the demolition should be able to present their past experience and the experience of the competent person that will implement the method proposed for structural demolition.

- Utility owners that occasionally engage in a low bid and lowest qualified bid award approach may want to place more emphasis on experience and qualifications. An unbiased third party demolition engineer or consultant may also provide a good source for third-party review of the demolition contractor or may help explain, model and validate the process and proposed methods against potential safety risks.

The project team is responsible for determining the appropriate demolition method. The method chosen should align with minimizing risk to personnel, the demolition contractor’s experience, available equipment and the structural systems to be removed.

Demolition is very complex, and the participation of a professional engineer may be needed. The level of involvement required from the professional engineer will be dependent on the type and complexity of the structures and methods employed. Any modifications or recommendations made by the engineer should be in coordination with the project team to ensure the proposed means and methods can be safely implemented. The engineering review does not relieve the contractor from their obligation to prepare an adequate demolition plan and conduct an adequate engineering survey that safeguards workers and the public.

The owner should identify and communicate the risks that contractors cannot reasonably be expected to know ahead of accessing the site and should be actively involved in demolition planning. Examples of owner input to the demolition plan may include: vibration limits, hazardous, regulated, or toxic materials and substances, critical infrastructure to remain or be protected, restrictions on sequence due to ongoing operations, underground infrastructure and environmental conditions.

Analysis for Different Demolition Methods

For any methods used for demolition operations that expose employees to collapse hazards, the competent person should consider the involvement of an professional engineer. Controlling authorities and jurisdictions may have their own guidance with regard to when a professional engineer should be included in demolition planning and implementation or should provide stamped engineering drawings and/or methodology analysis. Once the preferred demolition method has been determined by the planning team, a professional engineer may need to confirm that the preferred methodology maintains the structural integrity of the structure throughout the demolition. Different levels of analysis may be required depending on the structure and the method selected. The demolition analysis report, which may include the engineering drawings, calculations, estimated stress and strain actions, and a viewable version of the model, should be updated by the engineer if any differences are identified, or changes are made prior to and during demolition implementation.

Support from a professional pngineer may be required when:

- The load of the structure and equipment and material loads on the structure changes or wind and seismic effects on the remaining structure affect the structure.
- The actual condition of building superstructure and substructure may be different than those present in design drawings where modifications may have occurred and could be updated during site visits and inspections.
- Damage may be present in the structural members where corrosion or other damage has occurred over time.
- The strength of building materials may have changed over time and inspections may be able to adjust material property assumptions, including plastic behavior, cracking, local buckling, yielding of steel, stress concentration and stress redistribution.
- Inspections can verify the locations and confirm the conditions of supporting members, framing, foundations, etc., for consideration during partial demolition of a building or to help plan for and prevent damage to adjacent property.
- Significant equipment components and the loads of these features may remain inside the structure, such as boilers, tanks, large fans or turbines, and analysis may assist in tracking their behavior during the different stages of the demolition.

Where applicable, the additional analysis may be requested to assess:

- The possibility of premature collapse or collapse in an unplanned direction
- Possibility of squat or incomplete collapse
- Effect of sequence of demolition on load redistribution for different structural components and whether there is requirement for monitoring displacements during demolition
- The direction of fall and stability of remaining parts of the structure. Where applicable, the analysis should consider the separation of structural elements as well as possible collision effects on the remaining structure.
- Effects of variability in material properties and/or loads with a sensitivity analysis to assess the desired stability of the structure during demolition
- Construction equipment loading
- The impact force with the ground and consequent ground vibration impacts on adjacent infrastructure
- Effect of debris on the remaining part of the structure or neighboring structures
- Expected height of resulting debris

Loading on Modified or Prepared Structures

Where applicable, the load cases from American Society of Civil Engineers Standard ASCE 37 Design Loads On Structures During Construction (37-14), as modified by Structural Code Guidance for Decontamination and Decommissioning Activities at DOE Facilities, shall be used.

Noise Analysis

The EPA Noise Control Act is applicable for all situations. OSHA Standard 29 CFR 1926 Subpart D (1926.52) covers the OSHA requirements for occupational noise exposure. Local, state and federal noise ordinances must also be adhered to. For explosive demolition, additional analysis should be performed to calculate the expected noise levels during the demolition activities. The analysis should provide the anticipated noise level in decibels at various distances from the blast location to identify safety measures that need to be put in place.

Dust Analysis

OSHA Standard 29 CFR 1926 Subpart Z (1926.1153) covers the OSHA requirements for respirable crystalline silica. The competent person or other stakeholders may request additional substances be tested in the dust propagation analysis to estimate dust concentration at locations surrounding the structure. For example, asbestos and lead concentrations.

Ground Vibration Analysis

Where sensitive equipment, underground utilities or other sensitive receptors are expected to be impacted by the demolition, a ground vibration analysis is a suitable tool to ensure that maximum calculated vibration is within the allowable limits. Vibration propagation modeling should be based on available reports about soil properties for

different soil layers at the demolition site and allow for probability of variation in soil properties. Where demolition techniques include dropping the demolished components to the ground, a dynamic impact analysis can be completed to calculate the additional vibration due to the largest weight to be dropped and the tallest height of drop. Analysis for ground impact should consider structural geometry, mass, a predicted mode of failure and time sequence of impact with the ground obtained from high fidelity numerical analysis of the structure.

Analysis Considerations During Demolition

OSHA 29 CFR 1926 Subpart U (1926.900 – 1926.914) covers blasting and the use of explosives requirements.

