FATALITY ASSESSMENT AND CONTROL EVALUATION

Machine operator fatally struck by safety block ejected from mechanical power press
Case #: 16NY064

INCIDENT HIGHLIGHTS

DATE:

December 6, 2016

TIME:

11:20 a.m.

VICTIM:

49-year-old male worker at a busbar manufacturing facility

INDUSTRY/NAICS CODE:

Carbon and Graphite Product Manufacturing/335991

EMPLOYER:

Busbar manufacturing facility

SAFETY & TRAINING:

No safety training

SCENE:

At facility

LOCATION:

New York

EVENT TYPE:

Fatally struck by safety block

SUMMARY

On December 6, 2016, a 49-year-old male worker at a busbar manufacturing facility was fatally injured while operating a 200-ton press around 11:20 AM. The decedent and another employee were in the process of making busbars, a component of electrical devices, out of raw copper strips using a 200-ton mechanical press. The press frequently jammed, requiring the decedent to place two safety blocks between the ram and bolster and reach into the press to unjam the machine... Read the report (p.2)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Safety blocks were left in the press when the press was actuated.
- Safety blocks were not interlocked to the press circuitry.
- Safety blocks were not aligned with the longitudinal central axis of the ram, causing a pressure difference between the two halves of the press; Learn more (p.5)

RECOMMENDATIONS

NY FACE investigators concluded that, to help prevent similar occurrences, employers should:

- Ensure interlock devices are used in conjunction with safety blocks when working with mechanical power presses.
- Ensure that the selected safety blocks meet the rated capacity of the specific power presses.
- Employers should place safety blocks centered along middle length of press when servicing. Learn more (p.6)

SUMMARY

On December 6, 2016, a 49-year-old male worker at a busbar manufacturing facility was fatally injured while operating a 200-ton press around 11:20 AM. The decedent and another employee were in the process of making busbars, a component of electrical devices, out of raw copper strips using a 200-ton mechanical press. The press frequently jammed, requiring the decedent to place two safety blocks between the ram and bolster and reach into the press to unjam the machine. The decedent would then remove the safety blocks and return to actuate the machine at a dual-button control panel mounted to a pedestal, placed in front of the long side of the press. The decedent and the shift supervisor had to unjam the press multiple times. The last time they removed the jam, the safety blocks were unintentionally left on the bolster bed. The decedent, who was standing in front of the press by the pedestal controller, actuated the press. The two safety blocks were immediately ejected from the press; one block struck the decedent in the neck and chest inflicting severe injuries. Immediately after the injury, 911 was called, and another employee tried to help with basic first aid. Emergency medical technicians (EMTs) responded in minutes, but the employee died at the scene due to blunt force injuries to the neck.

INTRODUCTION

On December 6, 2016, a 49-year-old male worker at a busbar manufacturing facility was fatally injured while operating a 200-ton metal press around 11:20 AM. The New York State Fatality Assessment and Control Evaluation (NY FACE) staff learned of the incident from news media reports and contacted the employer to initiate an investigation. The employer did not respond to the NY FACE request. NY FACE also contacted the attorney who represented the manufacturer of the mechanical press involved in the incident to request for the press specification and information on operation and maintenance. The attorney declined to provide the information citing trade secrets. The incident was investigated by the Occupational Safety and Health Administration (OSHA). NY FACE discussed the case with the OSHA compliance officer and reviewed the OSHA report as well as the death certificate. Additionally, NY FACE researched the technical information including safety block design, selection, and installation and reviewed the worker fatality cases associated with power presses on OSHA and FACE databases. This report was developed based on the information provided by OSHA and NY FACE research findings.

EMPLOYER

The employer is a private international company with a non-union shop that has been in business for over a century as a producer of materials for the electric power industry such as high-speed fuses, busbars, surge protection, high and medium voltage fuses and bases, low voltage switches, and other types of electronics. The facility where the incident took place is a 110,000 square foot plant that produces busbars in a one-shift daytime operation. This is the second fatality that the employer had in the US within a two-year period; the previous fatality consisted of an explosion at a facility in another state that killed one person and injured another.

