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PUBLIC HEALTH SERVICE/CDC/NIOSH/DSR
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TO: **Director, National Institute for Occupational Safety and Health**

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

SUBJECT: **16 Year-Old Ride Attendant Dies After Being Caught and Dragged By Amusement Park Ride – Connecticut**

SUMMARY

On August 20, 1999, a 16-year-old amusement-park-ride attendant (the victim) died after he was caught and dragged by an operating amusement ride. The victim and a ride operator had been assigned to work a ride known as the Tornado, which operated in a darkened enclosure. While the ride was operating at full speed, the victim attempted to board one of the passenger seats. As he jumped on the seat step, he lost his balance and fell. He was caught by the ride and dragged across the concrete floor. The ride operator observed the victim fall and immediately activated the emergency stop control and applied the emergency brake. She was able to stop the ride quickly, but not before the victim had been dragged about half-way around the ride's operating circle. Immediately after the ride came to a stop, the ride operator called the park's emergency number, reported the incident, turned on the lights, and went to the victim. Park emergency personnel arrived at the ride in less than a minute. Park patrons who had been on the ride were escorted out of the ride enclosure by coworkers who had been on the ride at the time of the incident. Park emergency personnel notified the local police, the emergency medical service (EMS), and the fire department. These agencies responded within 4 minutes. The victim was recovered by firefighters and treated by the EMS. He was removed from the enclosure and airlifted to a local emergency room. He died the next day as a result of his injuries.

NIOSH investigators concluded that, to help prevent similar occurrences, amusement park owners and operators should:

- *ensure that their facilities are fully compatible with monitoring procedures for detecting and correcting unsafe work habits or conditions;*
- *develop safety policies and implement training programs that define direct links between unsafe behavior and the potential for injury;*
- *emphasize to workers the importance of reporting unsafe conditions or practices to management; and*

- *consider the use of engineering controls to reduce or eliminate worker exposure to moving machine parts.*

INTRODUCTION

On August 20, 1999, a 16-year-old ride attendant (the victim) at an amusement park was caught and dragged by the ride he was assigned to attend. On August 23, 1999, officials of the U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division notified the Division of Safety Research (DSR) of the incident, and requested technical assistance. Officials of the Connecticut Department of Labor. Wage and Workplace Standards Division also contacted NIOSH requesting technical assistance. On August 31, 1999, a DSR Safety Engineer met with the OSHA Area Director and investigative staff assigned to the case. Their initial findings were discussed. On September 1, 1999, the safety engineer, and an epidemiologist from the National Center for Injury Prevention and Control (NCIPC) traveled to the amusement park where they met with representatives of the Connecticut Department of Labor and the park's operations manager. Although the park was closed, the ride was demonstrated by park maintenance staff and photographs and measurements of the ride facility were collected. The employer's safety policy, training program, and investigative findings were reviewed with the operations manager.

The 332-acre amusement park had been in operation for 154 years prior to the incident. During that time, the park had been operated by several different companies. The victim's employer had been operating the park since 1996 with a year-round staff of 35 and a seasonal staff of 748 workers from May to September. Of the seasonal workers, 528 were under the age of 18. The employer also operated two other parks in another state. This was the employer's first fatality.

The employer had developed and implemented a written safety plan including safe work procedures, training, a point-based disciplinary system, and a program of work place observation. Employees received between 6 and 8 hours of combined formal and job-site training prior to being assigned work tasks. Written tests were administered to evaluate the effectiveness of the training and to verify that employees knew and understood safe procedures. The safe work procedures, training, and tests addressed the designated safe areas for ride attendants and operators to position themselves during ride operation, along with prohibitions against entering platforms or ride circles of operating rides. The employer had established minimum age policies for specific job tasks. For example, ride operators had to be at least 18 years of age, while ride attendants were required to be at least 16. Ride attendants were responsible for ensuring patron safety, greeting guests, and working with ride operators to ensure the smooth, efficient and courteous operation of all rides. The point-based disciplinary system included four levels of disciplinary action leading to dismissal after the accumulation of 8 points. Points were given for various infractions of company policy relative to guest relations, absenteeism, and violation of safety rules.

This was the victim's first working season at the park. He had successfully completed all training and testing for the position of ride attendant and had accumulated no disciplinary points.

INVESTIGATION

The Tornado is a flat ride which rotates around a center pole (see figure 1). The 1960's-vintage machine, originally designed and built as a portable ride for traveling carnival operations, had been permanently installed on a concrete pad. A year before the incident, the ride had been upgraded with the addition of a computer-controlled audio-visual effects system and covered with an igloo-like enclosure. Extending from the center pole are three arms, or main sweeps. A set of four shorter seat sweeps is mounted on the end of each main sweep. A three-passenger seat is mounted at the end of each of the shorter sweeps. Power for the ride is furnished by an electric motor mounted outside the enclosure and connected to a gearset on the ride's center pole by a shaft running in a covered trough in the concrete floor. Each set of seat sweeps is driven by another gearset mounted at the end of each main sweep and connected to the center-pole by a shaft mounted on the main sweep. During operation, the main sweeps rotate clockwise while the seat sweeps rotate counterclockwise. This counter-rotation causes each seat to trace a star-shaped pattern back and forth across the ride's operating circle. The counter-rotation also causes the speed of the seat's movement to constantly change. The seat accelerates from zero at the outside of the circle to a speed of about 25 mph by the time it crosses the main sweep near the center of the circle. As the ride continues to rotate and the seat moves outward, its speed decelerates reaching zero at the circle's outside edge. This instantaneous stopping of the seat's movement at the outside of the circle is clearly visible. During the 90-second ride cycle, the enclosure is darkened and flashing lights, music, and fog are combined with the ride's motion to mimic the effect of an actual tornado. The effects are synchronized with the operating cycle of the ride so that certain effects occur during startup, full speed, and slow down.

The ride is staffed by a ride operator and a ride attendant. The ride operator controls the ride from a control room adjacent to the ride area. The ride attendant assists guests to board and dismount the ride, ensures that the passenger restraints of each seat are safely secured before signaling the operator to start, and observes the ride for problems such as guests attempting to stand up. While the ride is rotating, the attendant stands inside or adjacent to the control room to observe the ride. A yellow warning line painted on the floor across the entrance to the ride area delineates the safe area for the attendant to stand while observing the ride's operation. Prior to starting the ride, the entrance door to the ride enclosure is locked to prevent patrons from wandering into the ride area.

On the day of the incident, the victim worked the 12:00 p.m. to 8 p.m. shift. He performed as ride attendant at a small roller coaster for about 45 minutes and then worked at the Tornado. The victim worked several other rides throughout the afternoon and returned to the Tornado at about 4:00 p.m. Shortly before 4:45 p.m., two co-workers who were on break arrived at the Tornado and discussed work assignments for the rest of the evening with the victim. While there, the coworkers decided to go for a ride. They boarded one of the seats and the ride was started. At this time, the victim, acting as ride attendant, had entered the control room and was standing next to the ride operator as the ride cycle continued. As the ride was nearing the end of its cycle and was about to begin slowing down, the victim left the room, entered the walkway around the circle, and walked clockwise to a location about 30 feet from the control room. The ride operator and both of the riding coworkers observed the victim attempt to board one of the seats as it instantaneously stopped at the outside of the circle.

As he grabbed the side of the seat and placed his foot on the seat step he lost his balance and fell. He was caught by the seat and dragged across the concrete floor. The ride operator immediately activated the emergency-stop button and applied the manual emergency brake. However, the victim, caught under the seat sweep and between the seat-unit pedestal shaft and the floor, was dragged about half-way around the ride circle before the ride stopped. Once the ride had stopped, the ride operator called the park's emergency number to request assistance, turned on the lights in the enclosure, and went to the victim while the riding coworkers dismounted their seat and evacuated the guests from the enclosure. Park emergency personnel responded in under a minute. Local fire and emergency personnel were notified and arrived within 4 minutes. The victim was recovered by firefighters and removed from the ride enclosure by the EMS. By this time, a helicopter from the local hospital had responded to the park, and the victim was air lifted to a local hospital emergency room. He died the next day from his injuries.

CAUSE OF DEATH

During the incident, the victim suffered a laceration of the heart, lacerations and contusions of the lungs, and a fractured pelvis. The medical examiner attributed the victim's death to blunt force trauma.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Employers should ensure that their facilities are fully compatible with monitoring procedures for detecting and correcting unsafe work habits or conditions.

