To: Director, National Institute for Occupational Safety and Health

From: Iowa FACE Program

Subject: Farmer dies while cleaning foot pedals of skid-steer loader -- Iowa.

Summary: On February 7, 1995, a 37 year old male farmer died while cleaning a skid-steer loader. On this machine the left foot pedal is used to raise and lower the loader arms, and the right pedal controls the bucket tilt. The pedals of this machine were seized up with frozen manure, snow, and ice, and the victim was attempting to free up these pedals. It was a cold and windy day, and the victim was in a hurry. At the time of the accident the skid-loader bucket was in the ¾ up position, jammed up against the door frame of an old garage used for storage of the machine. Mechanical lift arm safety stops are included with this machine, but require the lift arms to be in the full UP position. While working in front of the machine in a low crouched position, the victim apparently loosened the left pedal enough to allow the bucket to fall on him, pinning him between the bucket and the machine (see picture 1). The machine is equipped with a hydraulic lever interlock, which is connected to the safety belt. When the safety belt is not worn, the bucket and lift arm controls cannot be moved. This feature had been disabled by the victim. Rescue efforts by the victim's wife and another employee were delayed because the pedals were still frozen and inoperable. Mechanical lifting by the fire department using the Jaws of Life was required to raise the bucket sufficiently to provide access to the victim.

Recommendations following our investigation were as follows:

- 1. *Operators of skid-steer loaders should be made aware of the dangerous condition created by disabling machine's safety devices.*
- 2. *Manufacturers should provide at least three mechanisms to prevent the loader from falling unintentionally on the operator.*
- 3. *Operators of skid-steer loaders should always secure the loader by mechanical means whenever working under the bucket.*
- 4. *Equipment should have a proper place of storage that allows for safe maintenance and cleaning.*
- 5. *Manufacturers should design equipment and controls to function in wet, muddy, or cold conditions when these conditions are frequently encountered in normal operation.*

INTRODUCTION

On February 7, 1995, a 37 year old male farmer died while attempting to clean the operating pedals of a skid-steer loader. On April 11, 1995 the Iowa FACE program was informed of the incident by the Iowa State Medical Examiners office and began an immediate investigation. Additional information was gathered from the victim's wife who first found him, the EMS and Fire Department reports, and the victim's parents who live nearby. We took several photographs of the machine and also interviewed the local equipment distributor.

The victim had been farming full-time for 15 years. He was the owner of a dairy farm and also the owner of a swine farm. The accident happened at the swine farm where he had lived for only 3 months. He employed 3 farm workers, one of which was on the swine farm on Feb. 7.

There was no written or formal safety training program on the farm, yet the victim was conscious of safety and sternly instructed his employees about safety. The victim's parents stated that he warned his workers saying they would be immediately fired if seen walking under the raised bucket of the skid-steer loader. The victim had been using a skid-steer loader since a teenager. He was very familiar with this particular machine. This skid-steer loader was approximately 1 year old and, except for the clogged foot pedals, in normal operating condition at the time of accident.

INVESTIGATION

This skid-steer loader was used frequently every day on the farm for feeding swine and cleaning pens. The operator was frequently going in and out of pens, constantly getting in and out of the machine to handle gates and feed bunks. The seat belt had caused sufficient hindrance to the victim, that he used a heavy glove to hold the seat belt in a position where the hydraulics could be used, thus disabling the hydraulics safety interlock. The machine was continually getting soiled with manure, mud, and at this time, snow and ice. Apparently the operating pedals of this machine became clogged with manure and snow, which froze after the machine was turned off and left in the cold garage.

The victim had last talked with his wife at 10:50 A.M., and was expected to be back in the house shortly because he had an appointment in town. He had just gone out with a bucket of hot water to free up a frozen hog waterer, and apparently decided to quickly work on the skid-steer loader in the garage so employees could continue using the machine in his absence. The victims father who is very familiar with this machine assumed that when the victim started the engine the bucket started to rise because the hydraulic controls were frozen in the UP position. Fresh marks were seen in the garage door frame above the bucket confirming the report that the bucket was touching the door frame. The old garage used for storage of the machine allowed only 3 inches of clearance from the top of the ROPS cage. The victim apparently stopped the engine just before the loader lifted and damaged the door frame. The loader was left in this ¾ UP position when the victim stepped out of the machine and began cleaning the pedals through an access slot on the front of the machine. In the ¾ UP position the lift arm safety stops are inoperable. They require the bucket being raised to the full UP position.
The machine has a spring-loaded hydraulic interlock connected to the seatbelt. It mechanically frees up the hydraulic control linkages when an operator uses the seatbelt. This mechanism had been disabled by inserting a heavy leather glove behind the seatbelt lever, causing the hydraulic linkages to always be free to move. The machine had been used one hour previously, so the hydraulic oil was probably still warm, yet the pedals were frozen. Warning decals were placed on the machine, but they were obscured by dried manure during our investigation, and presumably at the time of the accident.