WRITTEN SAFETY PROGRAMS AND TRAINING

The employer did not have specific written procedures for Lock-out Tag-out of 200-ton mechanical press, or other types of operating procedures for placing die blocks, performing maintenance tasks, clearing jams, or other written safety procedures for utilizing the press. There was no documentation of employee training provided by the employer, but the employer did have a written health and safety program that was considered inadequate during the OSHA Fatality Inspection event after the incident occurred.

WORKER INFORMATION

The worker involved in the incident was a 49-year old white male. He had been employed by the company for about two months at the time of the incident but was a machine operator with twenty years of experience. He was assigned to work at the 200-ton press. Training for the decedent consisted of verbal communication from an employee with experience in the operation of the press (shift supervisor).

MACHINERY INVOLVED IN THE INCIDENT

The machine involved in the incident was a 200-ton mechanical power press with a bed area that was 42 inches wide by 78 inches long (see Photo 1), which was powered by a combination of electrical and mechanical energies utilizing a flywheel. This press consisted of a stationary bolster plate (mount for die block that sits on

the bed of the press) where raw material is placed, a ram (mount for die on the upper plate of the press) which moves in a vertical motion and forms or shapes raw material against the bolster plate into a finished product, and a frame that supports the structure of the press. Different types of dies can be mounted to the press that allow the press to manufacture finished products from different types of metals. Information regarding this press's specifications such as ram speed, specific pressures, shut height, capacities, etc., were not available for inclusion into this report.

This press was set up to run in individual pressings, or single cycle. Single-cycle press operation requires the operator to feed raw material into the press, align the material on the lower die block, then use a two-hand control to actuate the press. This press made its product from one-inch wide copper bands that were unwound from a coil at the beginning of the press, placed onto the bolster by the operator, and formed into busbars, which are pieces of copper used in electrical applications for power distribution, switchboards, and battery banks. After the press is actuated, the busbar could be removed by the operator by reaching in between the ram and the bolster.

The mechanical press was outfitted with a two-button control panel and an emergency stop. The two-button control panel required the operator to press both buttons on the control panel at the same time to actuate the press. This control is a built-in safety feature intended to prevent the operator's hands from entering the point of contact when actuating the press. The two-button control panel was installed on a pedestal and connected to the press with a long cord (see Photo 2). The pedestal could be moved to locations around the press allowing operator to have the best working view and easy access to the press.

Additionally, the press had a keyed control box built onto the press along its 42-inch wide face where raw