In cases where there are adjacent protected utility services or other infrastructure that could be impacted by debris or where the engineering assessment has determined that there is sufficient risk of damage to property, an analysis of the debris height, spread and impact may be desired. This analysis is expected to provide:

- Estimate of the debris height after an induced collapse and the spread of the debris field based on structural properties and demolition plan.
- Confirm the stability of the remaining structure after the dynamic impact of the debris of the previous stage of collapse where collapse stages are planned.
- Estimate the range of spread of flying debris.

For tall structures or complex site conditions, advanced engineering analysis can confirm the stability of the structure throughout the different demolition stages. Once work commences, no workers or personnel should re-enter the structure. Demolition should be carried out in a sequence that avoids uneven loading patterns. The sequence of demolition shall be based on structural analysis performed by a competent person.

- Condition of the roof, walls, floors
- Dynamic loading from demolition equipment
- Suspended floors and accumulated debris/material
- Increase loading due to water/wet debris
- Cutting sequence and modified structural conditions for each stage
- Additional or temporary supports required

Environmental Safety Specifications

- The work shall follow all applicable laws, rules or regulations relating to the protection of human health, natural resources, the environment, or the emission, discharge, release or threatened release of pollutants or hazardous substances into the environment, including without limitation, ambient air, surface water, groundwater, land or soil.

Prevention of Accidental Fires and Explosions

Accidental fires and explosions can eventuate on demolition sites due to the nature of the work and the chemicals, substances and atmospheres present on the site. Prevention of fires and explosions requires the contractor to not only understand the risk associated with their own processes but understand the chemicals, gases, etc., that were used during the operation of the facility and where they may still exist in the plant. A risk assessment shall be completed on the facility and demolition methodology. Where any hazards identified are above an acceptable level, additional controls and mitigations shall be implemented. Typical hazards conditions and work tasks on a demolition site can include but are not limited to:

- Confined spaces where volatile gas, vapor, mist or combustible dust can be present and provide a hazardous atmosphere;
- Hot work that generates sparks or uses cutting torches;
- Static or stored electricity;
- Explosive gas;
- Combustible dust atmospheres, particularly after an induced collapse event and around operating switchyards and transformers where combustible dust can lead to arching across contactors; and
- Chemicals.

Measures that can be taken to prevent fires and explosions include but are not limited to:

- Eliminate confined spaces where possible and ventilate areas to prevent the concentration of volatile gas, vapor, mist or combustible dust cloud;
- Eliminate or control ignition sources, which may include thermal, electrical, mechanical and chemical; and
- Use only suitably rated electrical equipment, grounding of personnel and equipment, electrical equipment maintenance, temperature maintenance and administrative controls.

Protection Measures

Protection measures shall be implemented to protect people, property and the environment. The hierarchy of controls shall be used when identifying the appropriate controls. Always aim for elimination of the hazard through engineering or administrative controls before relying on personal protective equipment (PPE), which is the last resort and least effective protective measure for worker exposures.

PPE is used to provide a layer of protection to demolition workers. All affected personnel need to be equipped with appropriate respiratory protection or other PPE, tools, equipment and resources to reduce the exposure to hazards such as falls, falling objects, entrapment, flying objects, residues and contamination, electric shock, fire, noise, dust, asbestos, lead, etc. All necessary PPE shall be checked to confirm that it is serviceable and properly fitted to prevent injury.

Precautions for Dismantling or Deconstruction

Dismantling and deconstruction exposes workers to close contact during hazardous activities. These activities need to be controlled through careful planning and oversight during implementation of the work. Hazards and safety plans need to be periodically reviewed and revised in accordance with actual site conditions and activities occurring on the site. The following practices apply when implementing a dismantling method:

- Dismantling should be conducted in the largest modules possible with the available equipment to reduce the exposure to high-risk activities such as the combination of hot work and working at heights.
- If lifting activities are required, engineering lift studies may be necessary to determine the weight and center of gravity of the module to ensure the crane has the required capacity and reach to complete the lift.
- OSHA regulations state that while the operator is not moving a suspended load, no employee must be within the fall zone, except for employees engaged in hooking, unhooking or guiding a load or engaged in the initial attachment of the load to a component or structure.
- Cuts should be completed in such a way that modules can be set down if the lift has been miscalculated or other circumstances prevent the lift from being completed.
- Structural members may have stored potential energy that could be released when they are cut, especially any final cuts to release the module. Workers shall be positioned out of the line of fire of any possible movement of structural members during the release of stored energy or potentially unbalanced swinging loads.
- When calculating the load for modules there should be allowance for material buildup inside pipes, ducts, and vessels and on other miscellaneous loads. Material buildup can be significant and increase the calculated load by significant percentage in some cases.
- Lifting operations should be conducted in such a way as to avoid unbalanced loads or dynamic loading on the crane.

References

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Recommended Practices for Safety & Health Programs in Construction, OSHA 3886, 2016. See **https://www.osha.gov/sites/default/files/OSHA3886.pdf**
- U.S. Department of Labor, OSHA, Demolition Standards, 2009. See **https://www.osha.gov/demolition/standards**
- U.S. Department of Labor, OSHA, Safeguarding Equipment and Protecting Employees from Amputations, OSHA 3170-02R, 2007. See **https://www.osha.gov/sites/default/files/publications/osha3170.pdf**
- National Demolition Association (NDA), Foundation of Demolition Training Series. See **https://www.demolitionassociation.com/foundationsofdemolition**

- NDA Safety Manual. See **https://nda.users.membersuite.com/shop/store/21d079c0-00ce-ca73-753f-0b40188f4fd1/detail**
- Environmental Protection Agency (EPA) Noise Control Act. See **https://www.epa.gov/laws-regulations/summary-noise-control-act**
- EPA Clean Air Act, Title IV, Noise Pollution. See **https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution**