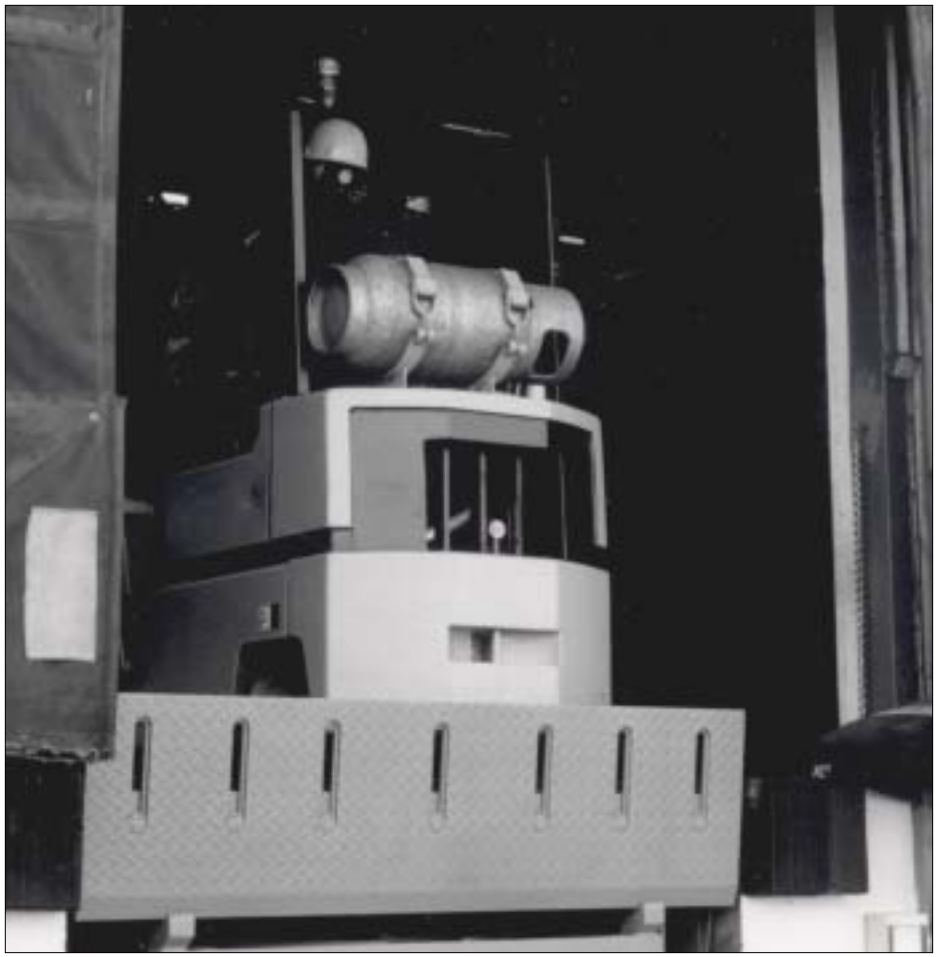
DANGER ZONE: THE INDUSTRIAL DOCK



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By GEORGE SWARTZ

Industrial docks are a vital component of the nation's economy. Large, fast-paced equipment are used to move tons of product each day. Unfortunately, industrial docks are also the source of many work-related injuries. According to some estimates, nearly one of four industrial injuries occur at shipping or receiving docks.

Dock workers (and visitors) can be exposed to many hazards—particularly at docks that are poorly designed or lack safeguards. This article examines the safety of docks and powered industrial trucks. Discussion focuses on serious dock-related incidents; safety statistics and related studies; safe dock design; typical dock hazards; and recommended safeguards.

SERIOUS DOCK-RELATED INCIDENTS

The following incidents, documented in various newspapers in the U.S. and Canada, illustrate some inherent dangers of docks.

- In a Montreal, Canada recycling plant, a truck driver delivering a load was killed after being struck by a forklift.
- In a Midwest facility, a forklift went off a dock when its brakes failed. As a result, the 21-year-old operator's left leg had to be amputated below the knee.
- In Georgia, a worker operating a floor scrubber drove rearward off a dock edge. His head and chest were crushed as a result of being trapped under the machine.
- A worker was crushed to death when his forklift fell off a dock. The trailer he was about to enter had pulled away from the dock—its driver did not know the forklift was still working in the trailer.
- In Orange County, CA, a truck driver was killed when he was pinned between the dock and a tractor. The backing driver did not know this driver was present.
- A forklift operator lost a leg in a loading dock incident. He entered a trailer just as it was pulled away from the dock. The forklift dropped, pinning the worker to the dock with the forklift prongs.

SAFETY STATISTICS & RELATED STUDIES

National Safety Council Study

To illustrate the significance of warehousing and dock-related incidents, National Safety Council (NSC) published an in-depth study covering the period 1992 to 1995. Table 1 lists the five most-serious events that contributed to warehouse fatalities. Although the study did not focus on specific dock-related deaths, based upon the NSC statistics and descriptors, one must assume that many of the fatalities identified occurred in the dock area.

Early OSHA Study

In the mid-1980s, OSHA conducted a comprehensive study of dock-related hazards. The purpose was to determine injury rates and causes, and identify the nature of existing safety programs and other factors associated with warehouse operations.

Twenty-six states participated for the calendar month of September 1984. During this time, some 2,700 workers were injured. The results reveal some

important statistics regarding dock-related incidents.

•Dock injuries accounted for 29 percent of the injury total; approximately one-half of the injuries occurred while the worker was in a trailer.

•Nearly 30 percent of all injuries occurred while unloading a vehicle.

•More than 13 percent of those injured were operating powered equipment.

•Nearly 65 percent of all injured workers were manually lifting, carrying or handling materials at the time of their injuries.

•Overall, 38 percent of workers suffered overexertion injuries while lifting or handling materials.

•Sixty-five percent of those injured were not wearing personal protective equipment (PPE) at the time of the injury.

•Some 48 percent never received safety training for the assigned job.

Although this study is more than a decade old, the cited hazards persist at many docks.

Ontario Incident Data

From 1990 to 1995, 17 workers in Ontario were killed by forklifts and 143 were critically injured. Some of these incidents occurred at docks. The Workers' Compensation Board cited statistics which showed that most of the disabling injuries occured when workers were struck by forklifts. Specific dock-related incidents cited included lift truck tipovers, workers being struck by falling product and off-dock incidents with powered equipment.

Between 1990 and 1995, approximately 6,100 lost-time injuries occurred in Ontario. Ministry of Labor inspectors issued 327 orders related to the province's OHS Act citing violations such as lack of operator training, improper procedures and failure to provide adequate lift truck maintenance.

The Provincial Regulations for Industrial Establishments are very specific when issuing citations. Of the 599 orders issued during this study, 63 percent involved mechanical fitness of a facility's lift truck as well as at the dock.

Hyster Study: Off-The-Dock Injuries

Hyster Corp. conducted an in-depth study in 1985 to assess injuries related to forklifts and off-dock incidents. The injuries identified included head, leg, foot, ankle, arm and head injuries. All injuries occurred to operators in the same proportion. The study also found that off-dock incidents, which are more varied with respect to direction of impact, tend to injure one part of the body about the same as the others. These incidents were analyzed to determine:

•predominant type of off-the-dock incident;

•relative frequency of off-the-dock incidents;

•speed and direction of forklift travel prior to going off the dock;

Several major types of off-dock incidents were identified.

1) Slide off dock: This occurs when the dock surface is slick (with water, ice, oil or snow), causing the operator to lose directional control of the lift truck. As a result, the operator is unable to maneuver away from the dock edge in time.

2) Dock edge: This occurs when the operator has directional control of the lift truck, but inadvertently drives off the dock edge while maneuvering close to it.

3) Trailer at dock: This involves forward trailer movement during loading (or unloading). It typically occurs when the trailer creeps forward, rolls away or is pulled away from the dock.

4) Miscellaneous: Incident types in this general category include elevator shaft incidents; falling from the second floor (or higher) of a building; or falling into water from a wharf or barge. Such incidents occurred much less frequently than the other types.

In this study, cushion-tire lift trucks were involved in four-fifths of all off-dock incidents; pneumatic-tire models accounted for the remaining one-fifth. Cushion-tire trucks were involved in slide-off dock incidents, trailer incidents (most common) and miscellaneous events. Three-fourths of pneumatic-tire trucks were involved in dock-edge incidents; the remaining incidents involved trailer-type incidents.

