APPENDIX

NIOSH Alerts

NIOSH

ALERT

JULY 1985

Request for Assistance in Preventing Electrocutions from Contact Between Cranes and Power Lines

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

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REQUEST FOR ASSISTANCE IN PREVENTING

ELECTROCUTIONS FROM CONTACT BETWEEN CRANES AND POWER LINES

BACKGROUND

Contact between cranes and overhead power lines is a major cause of fatal occupational injuries in the United States. Based upon an analysis by the National Institute for Occupational Safety and Health (NIOSH) of the data from the Supplementary Data System [1] of the Bureau of Labor Statistics, there were approximately 2,300 lost workday occupational injuries in the United States in 1981 which resulted from contact with electrical current by crane booms, cables, or loads. These 2,300 injuries were extremely severe, resulting in 115 fatalities and 200 permanent total disabilities. Comparable statistics obtained in studies conducted by the National Safety Council from 1964 to 1976 produced an estimated annual average of 150 fatalities resulting from such incidents [2]. NIOSH believes that this type of event is the most common cause of fatalities associated with mobile crane operations [3] and is responsible for approximately 1.5% of all fatal work-related injuries each year.

CASE REPORTS

As part of the Fatal Accident Circumstances and Epidemiology (FACE) Project conducted by NIOSH, six fatal injuries involving crane-related electrocutions were investigated. The synopses of these cases are as follows:

Case #1:

A 28-year-old construction worker was holding on to a steel ladder being moved by a telescoping boom crane. As the crane's boom was swung in the direction of 7,200 volt power lines, the cable contacted the closest of the lines and the worker was electrocuted.

Case #2:

A co-owner of a steel erection company and three workers were using a telescoping boom crane to move a section of a steel framing member at the construction site of a commercial storage shed. As the section was moved, it came into contact with a 23,000 volt overhead power line. Two of the three workers who were in direct contact with the load were electrocuted while the third received serious electrical burns.

Case #3:

Roof materials for an addition to a commercial building were stored outside the building directly beneath a 7,200 volt power line. While hooking a load (joist angle bracing) to the crane, a worker was electrocuted when the cable came into contact with the power line as the boom swung.

Case #4:

A construction company was in the process of laying concrete water pipe with a crane. As workmen were placing support timbers beneath the crane's outrigger pads, the operator began extending the crane boom for the next lift when the boom came into contact with a 3 phase 13,800 volt overhead power line. One worker touching an outrigger of the crane was electrocuted.

Case #5:

At a highway construction site, a carpenter attached a 4' x 8' wood and metal form to a crane. While holding on to the form in attempting to guide it into place, the carpenter was electrocuted when the boom or cable came into contact with a 34,000 volt power line.

APPROPRIATE STANDARDS AND RECOMMENDED WORK PRACTICES

The Occupational Safety and Health Administration (OSHA) Safety and Health Regulations for Construction, Subpart N--Cranes, Derricks, Hoists, Elevators, and Conveyors (29 CFR 1926.550(a)(15)) contains specific requirements for the safe use of cranes proximate to overhead power lines. Electrical distribution and transmission lines are required to be de-energized and visibly grounded, moved, or separated from cranes with independent insulating barriers. The regulation states that when it is not possible to meet these requirements, cranes may operate proximate to power lines only if:

a) minimum clearance (absolute limit of approach) is maintained between the crane and the lines (10 feet for $\leq$50 kV and 10 feet plus 0.4 inch for each 1 kV over 50 kV, or twice the length of the line insulator but never less than 10 feet); or,

b) in transit with no load and boom lowered, minimum clearance (absolute limit of approach) is maintained (4 feet for <50 kV, 10 feet for 50 kV to 345 kV, or 16 feet for up to and including 750 kV).

Additionally, 1926.550(a)(15) requires that: a person be designated to observe the clearance of the crane when it is difficult for the crane operator to use direct observation; cage-type boom guards, insulating lines, or proximity warning devices may be used, but their use does not eliminate the need to adhere to the other parts of the regulation; any overhead wire is to be considered energized until the owner of the line or the electric utility indicates that it is not energized and that it has been visibly grounded; transmitter towers should also be de-energized or tests shall be conducted to determine if an electrical charge has been induced on the crane. Induced charges shall be dissipated by providing an electrical ground directly to the upper rotating structure supporting the boom; ground jumper cables shall be attached to materials when an electrical charge is induced; crews shall be provided with nonconductive poles to attach the ground cable to the load; combustible and flammable materials shall be removed from the immediate area prior to operations.

The Construction Safety Association of Ontario, Canada (CSA-Ontario), recommends safe work practices [4] beyond those addressed in the OSHA standard including the use of nonconductive taglines to guide loads and the use of insulating personal protective equipment by exposed workers.

APPLICATION OF EXISTING STANDARDS AND RECOMMENDED WORK PRACTICES

Table 1 presents an analysis for each of the five cases described in this alert regarding compliance with the OSHA standard or CSA-Ontario recommended work practices. In two of the cases, neither the OSHA standard nor the CSA-Ontario recommended work practices were being followed. In the remaining three cases, only one of these safe work practices (avoiding the storage of materials directly under power lines) was being followed. In each of these five cases, there was demonstrable lack of compliance with the OSHA standard.