Discussion: During the investigation, it was learned that there had been previous instances when ride attendants had boarded the ride while it was operating. On these occasions, the ride had been coasting to a stop and was therefore not operating at full speed when the boarding attempt was made. It is not known to what extent this behavior was practiced, and the employer had been unable to detect it prior to the incident. The employer in this incident had implemented an extensive training and testing program to ensure that employees knew, understood, and followed safe procedures. Adult management staff continuously patrolled the park observing ride operation. However, the ride in the incident was contained in a windowless enclosure and the doors were locked from the inside to prevent patrons from entering while the ride was operating. There were a limited number of keys available to management which may have significantly affected park management's access to the facility to monitor and evaluate normal work habits inside the darkened enclosure.

A consulting agency had been contracted to observe and report on employee conduct and work procedures. Representatives of the agency observed ride operation while posing as patrons. While this activity was primarily focused on ensuring the safety and satisfaction of customers, issues of unsafe employee behavior may also have been reported. However, an interval of several weeks usually elapsed from the time of the observations until the reports were received by park management. Monitoring procedures for difficult work areas (such as those which must be secured against outside entry) could be improved by careful selection of enclosure layout and equipment. Viewing rooms,

accessible only from outside of the ride enclosure and without connecting inner doorways, would allow ready access for work place observation while still protecting against inadvertent entry into the ride's operating area. Alternatively, closed circuit television systems could be used to provide continual monitoring of the work area.

Recommendation #2: Amusement park operators and employers should develop safety policies and implement training programs that define direct links between unsafe behavior and the potential for injury.

Discussion: The written safety policy and training program implemented by the employer in this incident was comprehensive in its description of safe work procedures and company policy. The safety policy clearly stated that observed unsafe work behavior would result in disciplinary action. However, the cause and effect relationship between unsafe work behavior and the risk for injury was not so clearly or completely defined. Researchers have noted that risk taking is a normal facet of adolescent development, providing opportunities for learning and developing an appreciation for the consequences of specific behavior.[1] Policies and training programs defining a direct link between unsafe work practices and injury consequences in addition to disciplinary action may increase an adolescent worker's capacity to recognize unacceptable risks.

Recommendation #3: Amusement park operators and employers should emphasize to workers the importance of reporting unsafe conditions or practices to management.

Discussion: Employees may be reluctant to report unsafe work practices to management when it involves a co-worker. This may be especially true for workers under 18 who, influenced by a misplaced sense of loyalty, may not fully comprehend the importance of protecting their peers from serious injury instead of disciplinary action.[2] Employers of youth should take extra steps to encourage reporting of all unsafe acts. Employees should be continually reminded that shielding a coworker from disciplinary action may result in serious injury.

Recommendation #4: Amusement park owners and operators should consider the use of engineering controls to reduce or eliminate worker exposure to moving machine parts.

Discussion: The employer in this incident had adopted a policy that prohibited persons from entering the walkway around the amusement ride while it was operating. This policy had been implemented through a training program and by identifying, with yellow floor warnings, safe areas for workers to be located during ride operation. However, these efforts were not sufficient to prevent injury in this incident. For environments such as the ride in this incident, application of engineering controls would offer additional positive protection from injury due to contact with moving equipment. Some examples of controls applicable to amusement park rides are:

- An interlocked gate, swinging in the egress direction, could be installed across the ride entrance before the yellow floor warning (see figure 1). To allow for quick exit in case of emergency, this gate would not be latched, but would be held closed by springs or gravity.[3]

A switch mounted on the gate would be positioned such that it would be activated by opening the gate. The switch would be connected to the ride's control circuitry so that when activated, the ride would be automatically shut down and an audible or visible alarm would be activated.

- Infrared lights and sensors could be used to create a barrier across the ride entrance before the floor warning. The sensors would be connected to the ride's control circuit to activate alarms and shut down the machine if the beam was interrupted. Similar systems are commonly used on residential garage door openers to halt or reverse a descending door when persons or objects are in the doorway.

- A system could be devised using pressure-sensitive mats installed on the floor of the ride enclosure. One mat would be installed just before the entrance to the ride's walkway. A second mat would be installed in the floor just after the entrance, or a series of mats installed just after the entrance and around the ride's walkway. The mat switches would be connected to the ride's control circuit so that power would be interrupted unless the first mat was activated by the presence of the ride attendant or if the mats inside the ride were activated.

These controls would not be intended as a substitute for safe work procedures that require workers to remain in designated locations, but would provide additional protection from injuries due to contact with moving equipment.