Based on these results, trends were noted regarding what activity was being performed at the time of the incident.

1) Dock Edge

•Lift truck was traveling backwards in more than one-half of the incidents.

•Predominant direction was straight off the dock.

•Speed was generally slow.

•Lift truck was usually unloaded.

2) Trailer

•Lift truck was traveling in reverse in more than one-half of the incidents.

•Speed was slow.

•Lift truck was usually unloaded.

3) Slide off dock

•Lift truck was moving forward more often than in reverse.

•Lift truck slid off at an angle other than perpendicular.

•Speed was at least moderate.

•Both loaded and unloaded lift trucks were involved.

Narrow Aisle Lift Truck Study

In a 19-year study (1975-1993) of narrow-aisle-truck-related injuries, 72 of the 804 incidents were classified as "off the dock." These were subdivided into three categories, which identified the action of the narrow aisle (standup type) lift truck along with a "direction unknown" category. Using these definitions, injury reports were grouped into known or unknown action of the truck and operator. (It should be noted that this study assessed data from only one lift truck manufacturer.)

Injury investigation reports from facilities that experienced the losses were used to prepare data. In some cases, reports were incomplete. Table 2 identifies direction of travel as the lift truck went off the dock. Six operator actions were identified as well (Table 3).

The study produced some interesting data regarding the increased safety an operator experiences by staying inside the confines of the lift truck rather than attempting to jump clear as the vehicle fell off the dock (Table 4). Fifteen operators who jumped from the falling vehicle did not receive injuries. Three operators suffered major injuries and one died when leaving the lift truck. Of the operators who stayed within the confines of the operating compartment, none received fatal injuries, while 10 received minor injuries.

Highlighting several of the more-serious incidents helps to vividly describe the hazards of an off-the-dock incident.

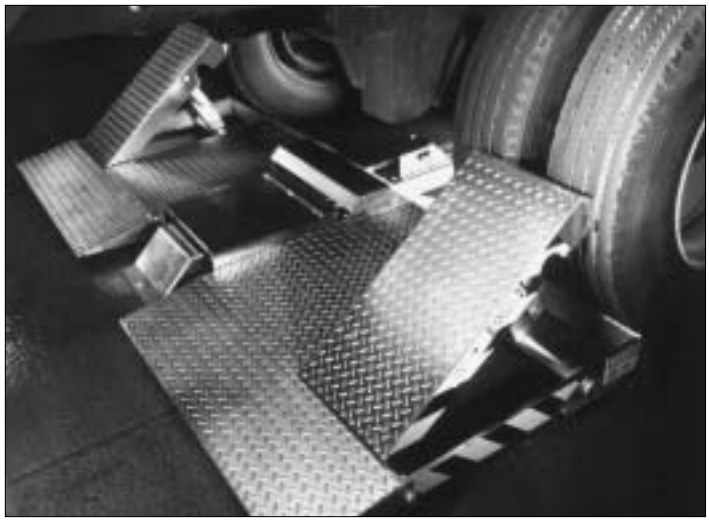
•Lift truck went off the dock when the dock plate fell. Operator was partially ejected and suffered a crushed hand.

•Worker drove lift truck rearward off of the dock. He attempted to jump clear and was pinned by the falling lift truck, causing major injuries to his torso.

•Worker drove lift truck rearward off the dock. He either jumped or was ejected and was pinned by the overhead guard; as a result, his leg had to be amputed below the knee.

•Worker drove rearward off of the

The unintentional movement of trailers is one of the more dangerous actions that occurs at a dock. Because a lift truck can easily fall from the dock due to trailer creep or premature departure, the trailer must be secured. To address this problem, industry has developed several safeguards, including trailer restraints (left), warning signs and lights (right) and dock levelers and barriers (below).



dock and either was ejected or jumped. The forklift crushed his head—a fatal injury.

The study reported some additional data that demonstrates the need for better safety precautions. In addition to the 72 off-the-dock incidents, 127 lift trucks tipped over and 64 pedestrians were struck by a lift truck or falling product.

SAFE DOCK DESIGN

Employers can take steps to improve the safety and efficiency of their docks. Dock design is the starting point. For example, a large area is needed in front of a dock so trailers have enough space to maneuver into the docking zone. Since most over-the-road semitrailer trucks are 65 feet long, this area must have at least as much space for backing in and pulling out.