CONCLUSION

The principal objective of the investigations undertaken by NIOSH as part of its Fatal Accident Circumstances and Epidemiology (FACE) Project is to determine what factors enabled the fatality to occur. The goal is to learn how such fatalities can be prevented. In this context, whether or not an operation was "in compliance" with existing standards is but one of many variables which may or may not have contributed to the fatality. However, in the course of the investigations reported here, it became obvious that full compliance with relevant OSHA standards and full use of the CSA-Ontario work practices would have prevented each fatality.

As an obvious first step in preventing such fatalities in the future, we conclude that all such operations should be done only in compliance with existing OSHA standards.

TABLE 1

Status of Compliance with OSHA Standards (or Use of CSA-Ontario Recommended Work Practices) in Operations Which Resulted in Six Crane-related Electrocutions

Relevant OSHA Standard (or CSA-Ontario Recommended Work Practice)	Status of Compliance by Case				
	#1	#2	#3	#4	#5
1. Move, insulate, or de-energize power line before starting work (OSHA)	No	No	No	No	No
2. Maintain recommended absolute limit of approach (minimum clearance) for specific voltage (OSHA)	No	No	No	No	No
3. Utilize a signal man (OSHA)	No	No	No	No	No
4. Utilize nonconductive taglines, rather than direct contact, to stabilize load (CSA-Ontario)	No	No	No	No	No
5. Do not store combustible materials directly beneath power lines (OSHA & CSA-Ontario)	No	Yes	No	Yes	Yes
6. Use boom guards, insulating lines, or proximity warning devices in addition to other requirements (OSHA)	No	No	No	No	No
7. Use insulating boots and gloves when workers connect loads or contact the crane while in the vicinity of overhead power lines (CSA-Ontario)	No	No	No	No	No

No = Data demonstrated lack of compliance with the OSHA standard (or lack of use of CSA-Ontario recommended work practices).

Yes = Data demonstrated compliance with the OSHA standard (or use of CSA-Ontario recommended work practices).

RECOMMENDATIONS BY NIOSH

The existing OSHA standard appears sufficient to prevent the crane-related electrocutions described in this alert as well as all others. NIOSH urges all employers who use cranes in the vicinity of overhead power lines to familiarize themselves with and implement the existing OSHA standard. NIOSH urges safety and trade associations, crane manufacturers, electric utility companies, and OSHA state consultative services to bring this standard to the attention of employers who use cranes. Implementation of the work practices described by the CSA of Ontario can provide an additional margin of safety.

Suggestions, requests for additional information on safe work practices, or questions related to this announcement should be directed to Mr. John Moran, Director, Division of Safety Research, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505-2888, Telephone (304) 291-4595.

We greatly appreciate your assistance.

J. Donald Millar, M.D., D.T.P.H., (Lond.)
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Centers for Disease Control

REFERENCES

1. Bureau of Labor Statistics: Supplementary Data System Microdisk Files User's Guide, 1976-1977, No. PB288258. Springfield, Virginia: National Technical Information Service, 1978.

2. National Safety Council utility study, 1964-1968. Accident Facts. Chicago, Illinois: National Safety Council, 1969-1976.

3. Coleman PJ, Gottlieb MS, Kaplan MC, Knutson SJ, McPeek JS. A human factor analysis of material handling equipment. Madison, Wisconsin: State of Wisconsin, Department of Industry, Labor and Human Relations, January 1978;132-4.

4. Crane handbook. Toronto, Ontario, Canada: Construction Safety Association of Ontario, October 1975;133-50.

NIOSH ALERT

JULY 1989

REQUEST FOR ASSISTANCE IN

Preventing Electrocutions of Workers Using Portable Metal Ladders Near Overhead Power Lines

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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NIOSH *ALERT*

Request for Assistance in

Preventing Electrocutions of Workers Using Portable Metal Ladders Near Overhead Power Lines

WARNING!

Persons using portable metal or conductive ladders near energized overhead power lines are at risk of electrocution.

The National Institute for Occupational Safety and Health (NIOSH) is requesting assistance in preventing electrocutions that occur when portable metal ladders (including aluminum ladders) contact overhead power lines. Portable metal ladders are used widely in many industries. This *Alert* describes six deaths that occurred because portable aluminum ladders, which are electrical conductors, came in contact with energized overhead power lines. If nonconductive ladders had been used instead, or if safe working clearances had been maintained, these deaths might have been prevented.

Specific Occupational Safety and Health Administration (OSHA) regulations govern the use of portable metal ladders. These regulations should be implemented and enforced by every employer, manager, supervisor, and worker in operations that use portable metal ladders. Editors of appropriate trade journals, safety and health officials, and other persons (especially those in the building trades) are requested to bring the recommendations in this *Alert* to the attention of contractors and workers.

BACKGROUND

Contact between portable metal ladders and overhead power lines causes serious and often fatal injuries to workers in the United States. Data show that during the years 1980 through 1985, the contact of metal ladders with overhead power lines accounted for approximately 4% of all work-related electrocutions in the United States (e.g., 17 out of 382 deaths for 1985) [NIOSH 1988].

REGULATIONS

Safety regulations promulgated by the Occupational Safety and Health Administration (OSHA) establish specific requirements intended to prevent workers from positioning portable metal ladders where they might contact electrical conductors [29 CFR* 1926.450(a)(11) and 1926.951(c)(1)]. These regulations stipulate that "portable metal or conductive ladders shall not be used for electrical work or where they may contact

*Code of Federal Regulations. See CFR in references.

electrical conductors." Other pertinent regulations require that "portable ladders in use shall be tied, blocked, or otherwise secured to prevent their being displaced" [29 CFR 1926.450(a)(10)]. Additional OSHA regulations require employers to instruct each worker to recognize and avoid unsafe conditions [29 CFR 1926.21(b)(2)], and to provide prompt medical attention in case of serious injury [29 CFR 1926.50].

