

# CRANE SAFETY

## Preventing Electrocutions from Contact with Overhead Power Lines

BY JEROME E. SPEAR

In 2010, OSHA revised its requirements for working around overhead power lines. The agency had determined that a more systematic, proactive approach was necessary to prevent cranes and other equipment from contacting overhead power lines, and published new requirements in its Final Rule for Cranes and Derricks in Construction.

OSHA had good reason for making changes. According to a review of crane-related fatalities conducted by CPWR, The Center for Construction Research and Training, contact with overhead power lines was the most common cause of crane-related fatalities from 1992 through 2006. See Table 1 for a list of the activities being performed by workers who were electrocuted by overhead power lines during this period.

This article summarizes measures to prevent contacts with power lines and actions to take if contact is made. For

complete guidance, refer to the OSHA standard 29 CFR 1926.1408 *Power Line Safety (Up to 350 kV) - Equipment Operations* and to the Final Rule for Cranes and Derricks in Construction.

### Assess the Hazard

Prior to beginning operations, a hazard assessment inside the work zone must be performed. The hazard assessment must identify the work zone, assess it for power lines, and determine how close the

crane could get to them. The employer has an option of doing this assessment for the area 360 degrees around the crane or for a more limited, demarcated area.

If the assessment shows that the crane could get closer than a trigger distance—20 feet for lines rated up to 350 kilovolts (kV); 50 feet for lines rated over 350 kV—then requirements for additional action are triggered.

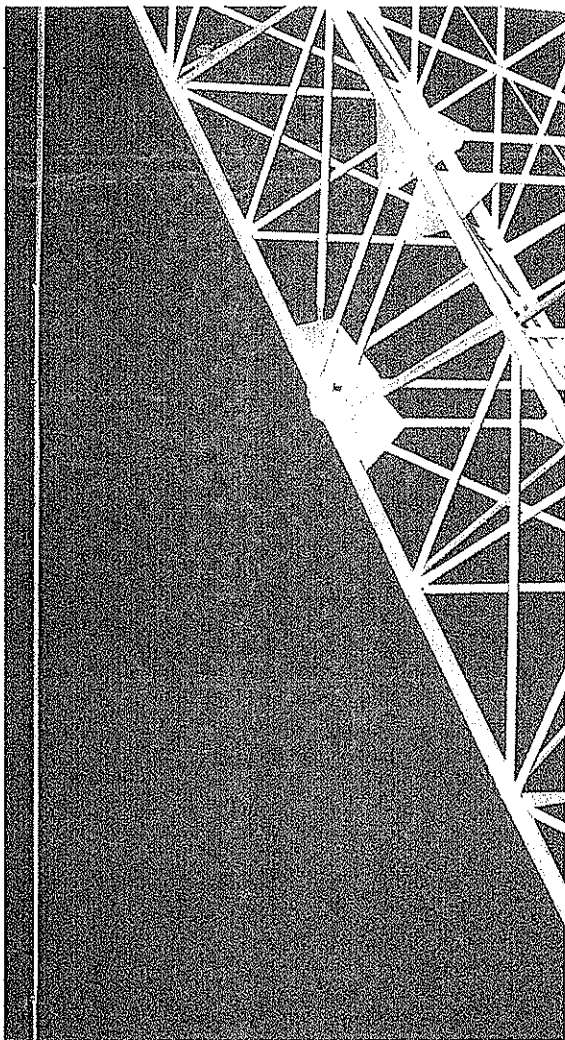
**Table 1.** Activity of Construction Workers Electrocuted by Overhead Power Lines, 1992–2006

| Contact with Overhead Power Lines              | No. | Percentage of Total |
|------------------------------------------------|-----|---------------------|
| Worker on foot touching/guiding load or cables | 40  | 39%                 |
| Operating crane*                               | 32  | 31%                 |
| Worker on foot touching crane                  | 19  | 19%                 |
| Other**                                        | 11  | 11%                 |
| Total                                          | 102 | 100%                |

\* Includes seven deaths of operators who jumped from crane.