Space for right-angle turns is another consideration. The outside turn radius must be at least 55 feet, while the inside turn radius must be at least 25 feet. The key is to allow as much room as possible to maneuver large trailers.

In April 1983, the U.S. government began to allow larger trailers on the highways. As a result, many trailers are now 103 inches wide. Consequently, existing dock doors, seals and shelters must be enlarged to accommodate these trailers. For new docks, facility management should consult a dock equipment manufacturer to ensure that proper specifications are adopted.

Ramp slope is another key consideration. A slight sloping driveway is best, as it allows for dock height to be about two inches below the average height of a truck bed. Since a full trailer will be lower when parked at the dock and higher when empty, dock height is crucial. Ideally, ramp slope should allow for a three-percent grade; three to six percent is practical; 10 percent is near the limit, since a steep slope affects wheel traction.

Weather plays a role as well. For example, warehouse employees must get down from the dock to the spotted trailer in order to check wheel chocks, trailer condition and landing wheels. To ensure safe access from the dock, a ladder designed according to OSHA specifications should be provided. Stairs with handrails and non-skid steps are also needed. Employees must also know that jumping off the dock is not acceptable, and signs should be posted to reinforce this rule.

Typical Dock Hazards

The unintentional movement of trailers is one of the more dangerous actions that occurs at a dock. Because a lift truck can easily fall from the dock due to trailer creep or premature departure, the trailer must be secured.

When one considers that a dock plate has a small moveable lip which is approximately 15 inches wide, it becomes clear that placement and security of this plate can be the difference between life and death. The dock leveler lip extends from the dock plate onto the rear of trailer bed. This metal bridge absorbs the impact of the forklift crossing over it repeatedly while loading/unloading the trailer.

To better understand the frequency of movement over the bridge plate, consider this scenario. Suppose a single dock door handles the loading/unloading of 10 trucks per day, each with an average of 20 pallets. This would equate to 200 loads,

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TABLE 1 Fatal Occupational Injury by Event or Exposure — Warehousing

EVENT/EXPOSURE	1992	1993	1994	1995
Contact with objects/equipment	1,004	1,045	1,017	915
Struck by object	557	556	590	546
Caught in or compressed by object	316	309	280	256
Caught in running equipment or machinery	159	151	147	131
Caught in or crushed by collapsing material	110	138	132	99

multiplied by at least 250 workdays per year = 50,000 total movements. This total is then is doubled because of actual crossings (two per load). Thus, some 100,000 crossings could occur per year at each dock door. At a facility with 10 dock doors, nearly 1 million crossings would occur.

In light of such activity, it is inevitable that a trailer could be pulled away or gradually creep forward, exposing the forklift operator to a potentially life-threatening fall. Each time a lift truck's wheels impact the dock bridge, the trailer can inch forward. Even with its brakes set and wheels chocked, a trailer can move beyond the reach of the dock leveler bridge.

Wheel Chocking

Wheel chocks are a standard safety device. It is the forklift operator's responsibility to ensure that the wheels (on both sides) are chocked. However, wheel chocks are often missing (stolen, lost) or go unused. Often, their use simply is not enforced.

In some cases, chocks are not fully effective. For example, at an outdoor dock, snow or ice may cause chocks to slip away from the wheel. Poor drainage can allow water to pool in areas where trailer wheels should be spotted. Rather than wade through ankle-deep water to place and remove chocks, some employees may simply decide not to use the devices.

Collapse of a landing wheel can cause the forklift and operator to be thrown forward into the nose of the trailer. Or, a trailer may tip to the side, causing the lift truck inside it to be thrown against the wall of the trailer.

If a trailer is shorter-than-average, its landing wheels are located closer to the rear of the trailer; as a result, the trailer can be spotted outside of the building. Once the forklift has unloaded product from the trailer, the weight of the lift truck and product will cause the back of the trailer to raise up and its nose to tip down and forward. This would propel the lift truck and operator toward the trailer's nose.