Due to a recent injury, the victim could not bend over to clean the pedals from inside the loader. He was kneeling in front of the machine trying to clean the pedals through an access

slot in front of the pedals. Using a crowbar and a screwdriver he apparently loosened the left pedal sufficiently to move the hydraulic linkage causing the bucket to fall quickly without power, crushing him in the chest.

When found by his wife, the victim was in a crouched position pinned between the bucket and the frame of the skid-loader. The victim was cyanotic and unresponsive upon her arrival at 11:10 A.M. and he never regained consciousness. His wife entered and started the machine, and attempted to raise the bucket by jumping on the pedals, but they were frozen solid. One employee soon arrived, and tried unsuccessfully to raise the bucket with a jack. Rescue workers were notified at 11:36 A.M. and arrived at 11:45 A.M. They immediately used the Jaws of Life to remove the victim and began resuscitation efforts in transit to the hospital. Resuscitation efforts failed and the victim was pronounced dead in the hospital emergency room.

CAUSE OF DEATH

The medical examiner determined death was due to "Crush injury of the chest"

RECOMMENDATIONS / DISCUSSION

Recommendation #1: *Operators of skid-steer loaders should be made aware of the dangerous condition created by disabling machine's safety devices.*

Discussion: In this case the operator had disabled the safety interlock due to inconvenience of use. This may have enabled better work efficiency, however at the cost of safety. An effective interlock would have prevented unintentional lowering of the bucket, thus saving the operator's life. All safety devices should be maintained and kept in working order, regardless of the possible inconvenience they may cause.

Recommendation #2: *Manufacturers should provide at least three mechanisms to prevent the loader from falling unintentionally.*

Discussion: The hydraulic interlock connected to the seatbelt was the only safety mechanism to prevent lowering of the bucket unintentionally. The other mechanism, the lift arm stops, could not be used in the ¾ UP loader position. Several safety mechanisms should be provided in all skid-steer loaders to protect the operators from the danger of being crushed under the bucket. These mechanisms could include a safety belt operated interlock, such as used on this machine, an ignition operated interlock which locks the hydraulics when the machine is not running, an operator presence sensor in the seat shutting off the engine, a front door interlocking the hydraulics, a safety bar requiring the operator to be present in the seat when using hydraulics, and a mechanical lift arm stop such as on this machine. These lift arm stops should be operable in all loader positions, where adequate clearance exists for the operator to safely step in and out of the machine. The local distributor for this machine showed us a newer model equipped with seat belt interlock, ignition interlock and a seat pressure actuated engine shut off. The foot pedal control linkages were raised higher from the floor.

Recommendation #3*:* *Operators of skid-steer loaders should always secure the loader by mechanical means whenever working under the bucket.*

Discussion: Hydraulic system alone does not provide adequate safety when working under the loader bucket. A worn hose, a poor connection, or other part of the system can fail, causing sudden movement of machine components. In this case the victim was unable to use the mechanical lift arm safety stops because the bucket could not be raised to the full UP position. The victim was in a hurry, and did not attempt to use other mechanical support for the loader bucket. He may have forgotten that the bucket could fall without power when the pedals were actuated. Normally this would not happen if the seatbelt interlock was working properly. A mechanical bucket support would have been needed to avoid this injury.

Recommendation #4: *Equipment should have a proper place of storage that allows for safe maintenance and cleaning.*

Discussion: This skid loader was stored in an old garage with a low ceiling. Therefore it was impossible to raise the bucket to a sufficient height to use the factory installed lift arm stops. If the ceiling was taller, the victim may have used these safety locks and prevented the accident. Using a skid loader on the farm in the winter requires frequent cleaning as mud and manure will freeze to the machine floor, especially if the machine is stored outside. Good storage would be needed for proper maintenance and cleaning in winter condition.

Recommendation #5: *Manufacturers should design equipment and controls to function in wet, muddy, or cold conditions when those conditions are frequently encountered in normal operation.*

Discussion: Build up of manure and mud under the floor pedals of this skid-steer loader is a common occurrence and becomes especially hazardous in winter when the accumulation can quickly freeze and limit the pedals' movement. Adequate room should be provided under the pedals and linkages from the pedals to the hydraulic system. In this case dirt and manure buildup caused the hydraulic controls to freeze and malfunction. Manufacturers should ensure that controls do not malfunction because of normal dirt buildup on the floor of the machine. Since this is very common for this type of machine, the design could be improved by providing adequate room under the pedals and linkages or replacing foot controls by hand controls away from the floor.

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