CASE REPORTS

As part of the Fatal Accident Circumstances and Epidemiology (FACE) Program, NIOSH investigated five incidents (resulting in six electrocutions) that occurred between 1985 and 1987 and that involved contact between portable aluminum ladders and overhead power lines.

Case No. 1 - One Fatality

On May 4, 1985, a 28-year-old male worker removed the bottom of a poster on a 12-by-24-foot (-ft) billboard that was scheduled for reposting. He then removed a 24-ft aluminum hook ladder from the service truck. While the worker was positioning the ladder to reach the top section of the billboard, the ladder contacted a 7,200-volt (-V) overhead power line that was located 8 ft from the top of the billboard, and he was electrocuted [NIOSH 1985a].

Case No. 2 - One Fatality

On July 21, 1986, a 27-year-old male painter was standing on a fully extended 24-ft aluminum ladder while painting a rain gutter on an apartment building. After painting a section of the gutter, the worker descended the ladder to move it to a new location. As he was repositioning the ladder, it contacted a 7,200-V overhead power line that was located 8 ft from the gutter, and he was electrocuted [NIOSH 1987d].

Case No. 3 - Two Fatalities

On November 17, 1986, two male painters (20 and 21 years old) were using a 36-ft aluminum extension ladder to paint a 20-ft-high metal light pole. One worker was standing on the ladder painting, and his coworker was on the ground holding the ladder. The ladder slipped away from the pole and contacted a 12,460-V overhead power line that was located within 2 ft of the pole. Both painters were electrocuted [NIOSH 1987c].

Case No. 4 - One Fatality

On September 1, 1987, a 28-year-old male painter and a coworker were using an aluminum extension ladder while cleaning the outside brick wall of a three-story convalescent home before painting. After cleaning one section, the workers moved the ladder to another location. The painter held the base of the ladder as the coworker simultaneously climbed and raised the extension of the 40-ft ladder. When the ladder was extended to approximately 34 ft, it tipped backward, contacting a 7,200-V overhead power line that was located 15 ft from the structure. The coworker on the ladder received an electrical shock and fell to the ground. The painter holding the ladder provided a path to the ground for the electrical current and was electrocuted [NIOSH 1987b].

Case No. 5 - One Fatality

On September 24, 1987, an 18-year-old male construction worker and two coworkers were looking for an area on an office building roof to store shingles. The 18-year-old and a coworker were holding a fully extended, 32-ft aluminum ladder as the other coworker descended it. The ladder tipped backward, contacting a 7,200-V overhead power line that was located 6 ft from the building, electrocuting the 18-year-old worker holding the ladder, and shocking the other two coworkers [NIOSH 1987a].

APPLICATION OF EXISTING REGULATIONS

Data demonstrated that employers and workers in all five fatal incidents violated the following applicable* OSHA regulations:

*Regulation No. 3 did not apply to Case No. 1.

1. Portable metal or conductive ladders shall not be used for electrical work or where they may contact electrical conductors [29 CFR 1926.450(a)(11) or 1926.951(c)(1)].
2. Employers shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury [29 CFR 1926.21(b)(2)].
3. Portable ladders in use shall be tied, blocked, or otherwise secured to prevent their being displaced [29 CFR 1926.450(a)(10)].

Compliance with these regulations might have prevented all five deaths.

CONCLUSIONS

The principal objectives of the NIOSH FACE Program are to identify potential risk factors that may contribute to traumatic worker deaths and to recommend measures that might prevent similar fatalities. Whether or not a work operation complies with existing OSHA regulations is only one variable that may contribute to a fatality. However, in the investigations reported here, full compliance with relevant OSHA regulations would probably have prevented these deaths. The lack of compliance with existing regulations in the five incidents described suggests that many employers and workers may be (1) working unaware of these OSHA regulations, (2) misinterpreting the requirements of the regulations, or (3) failing to inform their workers about the dangers of using metal ladders around overhead power lines.

RECOMMENDATIONS

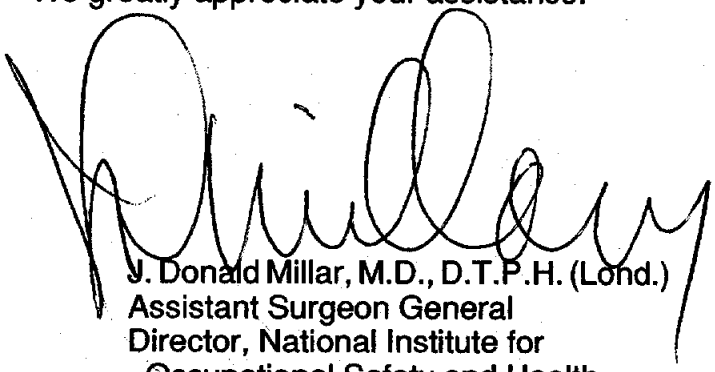
The following recommendations will help prevent deaths and injuries resulting from contact between metal ladders and overhead power lines:

- NIOSH recommends that employers and workers comply with the OSHA regulation prohibiting the use of portable metal or conductive ladders for electrical work or in locations where they may contact electrical conductors. Nonconductive ladders such as those made of wood or fiber glass should be used instead.
- Employers should fully inform workers about the hazards of using portable metal (including aluminum) ladders near energized power lines.
- If portable metal ladders are used in the vicinity of energized power lines, NIOSH urges that all employers and workers strictly adhere to the OSHA safety regulations [29 CFR 1926.450 and 1926.951(c)(1)] for providing proper balancing and securing of ladders, and for maintaining safe working distances to avoid contact with electrical conductors.
- To assure proper protection for anyone working near electrical power lines, arrangements should be made with the power company to de-energize the lines or to cover the lines with insulating line hoses or blankets.
- Employers should provide workers with training in emergency medical procedures such as cardiopulmonary resuscitation. Fatalities may be prevented by prompt emergency medical care.

