The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research NIOSH

Lathe Operator Electrocuted in North Carolina

FACE 87-29

Introduction:

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related and confined space-related fatalities. The purpose of the FACE program is to identify and rank factors that influence the risk of fatal injuries for selected employees.

On February 6, 1987, a lathe operator was electrocuted when he contacted the energized frame of a computerized lathe.

Contacts/Activities:

Officials of the Occupational Safety and Health Program for the State of North Carolina notified DSR concerning this fatality and requested technical assistance. This case has been included in the FACE Project.

On March 4, 1987, a DSR research team (a research industrial hygienist and a safety engineer) met with the compliance officer (who had conducted the investigation for the State) and a company representative. Comparison workers were interviewed.

Overview of Employer's Safety Program:

The employer in this incident is a division of a major corporation that manufactures turbo chargers for diesel engines. At the facility where the fatality occurred there are approximately 300 employees, consisting mainly of machinists with some assembly, maintenance, and office personnel. The employer has a written safety program and policy. The personnel manager is responsible for facility safety on a collateral-duty basis. (Approximately 10% of the manager's time is allocated to safety management.) The organization employs a plant safety officer at corporate headquarters. New employees are given a handbook which addresses general employee safety and company safety rules and regulations and receive basic plant safety orientation from the plant safety officer. New employees also receive on-the-job training from supervisors and co-workers for specialized procedures required in certain manufacturing processes. Machinists complete a comprehensive training program on design, maintenance, and operation of the various machines in the production area. A safety committee consisting of the plant safety officer, a plant management employee, and worker representatives meet monthly in order to address safety problems and to reinforce the safety policy.

Synopsis of Events:

In March of 1985 the corporation transferred an additional manufacturing process to the existing production area of the plant. In order to accommodate for the proposed increase in the plant electrical load, an electrical contractor was hired to install an additional 480Y/277 volt transformer at the power supply center inside the production area and a three-phase wiring system, also inside the production area. The wiring system was routed from the transformer through a metal busway (approximately 450 feet long) attached to the ceiling, 27 feet above the plant floor. In August, 1986, new lathe and mill machines were installed by a machine contractor representing the machine manufacturer. The machine contractor made electrical connections from each new machine to the individual switch boxes on the busway. On September 13, 1986, the electrical addition was completed and the busway system was energized. During the installation of the additional electrical system and machines, three grounding deficiencies occurred:

1. The electrical contractor failed to connect the “Z bar” or grounding conductor located inside the transformer cabinet to the grounding conductor in the busway which served the machines in the new production area of the plant.

2. The electrical contractor failed to connect the grounding conductor on the new transformer to building steel or to a grounded circuit conductor on the supply side of the electrical service disconnect.

3. The machine contractor connected the grounding conductor from the computerized lathe involved in this incident to the insulated neutral lug inside the switch box.

Any one of these grounding deficiencies interrupted the continuous ground for the lathe and the first two deficiencies interrupted the continuous ground for any of the other electrical equipment connected to this circuit. After installation, the machine contractor functionally checked the lathe and turned it over to the employer who began production in October, 1986. Until the time of the accident the employer was not aware that the grounding for this circuit was inadequate. There was nothing unusual about the electrical operation of any equipment connected to this circuit (according to machine operators, management, and other witnesses) and there were no reported incidents involving electrical shock from any of the new machinery. Some time prior to the accident (unbeknown to the employer until after the accident) a capacitor in the ungrounded lathe (between the frame ground and the lathe servo power supply) failed, energizing the frame of the lathe with 220 volts of electricity.

On February 6, 1987, at about 5:00 p.m. a computerized lathe operator (the victim) reported to work and continued the lathe operation being performed by the first shift lathe operator. The operation consisted of turning aluminum sand castings on two computerized lathes. The lathes faced each other with a four foot work space between them. The concrete floor between the lathes was covered with a 1/2 inch rubber mat. A pressurized 3/4 inch metal air line (at ground potential) ran vertically between the two lathes approximately eight inches from the inadequately grounded lathe. Although there were no eye witnesses, it is presumed that the victim’s hand made contact with the grounded metal air supply line while his other hand was in contact with the energized lathe frame. A few minutes later the victim’s supervisor was walking by when he noticed the victim lying face down between the two lathes. His right arm was touching the metal drip pan of the defective lathe beside the air pressure supply line. The supervisor received a slight electrical shock when he contacted the victim’s arm; so he grabbed the victim by the feet and pulled him away from the lathe.

Plant employees called the local emergency medical service rescue squad (EMS) and initiated cardiopulmonary resuscitation (CPR) on the victim until the arrival of EMS personnel, approximately eight minutes later. EMS personnel performed advanced cardiac life support (ACLS) measures, including defibrillation, at the scene. The victim was rushed to a local hospital where he was pronounced dead by the attending physician at approximately 6:00 p.m.

Cause of Death:

The medical examiner determined the cause of death to be cardiac arrest due to electrocution. Electrical burns were noted on the left side of the victim’s face.

Recommendations/Discussion:

Recommendation #1: The employer should ensure that electrical systems and each piece of equipment with an electrical connection within those systems have a permanent and continuous path to ground.

Discussion: Although the new electrical system and machines were installed by certified electricians from the electrical contractor and machine contractor, the employer should verify that each piece of electrical equipment has a proper equipment ground and that a continuous grounding path is maintained throughout the electrical system as required by 29 CFR 1910.304(f)(3) and (4) and the National Electric Code (NEC) 250-51. This could be accomplished by the employer implementing their own machine and electrical system ground maintenance program or through a program conducted by a qualified, independent electrical contractor.

Recommendation #2: State or local government agencies should implement and enforce an electrical inspection program to verify compliance with the National Electric Code or equivalent local regulations.

Discussion: Appropriate state or local governmental agencies should enforce electrical standards and prohibit the energizing of any newly constructed or modified electrical system until that system has been determined to comply with all applicable electrical standards (through an electrical inspection by authorized and qualified personnel). The modifications to the electrical system that ultimately resulted in this fatality were not inspected because this was not considered a new installation.

Recommendation #3: The computerized industrial lathe and other similar computerized machinery should be re-evaluated to identify possible electrical safety design modifications or the implementation of administrative controls for electrical safety.

Discussion: The computerized lathe in this incident was programmed to de-energize itself if the capacitor failed; however, this was dependent upon the presence of an adequate electrical ground. Because there was no continuous path to ground present when the capacitor failed, the frame of the lathe was energized and the lathe continued to operate. This present design should be re-evaluated to assure that any necessary design changes are retrofitted to prevent a reoccurrence of this type of accident.

Minimally the manufacturer should: 1) Emphasize to purchasing companies the importance of providing and maintaining a continuous electrical ground for any type of industrial machine. This could be accomplished through bold printed warnings in equipment operation manuals, warning tags attached to the power supply cord, etc.; 2) Verify that an adequate electrical ground is provided at the power source serving the machine and notify the purchasing company of any ground deficiencies encountered (if the machine manufacturer or representative of the machine manufacturer is also contracted to install the machine(s) as in this incident).

Recommendation #4: The electrical disconnecting means for each piece of equipment should be clearly and unmistakenly identified.

Discussion: Each machine in the production area has an individual over-current protection device inside a manual disconnect switch box attached to the busway approximately 27 feet above the plant floor. Several switch boxes were inadequately labeled and clustered so closely together that it was not apparent as to which machines they served. Each switch box should identify the machine it controls and should be located so that electrical current to any machine can be quickly and easily disconnected in the event of an emergency (in accordance with 29 CFR 1910.303(f) and NEC 110-22).

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