\*\* Includes six deaths of workers on foot near crane.

Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries Research File<sup>1</sup>



### Eliminate the Hazard

If operations involving cranes or other high-reaching equipment will be performed near overhead power lines and the OSHA-specified minimum clearance distances cannot be maintained, the first option is to de-energize and visibly ground the power lines. This must be coordinated with the utility company or owner of the line. The line owner may need several weeks to comply with the request, so the work should be planned appropriately. Only authorized personnel may de-energize a power line. All power lines should be presumed energized unless the utility owner or operator confirms that the power line has been (and continues to be) de-energized and visibly grounded at the work site.

If the power line cannot be de-energized for the duration of the work, another option is to move the line to maintain minimum clearance. Only the company that owns the line may move it, and the line owner may take several weeks to comply with the request.

### Keep Your Distance

OSHA has straightforward requirements for working near overhead power lines with cranes and other high-reaching equipment. If the power lines are 50 kV or less, the operator must keep all parts of the crane (or other high-reaching equipment) at least 10 feet away from all power lines. This requirement also applies to any load being carried by lifting equipment.

If the lines are greater than 50 kV, then the minimum clearance distance must be increased according to OSHA's Table A in 29 CFR 1926.1408 (reprinted here as Table 2). Distribution lines, the most common lines used by utilities, are typically 50 kV or less; transmission lines are typically greater than 50 kV. To determine the voltage rating, contact the utility company. If you still can't determine the voltage range, then keep at least 45 feet away.

### Preventing Encroachment and Electrocutation

OSHA requires specific procedures in cases where any part of the equipment, load line, or load (including rigging and lifting accessories) could get closer than the minimum approach distance of the power line permitted in 29 CFR 1926.1408. These procedures include holding a planning meeting with the operator and other workers who will be in the area of the equipment, using non-conductive "tag lines" (ropes, usually fiber, that control a load), and erecting

a warning line or barricade at the prescribed distances in 29 CFR 1926.1408. For more information about these procedures, refer to the standard.

In addition to these procedures, at least one of the following measures must be implemented: a proximity alarm, a dedicated spotter, a range control device, a range of motion-limiting device, or an insulating link. Brief summaries of these measures appear below; for more information, consult the OSHA standard.

#### Proximity Alarm

Proximity warning devices warn the crane operator when any part of the boom moves too close to an overhead line. The device must be listed, labeled, or accepted by a nationally recognized testing laboratory (NRTL) and should be set to give the operator sufficient warning to prevent encroachment.

It is possible to get false readings with these devices. A NIOSH study published in January 2009 tested the efficacy of two proximity alarm models under various simulated construction conditions. The study identified factors that could adversely affect the accuracy of the proximity alarms (for example, operating the equipment with a boom angle and length significantly different than that used for the device's most recent sensitivity adjustment).<sup>2</sup> Due to these limitations, the preamble to OSHA's Final Rule on Cranes and Derricks in Construction indicates that no proximity alarm can be listed, labeled, or accepted by an NRTL

**Table 2.** Minimum Clearance Distances (Table A, 29 CFR 1926.1408)

| Voltage (kV)      | Minimum Clearance Distance                                                                                                                                                 |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| up to 50          | 10 feet                                                                                                                                                                    |
| over 50 to 200    | 15 feet                                                                                                                                                                    |
| over 200 to 350   | 20 feet                                                                                                                                                                    |
| over 350 to 500   | 25 feet                                                                                                                                                                    |
| over 500 to 750   | 35 feet                                                                                                                                                                    |
| over 750 to 1,000 | 45 feet                                                                                                                                                                    |
| over 1,000        | As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution. |

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until the problems identified from the NIOSH study have been rectified.

#### *Dedicated Spotter*

The responsibility of a dedicated spotter is to watch the separation between the power line and the equipment, the load line, and load. By communicating with the operator, the spotter must ensure that the applicable minimum distance is not breached. The dedicated spotter must be a qualified signal person.