NIOSH also urges safety and trade associations, electrical utility companies, product manufacturers, and OSHA State consultative services to bring these recommendations to the attention of employers and workers using portable metal ladders. Further information on electrical energy hazards can be found in six previously published NIOSH *Alerts* [NIOSH 1987e, NIOSH 1986a, NIOSH 1986b, NIOSH 1986c, NIOSH 1985b, NIOSH 1984].

Suggestions, requests for additional information on safe work practices, or questions related to this announcement should be directed to Dr. Thomas R. Bender, Director, Division of Safety Research, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505-2888; telephone (304) 291-4595.

We greatly appreciate your assistance.



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REFERENCES

CFR [1988]. Code of federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

NIOSH [1984]. Request for assistance in preventing electrocutions of workers in fast food restaurants. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 85-104.

NIOSH [1985a]. Fatal accident circumstances and epidemiology (FACE): Billboard worker dies when metal ladder contacts 7,200 volt power line in Kentucky. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research, FACE-85-21-II.

NIOSH [1985b]. Request for assistance in preventing electrocutions from contact between cranes and power lines. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 85-111.

NIOSH [1986a]. Request for assistance in preventing electrocutions due to damaged receptacles and connectors. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-100.

NIOSH [1986b]. Request for assistance in preventing fatalities of workers who contact electrical energy. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-103.

NIOSH [1986c]. Request for assistance in preventing grain auger electrocutions. Cincinnati, OH: U.S. Department of Health and Human Services, Pubic Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 86-119.

NIOSH [1987a]. Fatal accident circumstances and epidemiology (FACE): Construction worker electrocuted in North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research, FACE-88-5-II.

NIOSH [1987b]. Fatal accident circumstances and epidemiology (FACE): Painter electrocuted in North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety

and Health, Division of Safety Research, FACE-88-4-II.

NIOSH [1987c]. Fatal accident circumstances and epidemiology (FACE): Two painters electrocuted in Ohio. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research, FACE-87-28-II.

NIOSH [1987d]. Fatal accident circumstances and epidemiology (FACE): 27-year-old painter electrocuted in Georgia. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research, FACE-87-32-II.

NIOSH [1987e]. Request for assistance in preventing electrocutions by undetected feedback electrical energy present in power lines. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 88-104.

NIOSH [1988]. National traumatic occupational fatalities (NTOF) data base. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research. Unpublished data base.

NIOSH ALERT

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Request for Assistance in

Preventing Grain Auger Electrocutions

July 1986

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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REQUEST FOR ASSISTANCE IN PREVENTING GRAIN AUGER ELECTROCUTIONS

WARNING!

MOVING GRAIN AUGERS IN THEIR ELEVATED POSITION MAY RESULT IN ELECTROCUTION IF THEY CONTACT OVERHEAD POWER LINES WHILE BEING MOVED. FARM OWNERS AND MANAGERS SHOULD ENSURE THAT AUGERS ARE IN THE LOWERED POSITION PRIOR TO MOVING THEM.

SUMMARY

This Alert requests the assistance of farm owners/managers, farm/agricultural workers, and farm equipment manufacturers in the prevention of electrocutions which may occur while moving metal grain augers. The grain auger is an essential piece of farm equipment which is used to move grain from one location to another. However, every year accidents occur when this piece of equipment is improperly moved in the elevated position and it comes into contact with high voltage power lines. This has resulted in one or more fatalities per incident. This Alert describes two separate incidents that resulted in five fatalities, and occurred within the same week (150 miles apart). Neither of the incidents fell under OSHA jurisdiction because both farms were family operations employing fewer than 10 workers.

July 1986

BACKGROUND

The grain auger is a portable piece of farm equipment, 50 to 60 feet long, and weighing several hundred pounds. It is used to move grain from one location to another (e.g., unloading grain from a truck or trailer and loading it into a dryer or storage bin). It is moved to a desired location on inflatable-type car tires and then raised into position by means of a hand crank attached to a steel pully system; the discharge end is elevated to the top of a dryer or bin, and the opposite end is lowered in order to pick up the grain to be moved. The auger is usually powered by connecting a universal joint to the power takeoff on a tractor or other piece of farm equipment. After transferring the grain, the auger should be lowered to a horizontal position for safe transportation to another location. However, the auger is not always lowered before being moved, and this unsafe practice could pose a life threatening hazard if the auger comes into contact with overhead electrical lines or if it were to tip over during transport.

CASE REPORTS OF TWO FATAL INCIDENTS

These case reports resulted from NIOSH investigations of the circumstances that led to the five fatalities described below. The investigations were conducted as part of the NIOSH Fatal Accident Circumstances and Epidemiology Program.

