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TO: **Director, National Institute for Occupational Safety and Health**

FROM: **Division of Safety Research, NIOSH**

SUBJECT: **Maintenance Electrician Dies From Crush Injuries When Caught Between Nip Barrier and Upper Frame of Paper Rewinder -- Virginia**

SUMMARY

On April 18, 1997, a 37-year-old male maintenance electrician (the victim) died when his lower torso was crushed between the nip barrier (a wire-mesh gate) and the upper frame of a paper rewinder machine at a paper-manufacturing facility. Without first de-energizing, locking out, and tagging the machine, the victim began to replace the arm for the limit switch that controlled upward movement of the nip barrier. He climbed an 8-foot stepladder to access the top of the machine where the switch was located, and leaned into the 16-inch opening between the top of the nip barrier and the upper frame of the machine. Co-workers observed him reaching with a screwdriver into the area where the switch was located. Apparently he inadvertently activated the limit switch and the nip barrier raised, carrying the victim and the stepladder upward and compressing both between the nip barrier and the upper frame of the machine. The victim's waist to lower back area was crushed. A co-worker paged the plant safety watchman, who contacted the rescue squad. The rescue squad arrived within 2 minutes, and the victim was pronounced dead at the scene. NIOSH investigators concluded that, in order to prevent similar incidents, employers should:

- *ensure that maintenance workers follow established lockout/tagout procedures for control of hazardous energy*
- *conduct regular worksite evaluations to ensure adherence to established procedures for control of hazardous energy*
- *train production workers and other non-maintenance workers to recognize potential workplace hazards and participate actively in workplace safety.*

INTRODUCTION

On April 18, 1997, a 37-year-old male maintenance electrician (the victim) died when his lower torso was crushed between the nip barrier and upper frame of a paper rewinder machine as he was

replacing a limit switch arm. On June 19, 1997, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On July 21, 1997, a DSR investigator visited the incident site and interviewed the company manager of safety and industrial health. The incident was reviewed with the VAOSHA compliance officer assigned to the case. Photographs of the incident site, descriptions of the company's safety program and lockout/tagout policies, and a copy of the lockout/tagout procedure for the paper rewinder were obtained. An identical machine was observed in operation and photographed.

The incident occurred at a paper-manufacturing facility, employing approximately 1,000 workers, which produced finished paper from raw materials. The mill had been in operation at this site since 1918, changing ownership 5 weeks after the incident occurred. Under both old and new ownership, the employer maintained a comprehensive written safety program that included hazard communication, lockout/tagout training, and regular safety meetings. Lockout/tagout procedures required for each machine were computerized and available in each work area.

The victim had worked for the company for about 8½ years. His job duties included electrical and instrument troubleshooting, repair, and maintenance for all machines in the mill. He began as a trainee, assuming progressively more responsibility as he acquired expertise and experience. This was the company's first fatality since the safety and health manager began work at the plant in 1989. The safety manager reported that there had been two separate fatalities at the mill early in the 1980s.

INVESTIGATION

The facility operated on three 8-hour production shifts with weekly rotating swing shifts. The incident occurred as the victim was working the 3 p.m. to 11 p.m. shift. The previous week, he had worked the 11:00 p.m. to 7:00 a.m. shift, finishing work at 7:00 a.m. Wednesday and beginning work on the afternoon shift at 3:00 p.m. on Thursday. The incident occurred on a Friday, the victim's second day on the afternoon shift.

The paper rewinder takes large rolls of paper, cuts them to customer specifications, and rewinds the paper onto smaller rolls. It is approximately 27 feet wide with an opening in the front of the machine through which a finished roll of paper is ejected. At the time of the incident, the finished paper roll on the machine was 58 inches in diameter, 256 inches wide, and weighed about 25 tons. The front of the machine is guarded by the nip barrier, a wire-mesh gate which remains lowered as the paper is wound. A 28-inch-wide concrete walkway 24 inches above floor level runs the entire width of the front of the machine, and is accessed by three

steps located on the far right of the machine. Operating controls for the machine are mounted on the right front of the machine. A floor-mounted console adjacent to the right side of the machine houses power controls. Positioned above the paper roll is the rider roll, a metal cylinder the width of the machine that rises as the paper is wound and activates a limit switch when the paper roll is the desired diameter. Below the paper roll is the roll kicker, which ejects a finished roll of paper onto a ramp called a cradle. A manually operated lever at the right front of the machine tips the cradle forward, lowering the roll to the floor.

The rewinding process is performed by a three-person crew, and may be carried out with the machine set in automatic or manual mode throughout, or in a combination of the two modes. Using a crane, the roll of paper to be rewound is positioned at the rear of the machine. The nip barrier is lowered at this time. One of the crew threads the paper on the rewinder reel, and sets the slitter blades to the proper size. The paper begins to wind from one roll to the other. When the new roll is complete, the rider roll activates the limit switch located at the top right front of the machine. The nip barrier raises and the roll kicker ejects the roll onto the cradle. The nip barrier then lowers, and the roll is lowered to the floor by tipping the cradle forward. The cradle is returned to an upright position and the process is repeated.

