The Risk From Above

An accidental power line contact illustrates the need to stay 'heads-up' on the jobsite and consider all possible dangers

By Michael S. Morse, Ph.D.

Humans have no natural enemies from the sky and have therefore been programmed by evolution to no longer look skyward. However, the advent of overhead power lines has given us something to fear from above, yet our evolutionary programming has not kept pace with technological advances. Those who operate machinery that can reach toward the sky must also learn to combine strict adherence to protocol with a constant respect for the potential of electrocution posed by power lines. For a team tasked with stringing optical cable in close proximity to an energized 69kV transmission line, just another day at work became an exercise in disaster when a series of choices coupled with questionable breaches of protocol and lapses in vigilance ended in a crane-power line contact.

The team members testified that they understood that power lines were inherently dangerous and attested to the fact that they had significant ongoing training regarding safe practices when working in close proximity to energized lines. As the scenario proves, even a well-trained crew can suffer a critical failure when circumstances combine with a moment of complacency. And the result is disaster, damage to property and personal injury.

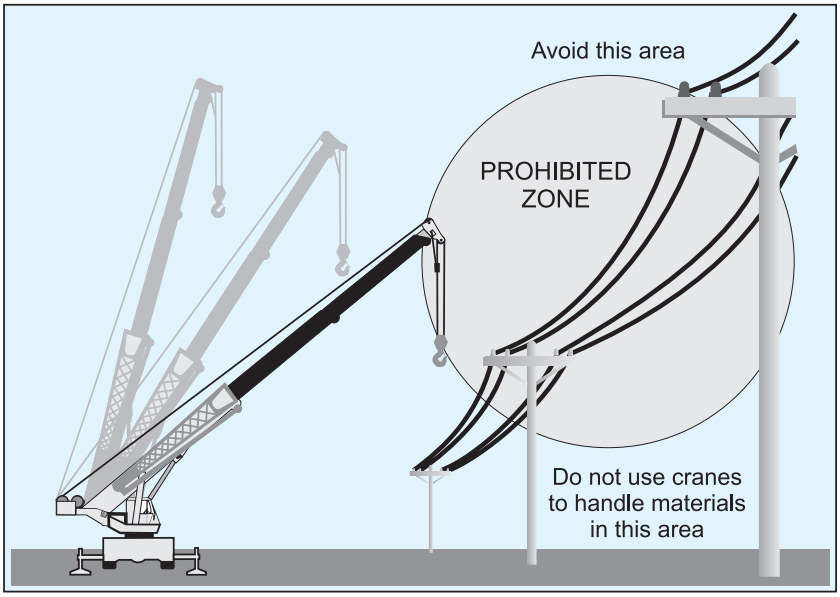

Photo courtesy of Crane Institute of America, Inc. 1-800-832-2726

OSHA guidelines stipulate that the prohibited zone extends 10 feet plus 0.4 inches for every kilovolt greater than 50kV. In this instance the boom should have remained 10.5 feet from the line.

Recipe for disaster. With minor exceptions, the day started as it usually did for the crew. The foreman responsible for planning the operation had obligations that took him away from the jobsite, but other crew members with years of experience were on hand to carry out the task. Although they didn't document it as they were supposed to, members of the crew held a tailboard meeting to discuss the day's tasks. Three teams were involved in the day's operations, but because of the layout of the jobsite, not all of them were present for the meeting. This wasn't a substantial problem because it didn't seem to hinder the necessary coordination required for the operation, which would require placing a crane in close proximity to energized lines.

Two cranes were available on-site—a 75-foot crane with an insulated boom and a 170-foot crane with an uninsulated boom. Because the team needed to access a large area, it decided to use the larger crane. The power line conductors were about 50 feet above the ground, and once the crane was in place, they would be well within the reach of the elevated boom.

Drawing upon past experience, the crew placed the crane in what they thought was the appropriate place, set the outriggers, and per company safety rules, drove a ground rod that was connected to the crane via 4-0 wire. The crew assessed the risk posed by the power lines and decided to place spotters on a bluff about 300 feet from the area where the crane would be working. One spotter would provide proximity information to a second person tasked with radioing the information to a third person near the crane who would repeat the information to the crane operator. As it turned out, the spotters weren't positioned directly in line with the overhead lines and therefore didn't have an optimal view of the crane's proximity to the conductors. Also of note is that the crane's controls could be operated by a person standing on the ground next to the crane. This configuration created a parallel pathway for current to ground through the crane operator.

