The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Worker Electrocuted in South Carolina

FACE 87-18

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 October 21, 1986, a worker was electrocuted while steam cleaning a rubber mill. The rubber mill had an on/off switch which was not watertight. Steam entered the switch and energized the outer surface of the switch and the rubber mill. The victim was holding the steam cleaner's wand in his hand and standing in water when the wand contacted the electrically energized rubber mill. The victim's body provided a path to ground and he was electrocuted.

Contacts/Activities:

Officials of the Occupational Safety and Health Program for the State of South Carolina notified DSR concerning this fatality and requested technical assistance. This case has been included in the FACE Project. On December 12, 1986, a DSR research team conducted an evaluation of this accident. The investigation began with an interview of the collateral-duty safety director for the company. FACE survey instruments were completed for the victim and two comparison workers. Discussions were also held with the OSHA Compliance Officer. The safety director of the company and the DSR research team visited the accident site. Photographs were taken of the accident site and the equipment being used by the victim at the time of the accident.

Background/Overview of Employer's Safety Program:

The company has been in operation since 1949, but has been under the present ownership for only one year. The company has a written corporate safety policy that is communicated during new employee orientation and is on file for reference by employees. This manual states that the

"Supervisor is responsible for the safety and loss control of his/her employees" and "Each employee is responsible for his/her own safety, the safety of others working with him/her and for the proper care of equipment and quality of the product." The manual further states that employees shall "Shut down your machine before cleaning, adjusting, or repairing, and lock and tag the machine." The company has a lockout and tagout procedure, but it does not mention steam cleaning.

Training of new employees is performed on-the-job by a foreman or experienced employee. The company requires respirators for employees who are exposed to toxic dusts and vapors and supplies hearing protection to workers who are exposed to noise levels over 90 dba. Periodic auditory and respiratory examinations are given to employees.

Synopsis of Events:

At approximately 2:30 a.m., Tuesday, October 21, 1986, a laborer was steam cleaning a rubber mill machine. A rubber mill is a machine which uses large rollers driven by electric motors to convert bulk rubber materials into flat strips that can be formed into tires. The rubber mill is powered by 440 volts supplied through a nearby breaker panel, and is also equipped with an on/off switch mounted on the rubber mill. The steam cleaning machine is a portable device consisting of a motor, a heater, a water tank, and a pump mounted on a metal frame with rubber wheels. A wand on the steam cleaning machine, which is held by the operator, is used to direct pressurized steam for the cleaning operation. Although the steam cleaner is a portable device, designed to plug directly into an appropriate power source, the male electrical plug on the steam cleaner was not compatible with an existing female receptacle located within reach of its power cord. Therefore, the steam cleaner was wired directly into one of several nearby breaker panels. Preliminary investigations by OSHA and company management indicated that the steam cleaning machine had been properly wired into the breaker panel and the method of supplying power to the machine was not implicated as a contributing factor to the accident.

While the victim was cleaning the rubber mill, steam entered the switch and condensed forming water, which partially filled the on/off switch. This water short circuited the switch and energized the frame of the rubber mill. The on/off switch, which was not designed for wet or damp locations, was incapable of preventing the steam and/or water from reaching electrical components inside the on/off switch. As the victim continued cleaning the rubber mill, he apparently contacted the energized rubber mill with the wand of the steam cleaner. Since the wand on the steam cleaner was made of conductive metal components, contacting the energized rubber mill with the wand provided a path for current to pass through the victim's body to ground. Although the on/off switch was in the off position during the steam cleaning operation, power to the on/off switch was not de-energized at the breaker panel. Thus, the on/off switch box and the rubber mill became energized as it filled with steam during the cleaning of the rubber mill. The victim was standing in water and was not wearing insulated gloves or boots when the accident occurred. This was the first time the victim had operated the steam cleaning machine.

The foreman discovered the victim lying on the floor with the steam cleaning wand in his hands. The foreman removed the wand from the victim's hands, yelled for help from co-workers and went to summon the emergency medical service. When the foreman returned, co-workers were administering cardiopulmonary resuscitation (CPR). Co-workers administered CPR for fifteen minutes until the emergency medical squad arrived. The victim was pronounced dead at a local hospital two hours later.

Cause of Death:

The death certificate lists the cause of death as electrocution. The victim had electrical burns on his right wrist and on the naval area of the stomach.

Recommendations/Discussion:

Recommendation #1: The employer should ensure that employees have been instructed on the operation and safe work practices for all machinery and equipment they are required to operate.

Discussion: This was the first time the employee had used the steam cleaning equipment. Employees must be made aware of and follow safe job procedures as defined in the company's safe job manual. It is the responsibility of the employer to instruct employees in safe work practices associated with using steam cleaners around electrical equipment.

Recommendation #2: A procedure for ensuring that the rubber mill will be locked-out and tagged-out at the breaker panel should be instituted.

Discussion: Locking-out the breaker panel would have de-energized the electrical components inside the on/off switch. The machinery or equipment being cleaned should also have been locked-out and tagged-out to prevent electrical shock or inadvertent start-up of the rubber mill during steam cleaning.

Recommendation #3: If steam cleaning of the rubber mill and other equipment is to continue, this equipment should be modified to meet all requirements of the National Electrical Code that apply to the use of electrical equipment in damp or wet locations.

Discussion: Since the on/off switch was not suitable for wet or damp locations, steam and/or water was able to enter the switch and energize the frame of the rubber mill during the steam cleaning operation. An on/off switch suitable for use in wet environments would reduce the possibility of water entering the box and providing an electrical path to the outside of the box.

Recommendation #4: The hand-held wand on the steam cleaner should be insulated or made of non-conductive materials.

Discussion: The hand-held wand was constructed of conductive material which allowed current to flow down the wand and through the victim. An insulated or non-conductive wand should be provided to reduce the risk of electrical shock to workers.

Recommendation #5: Specific safe procedures for steam cleaning operations should be developed and the steam cleaning machine should be clearly marked to warn that fatal injury can result if the equipment is used to clean equipment which has not been electrically de-energized.

Discussion: This was the first time that the rubber mill had ever been steam cleaned. It appears that the injured employee was unaware that water can introduce paths to ground from energized electrical components.

Return to In-house FACE reports

Last Reviewed: November 18, 2015