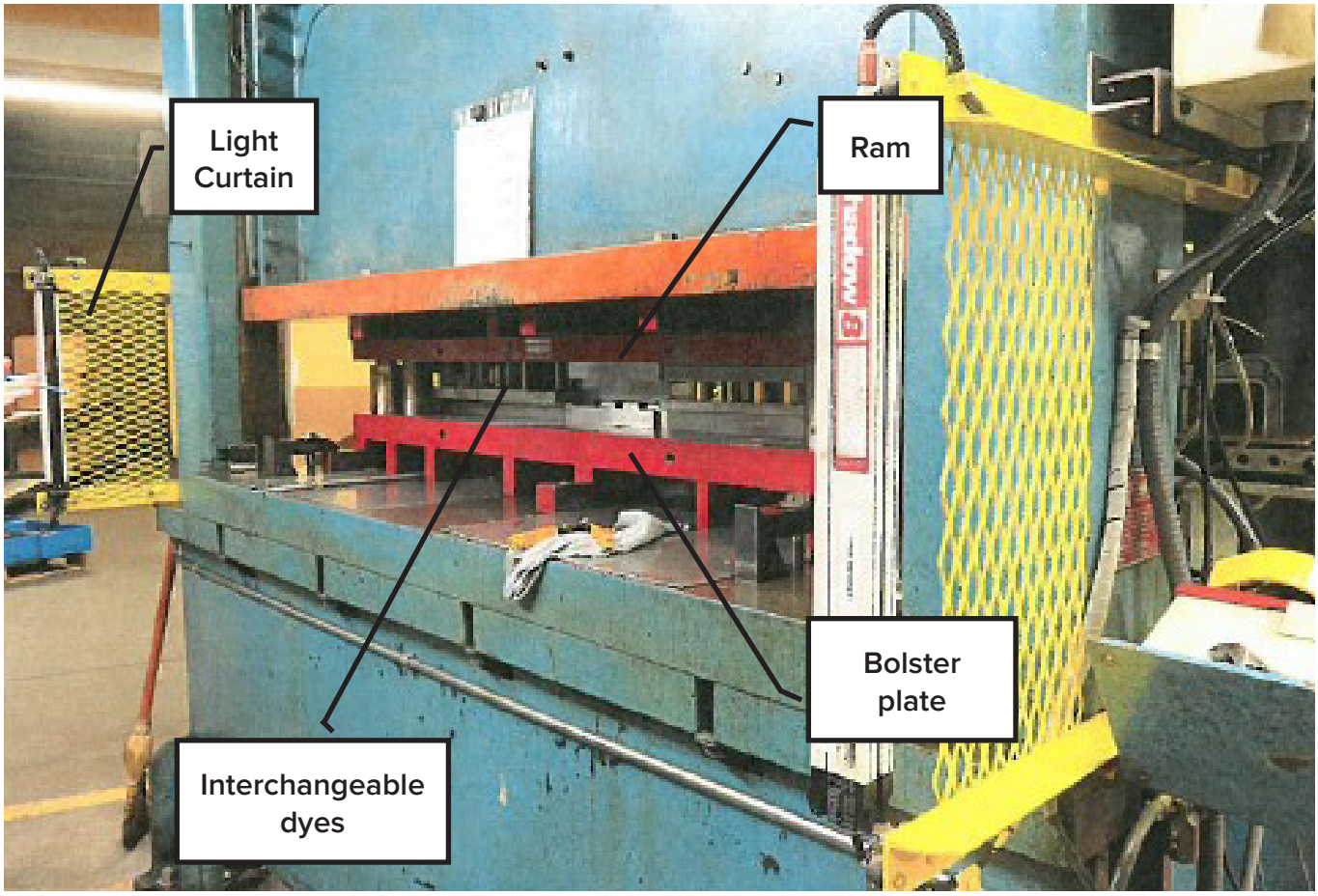

Photo 1. Mechanical Press involved in incident with light curtains (Photo courtesy of OSHA)

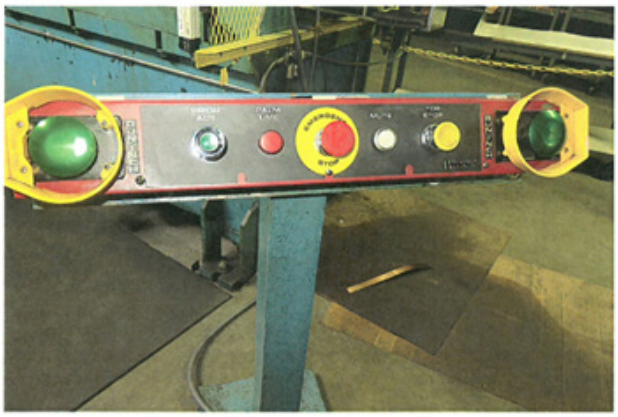

Photo 2: Pedestal-mounted two-button controller for press actuation. (Photo courtesy of OSHA)

Photo 3: Key-required controller mounted to infeed side of press. (Photo courtesy of OSHA)

material was fed into the press (see Photo 3). This control box required a key to switch press operational modes from "inch," where the ram moves in small incremental movements for die set up and test cycles, as well as a "run" mode which was for normal operation. The control box has an "off" selection, where the control box would override the dual push button control panel mounted to the pedestal.

INVESTIGATION

Prior to the incident, there was a near miss on the 200-ton press. Operators noticed that the ram would slowly start to slide down when the press was not being actuated by an operator. A third-party contractor came in and serviced the press by changing the clutch and rebalancing the press to prevent it from sliding on its own. Due to the near miss, the employer ordered the on-site fabrication shop to manufacture safety blocks to block the ram and prevent it from sliding without operator control, even though the press clutch had been repaired by the third-party contractor. Two safety blocks were furbished from aluminum available in house. The dimensions of the safety blocks were 16.75 inches long, 3 inches wide, and 3 inches deep.