Case #1 - TWO ELECTROCUTED, THREE INJURED

During mid-morning on October 14, 1985, five farm workers were in the process of moving a portable grain auger. To move the auger from a 30-foot tall grain drying bin to another location, it was raised to approximately 35 feet (an angle of about 45 degrees) so that the top could clear the bin. The workers then pulled the grain auger machine back approximately 15 feet from the grain bin, rotated the rear of the auger 90 degrees, and began pushing the auger to the new location. As the workers pushed the auger forward, approximately 90 feet, it contacted an electrical line which was about 25 feet above the ground. Two of the workmen were electrocuted and three others were injured.

Case #2 - THREE ELECTROCUTED

During the early morning of October 18, 1985, two farm workers and the farm owner were moving a portable grain auger from a grain bin, approximately 30 feet high, to another location. The auger was first raised to 35 feet to clear the top of the grain bin and then pulled back approximately 15 feet. The workers swiveled the auger 90 degrees to allow a

straight path to the truck, approximately 40 yards away, that was to be loaded with grain. As the workers pushed the auger forward, it contacted a 7200 volt electrical line which was 25 feet above the ground. The two workers and the farm owner were electrocuted.

REGULATORY STATUS

OSHA estimates that over 90% of all farms in the United States are not covered by OSHA regulations. OSHA regulations are not applicable to most farms because they employ fewer than 10 employees. However, for farms employing 11 or more workers (family members do not count in this number), OSHA jurisdiction does apply and mandatory compliance is required to 29 CFR 1928.57, Guarding of Farm Field Equipment, Farm Machinery & Farmstead, Sub Part D.

CONCLUSIONS

Based on the information collected on the two cases cited, it can be concluded that the five fatalities occurred as a result of the following:

1. The lack of hazard recognition.

2. The failure to lower the grain augers to the horizontal position before moving them to other locations.

RECOMMENDATIONS

NIOSH recommends that all farm owners/managers, farm/agricultural workers, and farm equipment manufacturers be made familiar with, and reinforce the following steps:

1. Hazard Awareness

A survey of the farm should be conducted to identify hazards posed by the locations of overhead electrical lines. When all such hazards are identified and documented for future reference, workers should be informed of their location and instructed in the steps necessary to safely move grain augers.

2. Safe Movement of Grain Augers and Other Farm Equipment

Grain augers pose a life threatening hazard when moved in an elevated position if they contact overhead electrical lines or if they tip over. Therefore, it is essential that grain augers be lowered to a horizontal position before being moved from one location to another. In addition, all other equipment to be moved should be evaluated in order to determine the most appropriate method that will ensure worker safety during its

transport. Manufacturers of grain augers are urged to consider design modifications that will prevent grain augers from being moved while in an elevated position.

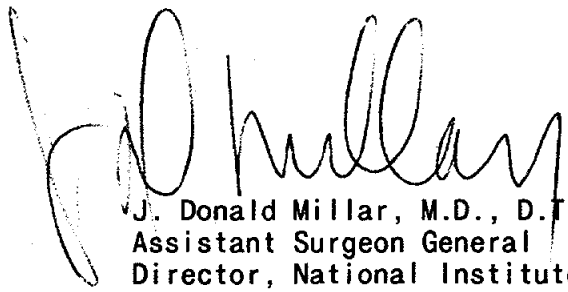
3. Safety Signs

It is recommended that users and manufacturers of grain augers affix safety signs onto the equipment that warn the user of the potential hazards of moving the auger in its upright position. A safety sign to draw attention to avoiding electrical hazards when moving grain augers is provided with this Alert. This sign should be placed on the grain auger in a conspicuous location so that it will alert workers of life threatening hazards.

We are requesting editors of appropriate trade and farm journals, members of farm extension associations, and those responsible for safety and health (e.g. inspectors, managers, and agricultural extension specialists) to bring these recommendations to the attention of farm workers, managers, and owners.

Requests for additional information on control practices or questions related to this announcement should be directed to Mr. John B. Moran, Director, Division of Safety Research, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505, Telephone (304) 291-4595.

We greatly appreciate your assistance.



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Request for Assistance in

Preventing Fatalities of Workers Who Contact Electrical Energy

December 1986

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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REQUEST FOR ASSISTANCE IN PREVENTING FATALITIES OF WORKERS WHO CONTACT ELECTRICAL ENERGY

ATTENTION!

PROMPT EMERGENCY MEDICAL CARE CAN BE LIFESAVING FOR WORKERS WHO HAVE CONTACTED EITHER LOW VOLTAGE OR HIGH VOLTAGE ELECTRICAL ENERGY. IMMEDIATE CARDIOPULMONARY RESUSCITATION (CPR) FOLLOWED BY ADVANCED CARDIAC LIFE SUPPORT (ACLS) HAS BEEN SHOWN TO SAVE LIVES.

SUMMARY

Recent incidents that have come to the attention of NIOSH have shown that electrocution victims can be revived if immediate cardiopulmonary resuscitation (CPR) or defibrillation is provided. While immediate defibrillation would be ideal, CPR given within approximately 4 minutes of the electrocution, followed by advanced cardiac life support (ACLS) measures within approximately 8 minutes, can be lifesaving. This alert describes recommendations that can be used to help save the lives of workers who contact electrical energy. Editors of appropriate trade journals, safety and health officials, and especially those who work with electrical equipment, are requested to bring these recommendations to the attention of owners, managers, and workers.