The machine operator (the 3rd hand) and two helpers (the 4th and 6th hands) were in the immediate area at the time of the incident. Shortly before 8:00 p.m., the victim was called to the paper rewinder because the nip barrier would not raise to allow ejection of the finished roll. The 3rd hand raised and lowered the cradle, then tried the roll ejector button with the machine set alternately in manual and automatic modes, but the barrier would not raise to allow ejection of the roll. The 3rd hand then called the maintenance staff on the pager phone.

The victim arrived at the site and tried similar measures to get the roll to eject, but was unsuccessful. He moved the nip barrier up and down with the machine in manual mode, then told the 3rd hand that the limit switch that signaled the barrier to raise was defective. He left the area to find a replacement arm for the limit switch. He returned with an 8-foot fiberglass stepladder, and placed it on the far right portion of the elevated walkway, leaning it against the nip barrier with the lip of the ladder hanging just over the top edge of the barrier. At this time, the nip barrier was in the lowered position, and there was approximately 16 inches of clearance between the top of the barrier and the steel beam that formed the upper frame of the machine. The victim climbed the ladder, then realized he had the wrong part. He left the area, returned with another part, and climbed the ladder again.

When the victim had left the area to get the part, the 3rd hand had moved behind the rewinder to operate the crane. However, the 6th hand and the 4th hand were standing approximately 12 feet in front and to the right of the victim's position. The 6th hand observed the victim standing on the third or fourth rung of the ladder, holding a screwdriver in his right hand. He was leaning into the 16-inch opening between the nip barrier and the machine's upper frame, with his waist level with the top of the barrier. The 6th hand saw the victim make a forward motion with the screwdriver. The nip barrier immediately raised, catching the victim and the stepladder, lifting and compressing both between the nip barrier and the upper frame. The victim's waist to lower back area was crushed. The 6th hand ran to the machine and attempted unsuccessfully to lower the barrier. The EMT-trained safety watchman on the shift was summoned by phone. He immediately radioed for the rescue squad, which arrived in less than 2 minutes. The victim was pronounced dead at the scene.

CAUSE OF DEATH

The cause of death was recorded as crush injury to the chest and abdomen.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that maintenance workers follow established lockout/tagout procedures for control of hazardous energy.

Discussion: A computerized listing of steps for locking out and tagging equipment prior to maintenance or repair was available for each machine in the facility. The company's written safety policy assigned initial responsibility for de-energizing, locking out, and tagging machinery to the production department responsible for the machinery. Any other person working on or inspecting the equipment was also to affix a personal lock and tag. However, none of the 20 lockout/tagout steps required for the paper rewinder was carried out by maintenance or production workers. The same 20 steps were required regardless of the maintenance work to be performed. They included locking out all fans and motors, hydraulic pumps, air valves, and machine parts such as the rolls and slitter. The 13th step in the process, de-energizing the main hydraulic pump which moved the nip barrier, was probably most directly associated with the incident.

The employer's lockout/tagout policy booklet stated that it was the company's responsibility to inform and train workers in lockout/tagout procedures and to supervise work practices to assure that these procedures were followed. However, the policy booklet did not include a discussion of disciplinary actions to be taken if the procedures were not followed. The company had adequate

lockout/tagout procedures in place, but the extent to which the policies were enforced is unclear. If in the judgement of company safety personnel the steps required to de-energize the rewinder were unnecessarily time-consuming or complicated, the employer might have reconsidered requiring all 20 steps in every instance. A simpler procedure may have provided greater incentive for compliance. The great advantage of the current procedure, however, is that if carried out and enforced, it ensured that both maintenance and production workers were protected from all possible sources of hazardous energy.

Recommendation #2: Employers should conduct regular worksite evaluations to ensure adherence to established procedures for control of hazardous energy.

Discussion: There were normally 17 maintenance personnel working each shift under the supervision of the maintenance foreman, who was responsible for all maintenance activities in the facility. In the past 6 months, the victim had been counseled for two violations of safety policy, one of which involved lockout/tagout. Although the task being performed by the victim was simple, increased supervisory monitoring of his work may have been warranted in this instance, given the potential consequences of non-compliance with lockout/tagout procedures. Since the incident, the employer has taken steps to increase supervisory presence in production areas.

Recommendation #3: Employers should train production workers and other non-maintenance workers to recognize potential workplace hazards and participate actively in workplace safety.

Discussion: In this incident, both the machine operator and the victim deviated from company policy by not following established lockout/tagout procedures. Neither of the crew members who witnessed the incident questioned why the machine was not de-energized. The crew members apparently assumed that in the victim's judgement, the task could be performed safely without de-energizing the machine. While production workers need not understand maintenance procedures in detail, they should have sufficient knowledge about machine functions to recognize hazards such as those present in this incident. Production workers should be trained to recognize the potential for inadvertent movement of machine parts if hazardous energy is not controlled, and to alert supervisors and other workers if hazardous conditions exist.

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Fatality Assessment and Control Evaluation (FACE) Project

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (FACE) investigations when a participating State reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

States participating in this study: North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

Additional information regarding this report is available from:

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