The use and deployment of these safety blocks was new at the time before the incident to all employees who worked at the 200-ton press, and no written procedures or methods existed for how to place the safety blocks between the ram and bolster. Neither the shift supervisor nor the decedent had been trained on how to properly use the safety blocks prior to the day of the incident. Both had been instructed to use the safety blocks during operations that involved reaching in under the ram of the press.

Photo 4: In-house fabricated aluminum safety blocks with deformed corners and scraped metal face. (Photo courtesy of OSHA)

Photo 5: Picture of mechanical press ram indicating where safety block had been placed. (Photo courtesy of OSHA)

The day of the incident, the press was frequently jamming. The decedent and the shift supervisor noted that jamming became more frequent as the spooled copper for busbar manufacturing got smaller. The two employees would cycle the press, place the safety blocks between the ram and bolster on the side of the press closest to the operator, remove jammed copper by reaching in under the ram and pulling it out by hand, feed

fresh copper onto the die block by hand, trim the copper at the spool, remove the safety blocks, and cycle the press again. The two-button pedestal used for actuating the press had been moved to a position in front of the long side of the press, presumably for better line of sight and easier walking distance between the operator and the press. A visual representation of the layout prior to the incident is shown in Figure 1. This procedure of cycling the press and removing jams happened several times. The last time it happened, the safety blocks were left between the upper and lower die sets (plates that hold the die blocks) after the jam had been cleared and copper was fed through. The decedent, who was standing in front of the long side of the press by the pedestal controller, actuated the press. The two safety blocks were immediately ejected from the press: one block struck the decedent in the neck and chest inflicting severe injuries. Another employee tried to help with basic first aid, but the injured employee was heavily bleeding internally. Immediately after the injury, 911 was called, and another employee tried to help with basic first aid. Emergency medical technicians (EMT) responded in minutes, but the employee died at the scene due to blunt force injuries to the neck.

Post incident examination of the ejected safety blocks revealed that block deformation was limited to corners of the 3-inchx3-inch block face, indicating that uneven pressure was exerted on the block. This was likely caused by the positions of the blocks which were not aligned with the longitudinal central axis of the ram (Photos 4 and 5). The uneven pressure exerted by the press contributed to the blocks to be forcefully ejected, striking the victim.

According to OSHA, the decedent had been told to place the safety blocks towards the middle of the press by personnel with more experience, but this was not included in any written program. The light curtain did not stop the press from cycling because the operator was outside its 18 inch-detection perimeter around the press.

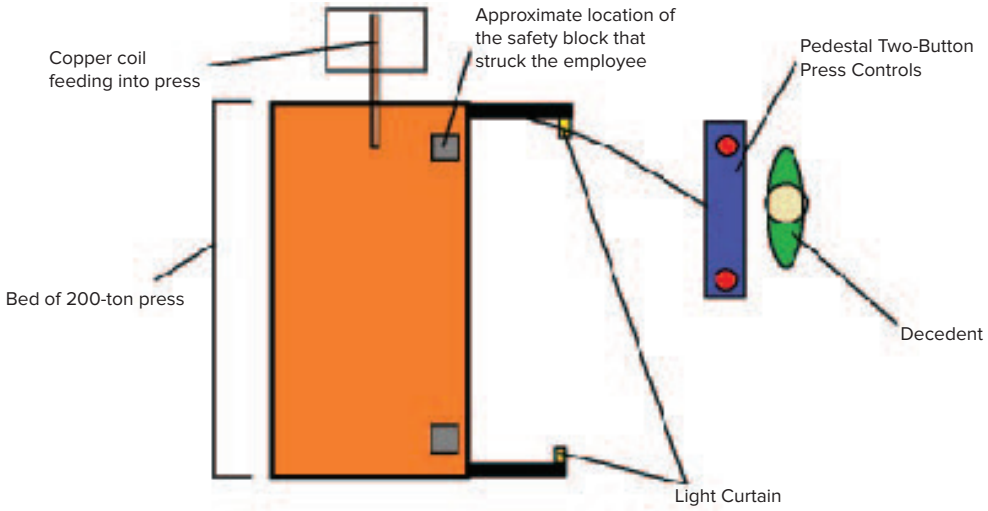

Figure 1. Overhead view of the incident scene

CAUSE OF DEATH

According to the medical examiner, the decedent died of blunt force injuries of the neck.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events. The NY FACE investigation identified the following key contributing factors in this incident:

- The operator was in the path of the projectile.
- No written procedures for setting up the machine, placing dies, clearing jams from the machine, or locking out the machine existed for reference by the operator(s).
- Limited training on the press was given to the decedent prior to his utilization of the press.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that interlock devices are used in conjunction with safety blocks when working with mechanical power presses.

Discussion: The safety blocks in this case were not interlocked with the power press. The safety blocks were left in the press unintentionally and became projectiles when the press was actuated causing the fatal injury. The incident would have been prevented if the safety blocks had been interlocked with the 200-ton press.

An interlock is a device that prevents unexpected or undesired movement of an energized machine through altering or impeding the flow of electrical energy to a machine when the interlock is disengaged. Regarding the mechanical power press, interlocks can be used to prevent machine actuation when physically attached to other manual safety devices, such as safety blocks, which when deployed would require the user to physically unplug

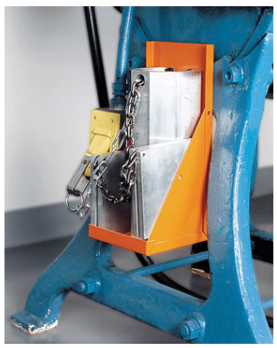

Photo 1: Example of safety blocks with interlock devices. (Photo from EHSToday.com)

the safety block from the interlock, which would in turn prevent the machine from actuating. The press would not have been able to operate again until all safety blocks were returned to their housings and plugged back into their interlock devices due to the disruption of electrical energy between the controls and the mechanical press.

The American National Standards Institute (ANSI) Standard B11.1-2009, section 6.13 talks about the requirements of safety blocks regarding mechanical power presses:

“Safety blocks, slide locks, or other die support means shall be designed, constructed and installed to either: a) hold the full working force of the mechanical power press and tooling members when machine actuation can take place while the mechanism is in place; or b) be interlocked with the mechanical power press to prevent actuation of hazardous motion of the machine while in place in its protective position and be designed and constructed to hold the maximum anticipated load.”

Several safety blocks are available on the market that include interlocks to avoid mechanical press cycling when the safety blocks are deployed. Safety blocks for mechanical presses are typically metal cylinders composed of an aluminum alloy with attached plugs on chains for interlock mechanisms (Photo 1). These plugs form the interlock system which when placed in-line with the press’s circuitry, prevent press actuation when the safety blocks are not plugged in.

Slide locks are another type of mechanical device like safety blocks that can be installed on the vertical portion of mechanical presses to support the ram. Like safety blocks, slide locks must also be designed to support the full static weight of the ram and all attached accessories, such as die blocks. Slide locks also require safety interlock devices to prevent unintentional press operation and/or be designed to withstand the full dynamic load of the press when actuated. Safety blocks and slide locks that can also stand up against the dynamic force (force when press is actuated), provide even further protection against electrical and mechanical safety failures.

Recommendation #2: Employers should ensure that the selected safety blocks meet the rated capacity of the specific power presses.

Discussion: Blocks can be purchased to support the full static weight of the 200-ton press ram and should be engineered to have sufficient contact area for ram support. Depending on the anticipated load of the press, up to four safety blocks may be required to withstand the static load of the ram.

The employer in this case did not consult with the press manufacturer about the appropriate specifications and requirements of the safety blocks, such as the size, height, and material strength as well as the number of the safety blocks needed for this press.

Recommendation #3: Employers should place safety blocks centered along middle length of press when servicing.