December 1986

BACKGROUND

It has been estimated that at least 700 occupational electrocutions occur each year [1]. Therefore, a primary goal of occupational safety programs must be to prevent workers from contacting electrical energy. Effective measures include safe work practices, job training, proper tools, protective equipment, and lockout/tag-out procedures.

Investigations by NIOSH, as part of its Fatal Accident Circumstances and Epidemiology (FACE) Project, also have revealed that once an electrical energy incident occurs, emergency response plans are often lacking, even in organizations which promote safety. Hence, a secondary goal of safety programs must be to provide appropriate emergency medical care to workers who contact electrical energy.

The National Electrical Code divides voltages into two categories: greater than 600 volts (high voltage) and less than or equal to 600 volts (low voltage) [2]. Momentary contact with low voltages produces no thermal injury, but may cause ventricular fibrillation (very rapid, ineffective, heartbeat) [3].

In contacts with high voltage, massive current flows may stop the heart completely. When the circuit breaks, the heart may start beating normally [3]. Supporting respiration by immediate mouth-to-mouth techniques may be required, even if heartbeat and pulse are present. If extensive burns are present, death may result from subsequent complications [4].

APPROPRIATE STANDARDS AND GUIDELINES

The revised "Standards and Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)" published in June 1986, is a product of the 1985 National Conference on CPR and ECC. There are two parts: basic cardiopulmonary resuscitation (CPR) and advanced cardiac life support (ACLS). A lay person can be trained in CPR to support circulation and ventilation of the victim of cardiac or respiratory arrest, until ACLS (provided by medical professionals using special equipment) can restore normal heart and ventilatory action [5].

Speed has been found to be critical to resuscitation: immediate defibrillation would be ideal. The highest success rate has been achieved in those patients for whom CPR followed cardiac arrest within approximately 4 minutes, and ACLS was begun within approximately 8 minutes of the arrest [5]. CPR often must be initiated immediately by lay individuals at the scene of the incident. It should be noted that CPR skills can be gained in 4-hour courses similar to those taught by the American Heart Association or the American Red Cross.

NIOSH CASE REPORTS

Case #1 - SUCCESSFUL RESUSCITATION

A 30-year-old construction worker was working on a fire escape in a building being renovated. Another worker handed the victim a metal pipe, and he was holding it with both hands when it contacted a nearby high voltage line, completing a path-to-ground. The worker instantly collapsed from this contact with electrical energy. Approximately 4 minutes after he collapsed, the fire department rescue squad arrived and began CPR. Within 6 minutes, a paramedic unit was on the scene providing defibrillation and other ACLS measures. They were able to establish a heartbeat and pulse, but the individual continued to require respiratory support during transport to the hospital. He regained consciousness and was discharged within two weeks. He did have to return for further medical care for burns he received on his hands (current entrance) and buttocks (current exit) [6].

Case #2 - UNSUCCESSFUL RESUSCITATION

An 18-year-old male restaurant worker contacted electrical energy when he kneeled to plug a portable electric toaster into a 110-120 V/20 amp floor outlet. After a scream was heard, the victim was found convulsing on the damp floor, with one hand on the plug and the other on the receptacle box. The assistant manager went to the electrical panel, but was unable to locate the appropriate circuit breaker. A coworker attempting to take the victim's pulse received an electrical shock, but was not injured. After telephoning the emergency medical service, the assistant manager returned to the panel and de-energized all of the circuits (3 to 8 minutes after the worker contacted electrical energy). The injured worker was covered with a coat to "keep him warm." After about 5 minutes, another call was placed to the emergency squad, and the assistant manager "yelled" for an off-duty employee who lived in an apartment across the lot, who came and began CPR. The emergency service was on the scene 10 minutes after receiving the first call. ACLS measures were available, but the resuscitation was unsuccessful and the worker was pronounced "dead on arrival" at the local hospital. The exact time span between the worker contacting electrical energy and the beginning of CPR is unknown, but it is reasonable to assume that it was longer than 4 to 6 minutes. Paramedics with ACLS capability arrived 10 minutes after receiving the call, but more than 10 minutes after the accident occurred [7].

CONCLUSIONS

In Case #1, basic life support was begun within 4 minutes by the fire department rescue squad who happened to be stationed nearby. They were experienced and had up-to-date knowledge in CPR techniques. In

this case, CPR was begun within the 4-minute recommendation. An ambulance, equipped and staffed to provide ACLS, arrived within 6 minutes. The standards and guidelines [5] for CPR within 4 minutes, and ACLS within 8 minutes, were met and the worker did survive.

In Case #2, the worker's contact with electrical energy was prolonged and a coworker who aided him received an electrical shock, because coworkers did not know how to de-energize the circuit. The optimal times for CPR and ACLS were exceeded, and the resuscitation was unsuccessful. Providing appropriate medical care after an electrical energy incident will not guarantee success. However, as has been reported elsewhere [5] and supported in the NIOSH case reports, the chance for successful resuscitation after cardiopulmonary arrest is best when the criteria for providing emergency medical care are met.

RECOMMENDATIONS

1. PREVENTION

PREVENTION must be the primary goal of any occupational safety program. However, since contact with electrical energy occurs even in facilities which promote safety, safety programs should provide for an appropriate emergency medical response.

2. SAFE WORK PRACTICES

No one who works with electrical energy should work alone, and in many instances, a "buddy system" should be established. It may be advisable to have both members of the buddy system trained in CPR, as one cannot predict which will contact electrical energy.