Trailer Restraints

An automatic trailer restraint is an excellent way to secure the trailer to the dock. This device attaches to a trailer's rear impact guard or Interstate Commerce Commission (ICC) bar. Approximately 90 to 95 percent of all trailers can be secured using such a device. However, trailers with hydraulic tail gates may not have a rear impact guard; and, in some cases, the horizontal bar may be missing or damaged, preventing use of the restraint. Table 5 reviews the pros and cons of using such a device.

To activate the restraint, a worker pushes a button on a panel located inside the dock. This causes the hook

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TABLE 2 Narrow-Aisle Truck Movement

INJURY/INCIDENT TYPE	INJURY TOTALS	PERCENT
Forward direction	13	18
Rearward direction	32	44
Dock plate fell	13	18
Direction unknown	14	19
TOTALS	**72**	**100**

TABLE 3 Operator Action Taken at Time of Incident

OPERATOR ACTION	NUMBER	PERCENT
Jumped	29	40
Stayed	13	18
Jumped or ejected	10	14
Partially ejected	4	6
Attempted to jump	2	3
No operator	2	3
Unknown	12	17
TOTALS	**72**	**100**

TABLE 4 Operator Action Taken at Time of Off-the-Dock Incident

OPERATOR ACTION	NO INJURY	MINOR	MAJOR	FATALITY	UNKNOWN	TOTAL
Attemped jump	0	1	1	0	0	2
Jumped	15	10	3	1	0	29
Jumped or ejected	0	0	5	4	1	10
No operator	2	0	0	0	0	2
Partially ejected	0	0	4	0	0	4
Stayed	2	8	1	0	2	13
Unknown	5	3	4	0	0	12
TOTALS	**24**	**22**	**18**	**5**	**3**	**72**

TABLE 5 Pros & Cons of Vehicle Restraints

PROS

- Securely holds trailer to dock.
- Employees can be easily trained.
- Can be used despite inclement weather.
- Saves time and money on the wheel chocking process.
- Restraints are simple to use.
- Provides greater security than standard wheel chocks.
- Hook-type models help in preventing forward or side-tipping of trailers.
- Restraints can prevent injuries and fatalities.
- Workers' compensation costs would be reduced.
- They require only minor maintenance.
- Lawsuits would be reduced.
- Prevents forklift damage if a truck goes off the dock.
- Can help in the security of trailers in preventing trailer theft.

CONS

- More expensive than wheel chocks; however, it is a small investment considering the benefits.
- Purchase and installation costs could be out of reach for some small employers.
- Periodic maintenance and repair may be required.
- A restraint may not be effective on every trailer or truck.
- Flashing red light on the inside panel does not guarantee that an operator will not drive a lift truck into an unsecured trailer.

or bar to travel upward in order to lock against the rear impact guard. A flashing green light on the panel alerts the forklift operator that the hook has been placed properly. A similar panel outside the dock door displays a flashing red light to warn the tractor operator that s/he cannot pull the trailer forward. A flashing amber light signals a system malfunction. If the rear impact guard is missing or defective, a flashing red light inside the building reminds the forklift operator about the danger of entering an unsecured trailer.

RECOMMENDED SAFEGUARDS

Reducing dock hazards requires installation of proper safeguards as well as increased safety awareness. Systematic inspection and auditing also help.

The first step is to identify the source and types of injuries occurring in a facility's dock area. This can be achieved by evaluating past workers' compensation (WC) losses. A firm's WC carrier should be able to provide relevant cost and frequency data.

Beyond this, management must take steps to organize product movement, control traffic patterns and secure racking. Other issues include: facility lighting; extendable conveyors; PPE; chemical handling; employee training; fire safety; and equipment maintenance. The following discussion highlights key considerations.

Good visibility is essential. Lighting must be bright enough to ensure the safe storage of product and to help lift truck operators recognize the presence of pedestrians. Lights mounted on forklifts aid entry into trailers and facilitate operations on ramps or in remote areas.

Dock shelters at the bay doors should be in good working condition; this equipment must be properly maintained as well.

Heat strips/climate curtains can help control temperature throughout the building. However, pedestrians must exercise caution when passing through these hanging plastic strips to avoid lift truck traffic; where possible, a separate doorway should be provided. In addition, strips must be replaced as they become scratched and/or discolored.

To prevent falls, walkways, stairs, walking surfaces of ramps and dock plates should be coated with non-skid paint. All walkways should be marked with yellow lines to control traffic.