Discussion: By placing safety blocks centered along the central axis of the press, any difference in pressure in the ram would be prevented. In this case the safety blocks were placed on one long side of the ram closest to the operator, so when the press was actuated, the force of the ram created a pressure differential between the two halves of the press, causing one side of the ram to press unevenly, applying shear forces to the safety blocks that ejected the safety blocks from the press.

Another option for employers would be to use safety blocks on all four corners of the press to ensure that the pressure is distributed evenly across the ram. This would prevent any uneven depression that would unevenly deform safety blocks or force them out from between the ram and bolster.

Recommendation #4: Employers should ensure that press controls are moved to short ends of press to avoid risk of being struck by materials ejected during press operation.

Discussion: At the time of the incident, the decedent was standing by the controls in front of the long side of the press. Controls for this press are on a chord and can be maneuvered to several positions around the press. Keeping the press controls by the spool of raw material as it enters the press keeps employees out of areas where material could be more likely to be ejected from the press and allows more opportunity for guarding around the operating area. Additionally, the keypad that controls press speed and cycle type is located on the short end of the press where raw material is uncoiled and fed into the press. Keeping all points of control within the operator's reach allows the operator to control press movement through the key-operated control system as well as maintaining control of press operation through the two-button control pedestal.

Recommendation #5: Employers should design machine guarding that allows for the safe movement of all employees around active machinery.

Discussion: Besides light curtains, the long sides of the press involved in the incident were unguarded in order to allow employees to access the point of contact when they were required to manually remove finished product, remove scrap metal, or adjust and retool die blocks. There is no hard guard or barrier that would prevent ejected materials from hitting employees or other nearby personnel. In order to eliminate the risk of unintentionally hitting employees with ejected materials, the employer could build a fixed guard such as a cage around the press to prevent ejected materials from contacting employees during normal production or other press actuation. The cage could have doors or gates built into it for access with machinery or personnel. Those doors and gates could also be interlocked to prevent machine actuation while guards were opened.

Recommendation #6: Employers should deploy a maintenance and inspection schedule of mechanical presses.

Discussion: During this investigation, it was determined that the press was not being maintained in compliance with the recommended maintenance schedule which included weekly, biweekly, monthly, and annual checks for the Heim press. Only monthly maintenance checks were performed and documented on a card attached to the press.

Frequently inspecting mechanical press components for wear, operability, or other abnormality allows maintenance staff to continuously upkeep machines so that machine safety and performance features are operating correctly. Mechanical presses and other energized machines should be inspected and adjusted routinely in line with the manufacturer's suggested maintenance intervals. The manufacturer of the press involved in the incident has written instructions in the press manual regarding scheduled maintenance and inspection requirements. This information is often listed in the operating manuals of mechanical presses and other types of machinery. Employers should ensure that routine maintenance and inspection practices on mechanical presses are implemented.

Recommendation #7: Employers should ensure employees are thoroughly trained on machines they operate.

Discussion: During the investigation, it was determined that the decedent and the shift supervisor were not adequately trained on the procedural change to use safety blocks in between press actuations while troubleshooting, which contributed to the cause of the incident.

Employers should ensure that employees are knowledgeable in the safe operation of machinery and should ensure employees are aware of the tasks involved with operating machinery, especially high-risk activities

where there is an elevated chance of injury. Employers should ensure operators read the manual for machines they are required to operate, and are knowledgeable in the machine's workings, capacities, and potential troubleshooting requirements. When procedural changes occur, all parties involved with the operation and maintenance of the machine should be trained on the changes. Routine retraining and testing should occur to ensure that machine operators understand and maintain their knowledge on the machines they use.

Recommendation #8: Employers should conduct Job Hazard Analyses (JHAs) for specific tasks and instruct employees on how to safely work with and troubleshoot machinery issues during normal production operations.

Discussion: No specific procedures such as JHAs existed prior to the incident that described safe methods for setting die blocks, clearing jams, or otherwise performing specific operations and maintenance tasks on the 200-ton press that kept press operators out of harm's way. JHAs can establish specific methods for safely setting die blocks, clearing jams, or otherwise working on the press, while also addressing potential hazards such as caught between, struck by, fall, or harmful exposure hazards (including hot surfaces). Additionally, JHAs can implement procedures that specify what to do with operable controls of machinery while troubleshooting. For example, placing the key control in "off" when actively working in the point of contact area when setting up or adjusting die blocks.