Every individual who works with or around electrical energy should be familiar with emergency procedures. This should include knowing how to de-energize the electrical system before rescuing or beginning resuscitation on a worker who remains in contact with an electrical energy source.

All workers exposed to electrical hazards should be made aware that even "low" voltage circuits can be fatal, and that prompt emergency medical care can be lifesaving.

3. CPR AND ACLS PROCEDURES

CARDIOPULMONARY RESUSCITATION (CPR) and first aid should be immediately available at every worksite. This capability is necessary to provide prompt (within 4 minutes) care for victims of cardiac or respiratory arrest, from any cause.

Employers may contact the local office of the American Heart Association, the American Red Cross, or equivalent groups or agencies, to set up a course for employees.

Provision should be worked out at each worksite to provide **ADVANCED CARDIAC LIFE SUPPORT (ACLS)** within 8 minutes (if possible), usually by calling an ambulance staffed by paramedics. Signs on or near phones should give the correct emergency number for the area, and workers should be educated regarding the information to give when the call is made. For large facilities, a prearranged place should be established for company personnel to meet paramedics in an emergency.

We are requesting that employers, worker representatives, editors of appropriate trade journals, and safety and health professionals assist in disseminating these recommendations to those individuals and organizations responsible for providing a safe workplace. Suggestions or questions related to this announcement should be directed to Mr. John Moran, Director, Division of Safety Research, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505-2888, telephone (304) 291-4595.

We greatly appreciate your assistance.

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REFERENCES

1. Centers for Disease Control: Leading Work-Related Diseases and Injuries--United States. MMWR 33:3-5 (1984).

2. National Fire Protection Association: National Electrical Code 1984, NFPA 70-1984. Quincy, MA: NFPA, 737 pp., (1983).

3. Wright RK, Davis JH. The investigation of electrical deaths: a report of 220 fatalities. Journal of Forensic Sciences, JFSCA 25(3):514-521 (1980).

4. Straatsma Glen W. Electrical shock syndrome. Alaska Medicine, pp. 129-130 (November 1973).

5. 1985 National Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC). Standards and Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC). JAMA 255(21):2905-2989 (June 1986).

6. Contributed by Mr. Edward J. Craren, Assistant Director, Emergency Medical Services, Nebraska Department of Health, Lincoln, Nebraska and Mr. Michael Dodge, Vice President, Eastern Ambulance Service, Lincoln, Nebraska.

7. National Institute for Occupational Safety and Health: Alert: Request for Assistance in Preventing Electrocutions of Workers in Fast Food Restaurants. Cincinnati, OH: DHHS (NIOSH) Publication No. 85-104, pp. 1-3 (December 1984).

NIOSH ALERT

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Request for Assistance in

Preventing Electrocutions Due to Damaged Receptacles and Connectors

October 1986

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

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REQUEST FOR ASSISTANCE IN PREVENTING ELECTROCUTIONS DUE TO DAMAGED RECEPTACLES AND CONNECTORS

WARNING!

PERSONS USING ELECTRICAL EQUIPMENT ARE CAUTIONED THAT THE USE OF DAMAGED RECEPTACLES AND CONNECTORS CAN BE EXTREMELY DANGEROUS.

SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) is requesting assistance in preventing the electrocution of workers due to the use of damaged electrical receptacles and connectors. Two recent incidents are described. Results of the investigations indicate that **periodic inspection**, **recognition of hazards**, and **proper use of receptacles and connectors**, and **prompt repair of damaged connectors and receptacles**, could prevent such incidents. Editors of appropriate trade journals, safety and health officials, and especially those who work with electrical equipment, are requested to bring these recommendations to the attention of owners, managers, and workers.

October 1986

BACKGROUND

Occupational electrocutions continue to be a serious problem throughout the United States. Data obtained from the Bureau of Labor Statistics' Annual Survey indicate that approximately 10% of all occupational fatalities are due to electrocutions. Those data, as well as other information collected by the National Institute for Occupational Safety and Health (NIOSH), demonstrate that fatalities due to electrocutions occur in a variety of ways. For example, previous NIOSH Alerts have described cases in which workers have been electrocuted as a result of contacting improperly grounded equipment, or when cranes or grain augers have contacted overhead power lines [1,2]. This Alert presents information on two fatal electrocutions that occurred as a result of using damaged receptacles and connectors.

Two investigations by NIOSH found evidence to suggest that the victims were unaware of hazards associated with the use of damaged connectors. In both cases, it was assumed that because a connector fit into a receptacle, the connection was proper and no hazard existed. The prevalence of this particular hazard is not clear. However, the cases described below point out the insidious nature of this hazard. The presence of receptacles and connectors in all workplaces, and the repetitive nature of their use (which in certain workplaces increases the possibility of damage) suggests that the potential hazard is widespread. These investigations also demonstrate that careful routine inspection and aggressive maintenance might well prevent such fatalities.

CASE REPORTS OF FATAL INCIDENTS

Case #1 - (ONE FATALITY)

On July 23, 1985, a 24-year-old employee of a textile mill was electrocuted when he **touched a loom frame** while performing his routine duties at the loom. The loom had become energized when an electrical, three-prong connector from a thread feeder machine was inserted into a damaged receptacle mounted on the loom. The damage to the receptacle permitted the ground prong of the plug to be improperly inserted into one of the phase terminals (90 degrees clockwise away from the appropriate ground terminal). This resulted in energizing the ground prong and the frame of the loom. When the worker touched the energized loom, he was electrocuted. It appeared, upon subsequent inspection, that the receptacle had been damaged because of a lack of adequate strain relief for the electrical cord from the thread feeder.

