DATE: February 11, 1993

FROM: Minnesota Fatality Assessment and Control Evaluation (MN FACE) Project
Minnesota Department of Health

SUBJECT: MN FACE Investigation MN9220
Zoo Maintenance Worker Dies After a 400-Pound Cage Falls on Him

SUMMARY

A 42-year-old zoo maintenance worker (victim) was fatally injured when a 400-pound birdcage assembly, mounted on a 60-foot pole, free fell and hit him as he was installing an electrical limit switch near the bottom of the pole. The victim was working alone, using no personal protective equipment, and had elevated the cage assembly to an unknown height. The cage assembly was not blocked (supported from underneath by means of a block) at the time of the incident. The zoo planned to use the pole and cage unit as part of a bird show. During the show cages would be elevated to the top of the pole using a remote control device and then the birds would be released. Limit switches were being installed at the top and bottom of the pole to automatically stop the cage platform after ascending or descending. It was determined after the incident that the cage fell because of a gear failure in the pole's motor/winch assembly. The victim, who never regained consciousness, suffered a cardiac arrest and spinal injuries from the blow of the cage. He died 107 days after the incident. MN FACE investigators concluded that, in order to prevent similar occurrences, the following guidelines should be followed:

> heavy elevated structures should be blocked when it is necessary for employees to work beneath them;

> hard hats should be worn in construction work areas when there is a possibility of items falling from above; and

> manufacturers should establish a rigorous maintenance/monitoring schedule for critical parts of equipment which may be affected by equipment modification.

INTRODUCTION

MN FACE was informed of a work-related construction fatality on October 14, 1992, by MN OSHA personnel. This incident had been reported and listed as a serious injury for three and one- half months prior to the victim's death. The victim's employer was contacted, and a site investigation was conducted on November 12, 1992. Police and coroner reports were requested.

The victim had worked as a zoo monorail maintenance worker for 13 years. Though not part of his assigned job duties, he decided to install a limit switch on the pole one morning. The zoo employed a full-time safety officer. Written safety rules and procedures and various types of safety training, including classroom instruction, manuals, and videos, were provided for employees.

INVESTIGATION

Two poles, one 60 feet high and one 100 feet high, were being assembled at a zoo under the supervision of the pole manufacturer. The poles were originally designed for supporting highway lights but were being modified for zoo purposes. The zoo planned to use the pole structures to raise and lower platforms supporting birdcages for a zoo show. As originally designed, lights were attached to a collar around the pole which could be raised and lowered with a 1 horse power (hp) motor/winch assembly within the pole structure for light replacement. The collar's travel speed with this motor was 12 feet per minute. The pole structure's lifting capacity was 1200 pounds. In the event of a power failure, the pole was equipped with an electromagnetic braking mechanism, which held the pole collar in place with a spring device. In addition, a 72:1 ratio gear train in the winch assembly allowed only a slow descent of the collar if the electromagnetic brake failed. The gear train consisted of a large cast iron gear and a small steel gear. The purpose for which this system was designed, highway light replacement, was expected to be infrequent, perhaps twice per year.

For the zoo's purposes, the platforms would be raised and lowered and the bird cage doors would be opened with a remote control device. The pole manufacturer modified each pole collar to support two large flat platforms, each of which supported four birdcages. The total weight of the cage assemblies lifted by each pole structure was 400 pounds. To increase the collar's travel speed the pole manufacturer suggested replacing the 1 hp motor with a 1 1/2 hp motor and this change was implemented. The zoo expected to use the poles in its show four

times a day, seven months per year.

Zoo personnel were installing limit switches on the poles to automatically stop the cage assemblies at the top and the bottom of the poles. Even though it was not an assigned task, the victim decided to install the bottom limit switch on the 60-foot pole. He proceeded to the site and entered the fenced and locked compound. Because the pole was still under construction, there was no lockout system in effect at this time, and several employees still had keys to enter the area. The compound did, however, prevent public entrance into the construction area. Plans for lockout after construction included installing a switch on the compound gate, which would render the pole inoperable if opened.

He raised the cage assembly to an unknown height and began installing the switch approximately 51 inches above the ground. He did not block the cage assembly to prevent it from falling. He had, however, cut power to the pole after raising the platform. It appears he was relying on the gear mechanism to prevent slippage of the cage assembly, because he noted in his log book that day that the brake had burned out. Evidence and reconstruction of the incident by the zoo's health and safety supervisor and other employees working on the project indicated that the victim had installed a portion of the limit switch parts and drilled two holes for continuation of the attachment procedure. While tapping the top hole the tap broke; the broken tap remained in the hole after the incident. At this point, the cage assembly free fell and landed on top of him. A corner of one cage platform hit the back of his head and the remainder of his body was trapped beneath it. The zoo health and safety supervisor estimated that, had the 400-pound cage been at the top of the pole, it would have completed its fall in approximately 1.4 seconds.

Other employees, approximately one-quarter mile from the pole site, heard a whirring sound and then a loud crash. They looked in the direction of the sound with binoculars and noticed that the pole's cage assembly had fallen to its base. They arrived at the site approximately 8 minutes later to investigate and, upon discovery of the victim, immediately radioed the dispatcher for first aid and ambulance help. Eventually enough people were on site to lift and block the cage assembly off of the victim; he was extracted and airlifted to a hospital. He suffered spinal cord injuries from the blow to his head and a cardiac arrest from compression under the cage assembly. He never regained consciousness and died 107 days after the incident.

Testing by a private company later showed that the pole's large cast iron gear of the

motor/winch assembly had failed. All of its teeth had been worn or sheared off to an almost smooth surface; the cage assembly's free-fall occurred as a result. Inspection of the same gear on the 100-foot pole showed similar wear. Gear damage to both poles had occurred during, at most, 12 uses. The zoo's health and safety supervisor informed MN FACE investigators that further testing showed that the cast iron gear's tensile strength was not up to specifications.

CAUSE OF DEATH

The cause of death listed on the death certificate was respiratory arrest due to or as a consequence of sleep apnea due to or as a consequence of closed head injury.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Heavy elevated equipment should be blocked when it is necessary for employees to work beneath it. This recommendation is in accordance with Minnesota Rules 5205.0670 - Blocking and Cribbing Machinery.

Discussion: The height of the cage assembly before it free fell onto the victim could not be determined. The minimum cage assembly height necessary for the victim to easily and effectively install the limit switch (the height at which the bottom collar ring was clear of the limit switch position) was approximately 55 inches. At this height, blocking of the assembly was possible and could easily be accomplished by, for example, placing sturdy wooden beams underneath the bottom collar ring to ensure that it remained stationary. The pole's manufacturer could have, in addition, provided a means of blocking the collar (e.g., pin in hole arrangement) during initial pole design.

Recommendation #2: Hard hats should be worn in construction work areas when there is a possibility of items falling from above. This recommendation is in accordance with 29 CFR 1910.132(a).

Discussion: Hard hats should be worn by persons in construction areas for protection against head injury. Though a hard hat may not have altered the end result in this situation, guidelines for safe work practices should be followed by employees and enforced by employers to avoid the specific hazards of each work environment.

Recommendation #3: Manufacturers should establish a rigorous maintenance/monitoring

schedule for critical parts of equipment, which may be affected by equipment modification.

Discussion: Pole modifications made for the zoo's anticipated use included installation of a larger (1 1/2 hp) motor for increased speed, different platforms for supporting the bird cages, and dramatically increased use. This was the first instance of pole modification for any purpose other than that which they were designed for. Brakes had burned out previous to the incident on both the 100-foot and 60-foot poles. Considering the modifications and these difficulties, regular monitoring of critical equipment parts for signs of wear and damage would have been an advisable safe work practice.

REFERENCES

1. Minnesota Labor and Industry, Occupational Safety and Health Standards, Chapters 5205, 5206, 5210, 5212, Extract from 1991 Minnesota Rules. 5205.0670. St. Paul, Minnesota.

2. Office of the Federal Register, Code of Federal Regulations, Labor, 29 CFR Part 1910.132(a), U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., July 1991.