Team members later testified that all

risks appeared to have been assessed and that the operation was good to go. Although they knew the risks of contact between an uninsulated crane arm and an overhead power line, the general consensus among them was that the risks had been abated through planning. The operator testified that he couldn't remember if he had read the sign on the crane that warned not to come within 10 feet of energized overhead power lines, but he did know that the company's safety rulebook set the proximity limit at a critically small clearance of 4 feet.

Accidental contact relived. In accordance with the communications relay system the crew had established, the operator listened to the commands relayed from the spotters and then moved the crane. He testified that he recalled stopping the crane twice to get updates. His last recollection prior to making contact with the power line was a message that the crane was 8 feet to 10 feet from the line. However, because the spotters had a poor angle on the crane's location, they were relaying incorrect information and before anyone could respond, the contact occurred. The electrical impact threw the operator back 7 feet from the controls. He suffered burns to one hand and both feet and the ultimate injury was long-term pain and the amputation of one finger.

Required Clearances for Operation in Transit Near High Voltage Power Lines	
to 0.75kV	4 ft (1.22m)
0.75kV to 50kV	6 ft (1.83m)
over 50 to 345kV	10 ft (3.05m)
over 345kV to 750kV	16 ft (4.87m)
over 750kV to 1,000kV	20 ft (6.10m)

The rules for clearance change when the crane is in motion.

The plaintiff sued the crane manufacturer as well as others in the chain of commerce for the crane and retained me for the ensuing investigation, which consisted of a material review of witness reports, investigative reports, and expert depositions. Multiple experts offered their opinions as to whether control and operation isolation would have prevented the injury, and when the dust settled, so did the case. In assessing this case in the context of all the facts and also when considering OSHA, ANSI, and NIOSH standards and recommendations, my investigation revealed that multiple failures brought about the power line contact and the ensuing injury. But this revelation should also have been apparent to the team members involved in the accident as well as those who promulgated the safety rules.

The first problem was the team's decision to use a crane with an uninsulated boom inside the 10-foot safe zone specified by the manufacturer. Had a crane with an insulated boom been used or had they maintained the 10-foot boundary, the operator wouldn't have been injured. However, given the team's choice, the accident still could have been prevented had the crane been modified to include an isolation platform and isolated controls that ensured the operator would be safely within an area of uniform voltage. Ohm's law tells us that one can't be shocked or injured by electricity if we are held in an area of a singular voltage. Injury can only occur when there is a voltage differential across the body. NIOSH document 95-108 Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Power Lines suggests that the development of "isolated crane control systems" would enhance electrical safety. However, this only protects the operator from injury and wouldn't prevent the exceptional discharge of current, which could injure those close to the crane and damage the crane itself.

The next issue to consider is that of

the spotters. Clearly, they should have made sure they were in the best possible position and that they had a clear line of sight to the crane and power line that didn't create the potential for optical illusion or distortion. By the time they recognized their error it was too late.

The relay system of communications also led to a breakdown in safety. Much like the children's game of telephone, the information had to pass through multiple hands before it got to the crane operator. A critical or imminent failure couldn't be relayed quickly enough to prevent its occurrence. A practiced and pre-planned communications protocol considering this risk was necessary. OSHA also recommends that cranes be operated slowly when in close proximity to power lines. The crew failed to heed that recommendation, which might have prevented the accident in this case.

The final element that contributed to the accident was the company safety rule that set the proximity safe zone at 4 feet. OSHA regulations in 29 CFR 1926.550(a)(15) set the safe zone at 10 feet plus 0.4 inches for each kilovolt above 50kV. For 66kV, that would make the safe zone slightly more than 10.5 feet. The ANSI guideline would set the safe limit at 15 feet for 66kV. Clearly, the company safety rule isn't consistent with other standards or with the value set by the crane manufacturer. The standards recognize the value of proximity sensing devices but not as an alternative to maintaining the prescribed safe zone.

Clearly, the spotters should have made sure they had a clear line of sight to the crane that couldn't be distorted.

Looking forward that morning, everyone involved saw a safe and appropriate effort ahead of them, but looking back now, it's clear that errors were made and unnecessary risks were taken. The preparation had gaps, the choice of hardware wasn't the best, the company safety rule wasn't adequate, and team communications wasn't adequate for the task. Electricity is way too dangerous—especially at transmission line levels—to let foresight be anything less than what hindsight will ultimately be. EC&M

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