Spills—oil, fluid or grease—will affect the stopping ability of powered equipment and the walking surface for pedestrians. Leak sources must be corrected, and oil and grease spots cleaned up immediately.

Chemical spills can occur if a lift truck operator drops or penetrates (with a fork) a chemical container. Dock workers must be aware of spill containment procedures; trained to recognize chemical hazards; and know what PPE to wear when handling chemicals.

In addition, management must place spill cleanup kits in the dock area and train employees in their use. Dock workers must also understand the features of standard chemical container labels (e.g., HMIS or NFPA 704); material safety data sheets must be readily available for any chemicals handled as well.

Fire extinguishers should be readily accessible, and employees trained in their use. Signs identifying fire safety equipment must be properly displayed. Lift trucks that operate outside or in remote areas must be equipped with a fire extinguisher as well.

Sprinklers, extinguishers and other emergency equipment must be protected to prevent damage. A damaged sprinkler head or broken pipe can cause significant water damage to stored goods and will also affect traction in the dock area (for both equipment and pedestrians). Pipes can be identified by hanging caution signs or streamers on them for greater visibility. Barriers can be placed in strategic locations to prevent damage by lift trucks/loads.

Loading/unloading flatbed trucks poses some unique risks. The typical trailer contains walls and a roof, which prevents the lift truck operator from driving off the side of the trailer. Most flatbeds have no sidebars to prevent this. Therefore, if possible, flatbed trailers should be loaded/unloaded from the dock well or other flat/lower surface.

Some docks are equipped with fixed or extendable conveyors, which can be used to move product inside a trailer. Safeguards that must be considered include: guarding of moving parts and nip points; power disconnects (if applicable); proper lighting; and correct height adjustment for ergonomic factors.

Basic PPE—hard hats, gloves, steel toe boots and eye protection—is a must. Task-specific gear such as face shields, rubber gloves, earplugs/muffs, rubber boots and dust masks should be provided as necessary.

Safety inspections are essential. Depending on dock activity, product being handled and past safety performance, weekly inspections may be necessary. To create the proper inspection form, a loss control professional should prepare a comprehensive list of safety factors present at the dock. Informal daily inspections are also an important component; they can be facilitated by concise, easy-to-read checklists.

Operator training is critical. Each forklift operator must receive training specific to the type of powered industrial truck that will be used.

Due to the large amount of manual handling performed at docks, back injuries are common. Where possible,

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powered equipment should be used to minimize manual handling activities. Shelving, tables and conveyors must be placed at the correct height so product can be handled safely. Management must also make sure that employees use safe lifting techniques.

Many docks are serviced by ramps, which can present hazards related to slippery surfaces, lighting, visibility and vehicle traffic. If a ramp is the only means of access to an area, pedestrian walkways must be provided; if this is not possible, pedestrian access must be banned. Handrailings, barriers, lighting, strategically placed mirrors and appropriate signage can help improve safety.

Carbon monoxide (CO) can be a problem as well, particularly if lift trucks are not properly maintained. OSHA has established a time weighted average of 50 ppm; ACGIH recommends a 35 ppm limit; NIOSH has established a level of 1200 ppm as immediately dangerous to life and heath (IDLH). If lift truck maintenance is lax, CO levels could easily exceed these limits. Exposure to high concentrations of CO may result in a rapid loss of conciousness or life without first producing other significant symptoms.

To safeguard against such problems, forklifts, sweepers or other powered equipment that use propane, diesel, or gasoline as a fuel must be maintained according to manufacturers' guidelines. Management should also install instruments to measure CO levels. These can be mounted at the dock or on powered equipment and should be set to alarm if 25 ppm of CO is detected.

CONCLUSION

Docks are a vital component of the nation's economy. Due to the high rate of activity, injuries are commonplace. According to some estimates, injuries associated with the dock account for 10 to 25 percent of all workplace injuries. OSHA's 1985 study concluded that dock-related injuries accounted for 29 percent of the totals. A recent article in *Occupational Hazards* stated that all lift truck injuries at the dock can be as high as 70 percent (Smith 44+).

Clearly, the injury data indicates that employers must act to improve safety at industrial loading docks. Many injuries can be eliminated if operators are properly trained and management requires and enforces safe work practices. ■

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