Case #2 - (ONE FATALITY)

On July 29, 1985, a 29-year-old welder was electrocuted when he inserted the "male" end of an electrical plug on a portable arc

welder into a broken "female" connector of an extension cord. As in the previous case, the victim inserted the ground prong of the welder cord 90 degrees clockwise away from the appropriate ground terminal of the extension cord, and the metal casing of the welder connector became energized. It appeared that the connector on the extension cord had been damaged by everyday use or abuse (being thrown down on and dragged across concrete floors, being run over by industrial equipment, etc.).

REGULATORY STATUS

Although, in these investigations the receptacles and connectors in these investigations were listed by a nationally recognized testing laboratory, the damaged state of the receptacles negated their conformance to these listings*, to the manufacturers' specifications, and to the safety features inherent in their design. NIOSH strongly urges periodic inspection and maintenance of electrical systems to assure compliance with applicable sections of the National Electric Code, OSHA standards, and other listing requirements. Electrical components should be used only in accordance with the manufacturers' specifications, and should be tested and approved by a nationally recognized laboratory (such as Underwriters Laboratory, Factory Mutual, etc.).

CONCLUSION

The investigations by NIOSH indicate that damaged receptacles may physically permit improper electrical connections to be made, negating the intended safeguards designed into them. Furthermore, workers may not recognize a hazard of electrocution associated with the use of worn or damaged receptacles and connectors. Electrical hazards of this sort are of particular concern because of the large number of users of electrical equipment in all kinds of workplaces. Investigations of such incidents suggest failures in the areas of **PROPER UTILIZATION OF ELECTRICAL COMPONENTS**, **HAZARD RECOGNITION**, and **PERIODIC INSPECTION AND MAINTENANCE OF ELECTRICAL SYSTEMS**. These basic safety activities are potentially lifesaving in preventing such incidents.

Caution should be used around **ALL** electrical circuits and equipment. The potential for electric shock should never be underestimated. Employers and other groups should regularly emphasize the safe use of electricity in the workplace. Continuous efforts must be made to prevent electrical injuries and deaths due to damaged receptacles and connectors.

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*A listing means that the piece of equipment has met the safety criteria established by the testing laboratory.

RECOMMENDATIONS

NIOSH makes the following recommendations in these areas:

1. **PROPER UTILIZATION OF ELECTRICAL SYSTEMS**

   All receptacles and connectors should be used only in accordance with the manufacturers' specifications, and the specific listing for the item as set forth by nationally recognized testing laboratories. Users should be advised of the importance of using receptacles and connectors only for applications for which they have been designed. When a component is selected for use, it should be evaluated to determine if it can tolerate the environment to which it will be exposed. Physical abuse and stress on these components should be minimized by the selection of a safe location and by the use of stress/strain relief devices.

2. **AWARENESS AND RECOGNITION OF HAZARDS**

   Policies that address the proper use of receptacles and connectors should be developed and implemented by qualified safety personnel. Safety training should emphasize awareness and recognition of electrical hazards associated with receptacles and connectors (i.e., broken receptacles and connectors, improper electrical connections, damaged cords, the importance of grounding, etc.). Immediate corrective action should be taken when damaged components or safety hazards are encountered. When safety policies and procedures are developed, they should be enforced.

3. **PERIODIC INSPECTION AND MAINTENANCE OF ELECTRICAL SYSTEMS**

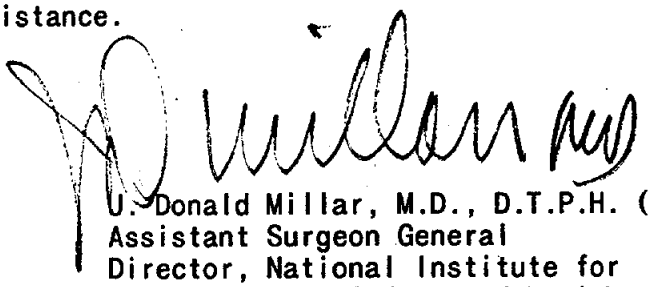
   Periodic inspections should be conducted for all electrical system equipment and components in order to identify all electrical hazards present. Records should be kept of any electrical hazards identified, and appropriate corrective action should be taken immediately. These periodic inspections should be supplemented with daily inspections by the personnel using this equipment.

We urge safety and trade associations interested in job site safety to bring these recommendations to the attention of employers.

Requests for additional information, and comments or questions concerning this announcement, should be directed to Mr. John Moran,

Director, Division of Safety Research, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505, Telephone (304) 291-4595.

We greatly appreciate your assistance.



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REFERENCES

1. NIOSH Alert: Request for Assistance in Preventing Electrocution from Contact Between Cranes and Power Lines. DHHS (NIOSH) Publication No. 85-111, National Institute for Occupational Safety and Health, 6 pages (1985).

2. NIOSH Alert: Request for Assistance in Preventing Grain Auger Electrocutions. DHHS (NIOSH) Publication No. 86-119, National Institute for Occupational Safety and Health, 4 pages (1986).

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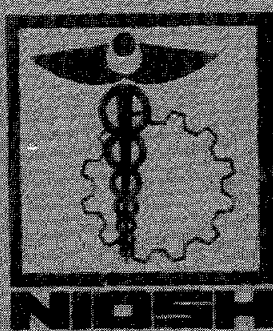

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