#### *Range Control Warning Device*

A range control warning device automatically warns the operator when to stop moving a crane or other piece of equipment. This device can be set to warn that the boom or jib tip is at a particular plane or multiple planes. For example, if an employer has opted to maintain a 20-foot distance from the power line, the device could be set to alert the operator in time to prevent the boom, load line, or load from breaching that distance. Since the operator will need some time to react and to account for the momentum of the equipment, the device would have to be set to sound the warning more than 20 feet from the line.

#### *Range of Motion-Limiting Device*

This kind of device automatically limits the equipment's range and can be set to prevent encroachment. Such a device is well suited for tower cranes: by programming it to limit the swing angle, the operator can ensure that the boom or jib will not move past a certain range. Currently, these devices are more difficult to apply in mobile cranes.

#### *Insulating Links*

Insulating links are devices used on the hooks of cranes that protect employees handling the load against electrocution. If contact with a power line occurs, the linkage will prevent electricity from passing to the load. The entire structure of the crane, however, is not protected and will remain energized, so any worker near the crane body may be electrocuted from the current passing through the ground.

When insulating links are used, the operator is still required to prevent any part of the crane or load to move inside the power line's minimum clearance distance. Insulating links must be listed, labeled, or accepted by a nationally recognized testing laboratory.

#### **Additional Safety Measures**

In addition to the OSHA requirements summarized above, the following safety controls can be used for further protection against contacts with power lines.

#### *Insulated Sleeves*

Insulated sleeves made of nonconductive material can be attached directly to the power lines to prevent physical contact with the crane. Only the utility company or the line owner's representative may install insulated sleeves, which are designed only for brush contact; therefore, the minimum distance must still be maintained.

#### *Boom-cage Guard*

A boom-cage guard is a nonconductive cage that surrounds the boom of the crane. If a power line contact occurs with the boom-cage guard, the guard will prevent the boom from becoming energized, thus protecting all workers involved. The drawback of this technology is that it protects only the portion of the boom covered by the guard. Contacts that occur on other parts of the boom, load line, and load will still present an electrocution hazard. Again, the operator must still maintain the minimum clearance distance as specified in 29 CFR 1926.1408.

#### **What to Do If Contact Occurs**

Most of the injuries and deaths that result from mobile cranes contacting power lines occur among riggers and other workers standing near the equipment. Crane operators experience fewer injuries because of the equipment's design: if a contact occurs, the operator is at the same voltage potential as the crane.

If a crane contacts a line while the operator is isolated in the cab, the operator should wait in the crane, and all other workers should stay away from the equipment. The operator should

leave the crane cab only after the line is de-energized by the power company or contact between the boom and the line is broken.

Only in extreme circumstances (a fire, for example) should the operator leave the equipment while it's in contact with an energized line. In such an emergency, the operator must jump from the equipment, land with feet together, and take care not to touch any part of the crane and the ground at the same time. The operator must then either bunny hop or shuffle his or her feet in very small steps away from the crane. After a power line contact, the current flows outward from the point of contact through the soil in a ripple pattern. Areas of high and low potential circle the energized equipment like ripples in a pond after a stone hits the surface. If a person steps from an area of high potential to an area of low potential, electricity can flow through the person's legs and cause injury or death. The current flowing through the ground is also why other workers in the area of the energized equipment must stay away.

#### **Minimizing Danger**

Operating cranes and other high-reaching equipment near overhead power lines is an inherently dangerous activity that accounts for a significant percentage of worker fatalities in construction. Ample guidance is available from OSHA, CPWR, and other sources for minimizing the danger and, if possible, eliminating the hazard. ❖

#### **References**

1. *Crane-Related Deaths in Construction and Recommendations for Their Prevention*. CPWR, The Center for Construction Research and Training (November 2009).
2. *A Performance Evaluation of Two Overhead Power Line Proximity Warning Devices*. NIOSH (November 2008).

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