Recommendation #9: Employers should train employees in Lock-out Tag-out (LOTO) procedures.

Discussion: During the OSHA investigation, it was determined that press operators were not trained in LOTO procedures, and that only maintenance personnel were LOTO certified. Also discovered during the investigation was the use of only one lock on LOTO points despite multiple employees working on the same machine. All personnel working on a mechanical press or other machine should place their own lock on energy isolation points for mutual protection against unintentional or unknown machine re-energizing. Locks and tags should clearly indicate who they belong to. This then requires all parties working on the machine to be aware of when the machine is and is not locked out and actively protects all participants in maintenance or other activities that require lockout tagout.

DISCLAIMER

Mention of any company or product does not constitute endorsement by the NY FACE and National Institute of Occupational Safety and Health (NIOSH). In addition, citations of websites external to NY FACE and NIOSH do not constitute NY FACE and NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NY FACE and NIOSH are not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

REFERENCES

American National Standards Institute (ANSI). Safety Requirements for Mechanical Power Presses. ANSI B11.1-2009 (R2014).

Michigan Fatality Assessment and Control Evaluation Program. "Co-Owner of Metal Forge Shop Dies When an Ejected Piece of Steel Used as a Stop Block in a Full Revolution Press Strikes Him in the Chest." Retrieved July 30, 2020 from https://www.cdc.gov/niosh/face/stateface/mi/03mi029.html

NIOSH. Injuries and Amputations Resulting from Work with Mechanical Power Presses. Retrieved July 30, 2020 from https://www.cdc.gov/niosh/docs/87-107/default.html

OSHA. Machinery and Machine Guarding, Mechanical Power Presses. 29CFR1910.217. Retrieved July 30, 2020 from https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.217

OSHA. Osha Instruction: Slide Locks-Enforcement Policy, Inspection Procedures and Performance Guidance Criteria. Retrieved July 30, 2020 from https://www.osha.gov/OshDoc/Directive_pdf/CPL_02-01-043.pdf

OSHA. Control of hazardous energy (lockout/tagout). 29 CFR 1910.147. Retrieved July 30, 2020 from https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.147

OSHA. Hazards Associated with the "Unintended (Double) Cycling" of Mechanical Power Presses. Retrieved July 30, 2020 from https://www.osha.gov/dts/shib/shib020210.html

Hale, Carrie. 2017. Die Safety Blocks: Why They're Needed and How To Use Them Retrieved July 30, 2020 from https://www.ehstoday.com/safety/article/21917888/die-safety-blocks-why-theyre-needed-and-how-to-use-them#:~:text=With%20the%20press%20motor%20off,weight%20the%20blocks%20must%20support

Rockford Systems, LLC. Safeguarding Mechanical Power Presses. Retrieved July, 30, 2020 from https://www.rockfordsystems.com/safeguarding-mechanical-power-presses/

INVESTIGATOR INFORMATION

This investigation was conducted by NY FACE, Bureau of Occupational Health and Injury Prevention, Center for Environmental Health, New York State Department of Health.

ACKNOWLEDGEMEMENT

The NY FACE Program would like to acknowledge the OSHA Buffalo Area Office for providing assistance and information for this investigation.

The New York State Fatality Assessment and Control Evaluation (NY FACE) is a research program funded by the National Institute for Occupational Safety and Health and administered by the New York State Department of Health. NY FACE collects information on work-related fatalities, investigates the incidents to identify the causes and contributing factors, proposes prevention measures, and shares the injury prevention information with employers, workers, and other organizations interested in promoting workplace safety. NY FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are kept confidential. Additional information regarding the NY FACE program can be obtained from:

New York State Department of Health FACE Program
Bureau of Occupational Health and Injury Prevention
Corning Tower, Room 1325
Empire State Plaza
Albany, NY 12237
866-807-2130
518-402-7900
boh@health.ny.gov
www.health.ny.gov/WorkSafe