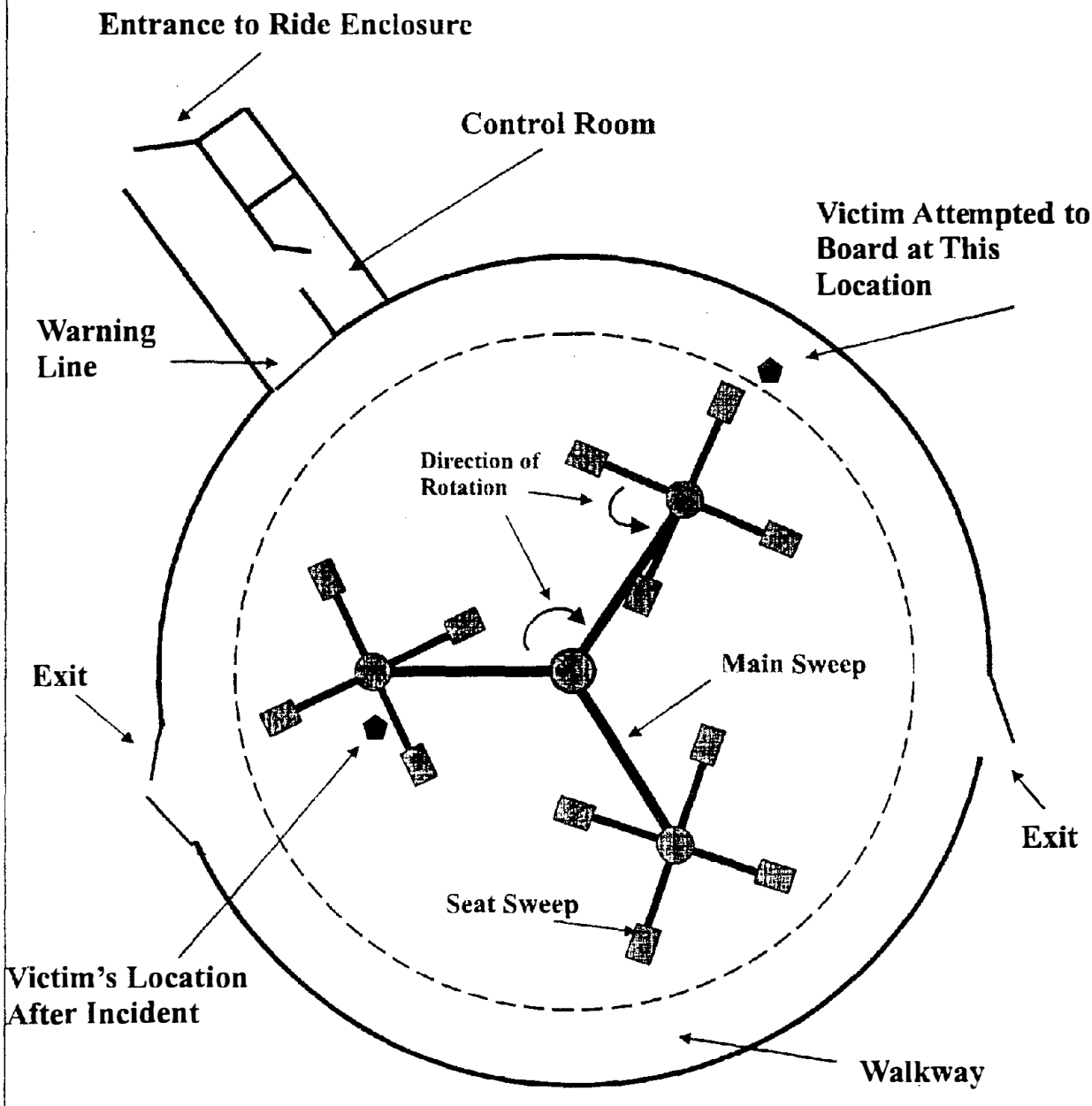
REFERENCES:

[1] Ponton, Lynn E. M.D. (1997), *The Romance of Risk, Why Teenagers Do the Things They Do*, New York, NY: BasicBooks.

[2] Lightfoot, Cynthia (1997), *The Culture of Adolescent Risk-Taking* , New York, NY: The Guilford Press.

[3] American Society for Testing and Materials (1997), Standard Practice for the Design and Manufacture of Amusement Rides and Devices, ASTM 1159 - 97a, West Conshocken, PA.

Fig. 1 - FACE 99-06: Amusement Park Ride



Sketch not to scale

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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, Pennsylvania, South Carolina, Tennessee, and Virginia.

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FACE 99-06