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Joint FAM/Line Management Assessment Report on LLNL Machine Guarding Safety Program

J. J. Armstrong

August 4, 2016

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Ext: 2-3343

July 27, 2016
ESH-2016-049

MEMORANDUM

To: Thomas F. Gioconda

From: Frances Alston

Subject: *Joint FAM/Line Management Assessment Report on LLNL Machine Guarding Safety Program*

Please find attached for your approval *Joint FAM/Line Management Assessment Report on LLNL Machine Guarding Safety Program.*

For additional information, please contact Steve McConnell at extension 3-7386.

Frances Alston

Frances Alston, Director
Environment, Safety & Health

First Endorsement to Frances Alston's letter of 7/27/16:

From: Thomas F. Gioconda
To: Frances Alston

Assessment Report is, check one:

1. ✓ Approved
2. ____ Disapproved

On deficiency noting "needs a guard" need to know minimum get well date and deliberate operations till guards in place!

Thomas F. Gioconda

Enclosure: Joint FAM/Line Management Assessment Report on LLNL Machine Guarding Safety Program

Lawrence Livermore National Laboratory

Copy:
Armstrong, John
Larson, Diana
Kato, Thom
McConnell, Steve
Merrigan, Jim
Schultz, Bruce

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Joint FAM/Line Management Assessment Report on LLNL Machine Guarding Safety Program

ITS # 40478

J. Armstrong

July 19, 2016

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Joint FAM/Line Management Assessment Report on Machine Guarding Safety Program

May / June 2016

Prepared by:

John Armstrong 7-19-2016

John Armstrong Date
Worker Safety and Health Functional Area
ES&H Directorate

Reviewed by:

07/19/2016

Jim Merrigan Date
Assurance Manager
ES&H Directorate

Approved by:

Steve McConnell 7/19/16

Steve McConnell Date
Worker Safety and Health Functional Area Manager
ES&H Directorate

Joint FAM/Line Management Assessment Report on Machine Guarding Safety Program

1. Executive Summary

The LLNL Safety Program for Machine Guarding is implemented to comply with requirements in the *ES&H Manual* Document 11.2, "Hazards – General and Miscellaneous," Section 13 Machine Guarding (Rev 18, issued Dec. 15, 2015).

The primary goal of this LLNL Safety Program is to ensure that LLNL operations involving machine guarding are managed so that workers, equipment and government property are adequately protected. This means that all such operations are planned and approved using the Integrated Safety Management System to provide the most cost effective and safest means available to support the LLNL mission.

This Joint FAM/Line Management Assessment (JFLMA) conducted a broad review of performance of the machine guarding safety program at LLNL since the last assessment, completed in Aug. / Sept. 2013. The Machine Guarding Subject Matter Expert completed a Triennial Program Management Review and Health of the Program (HOTP) in May 2016.

A total of 13 lines of inquiry were developed to investigate three key areas that are selected to serve as representative indicators of compliance: A) operator training, B) equipment guarding, and C) operator work practices.

Training materials were found compliant with requirements, and equipment operators were found to be trained and currently qualified. Equipment guarding was found to be present, in good condition, adjusted properly, and effective, except for 10 deficiencies and with 6 observations. Operator work practices were found to follow machine-specific procedures, to use work-holding devices, to include inspection of guarding, to utilize correct eye and face PPE, to mitigate entanglement risks, and to follow lockout of energy controls when guarding is removed, except for 2 deficiencies and with 2 observations.

Utilizing the findings of the lines of inquiry, the assessment team concludes that overall the Lab safety program for machine guarding is effective in meeting the requirements. Through the course of this review, the assessment team identified a total of 12 deficiencies, 8 observations and 5 strengths. One issue, the missing guard on the B-873 table saw, was identified as an at-risk condition that was immediately mitigated to a safe configuration at the time of the observation to the satisfaction of the assessors.

Issue type by Line Of Inquiry	Issue Description
Strength 1 (LOI A2)	In the B-873 plumbing machine shop, a new Marvel band saw had been setup and operators received manufacturer training. The Marvel band saw was not yet released for work because the training was not yet complete, and it was not yet secured to the floor.

Issue type by Line Of Inquiry	Issue Description
Deficiency 1 (LOI B1)	In the B-873 carpenter's shop, there was no point of operation guarding on the Delta Uni saw table saw.
Deficiency 2 (LOI B1)	In B-806 Bay 4 a horizontal band saw (Wells) has a maximum exposed blade about 18 inches long, with insufficient guarding to cover the blade exposed outside of the point of operation.
Observation 1 (LOI B1) Observation 2 (LOI B1)	In the B-383 machine shop, vertical belt sander SA25 had a fan impeller housing on the dust collection system with openings in the cover that could allow a worker's finger to contact the fan blades. In B132S machine shop a belt sander SA79 fan impeller housing on the dust collection system had openings that could allow a worker's finger to contact the fan blades.
Deficiency 3 (LOI B1) Deficiency 4 (LOI B1) Deficiency 5 (LOI B1)	In B-806 Bay 2 a small lathe L185 needs a guard outside the headstock at the vacuum entry. In B-807 a lathe L485 needs a guard fabricated to cover the outside of the headstock at the vacuum fitting entry. In B-805 a lathe needs a guard fabricated to cover the outside of the headstock at the vacuum fittings entry.
Observation 3 (LOI B1)	In B-806 Bay 4 a lathe L299 has a partial guard on the top of the vacuum fitting outside the headstock that was not complete at the bottom.
Observation 4 (LOI B2) Observation 5 (LOI B2)	In the B-383 machine shop, LeBlond lathe L559 had a cracked chuck shield. In B-875 LeBlond lathe L196 had a cracked chuck shield.
Deficiency 6 (LOI B3)	At B-490 in the mechanical room at the SW corner, motor pump sets did not have custom shaft guarding secured (PHW-2-R(A), PCHW-02), or manufacturer-supplied guarding allowed excessively large gaps (PHW-1-R1(A1)).
Deficiency 7 (LOI B3) Deficiency 8 (LOI B3) Deficiency 9 (LOI B3) Deficiency 10 (LOI B3)	In the B-383 machine shop, pedestal grinder PG185 had tongue guard gaps >1/4 inch. In B-875 maintenance mechanics shop, Dayton grinding wheel right side had a clearance to the tongue guard >1/4 inch. In B-511 maintenance mechanics shop a pedestal grinder PG17 had a left side tongue guard opening >1/4 inch. In B-511 maintenance mechanics shop had a pedestal grinder PG73 with a right side tongue guard opening >1/4 inch and a tool rest opening >1/8 inch.
Observation 6 (LOI B4)	In the B-490 machine shop, there was no chip shield available for the lathe or drill press.
Observation 7 (LOI C1)	In B-806 Bay 2 a large lathe L8 should be secured by more than an out-of-service sign to notify operators it is not to be operated.
Strength 2 (LOI C1)	In the B-873 Carpenter's shop, slip resistant tape was applied to the floor at operator positions for machine tools that could generate significant amounts of sawdust.
Strength 3 (LOI C4) Strength 4 (LOI C4)	In B-132S machine shop a tapping tool was tagged as Out-Of-Service until a secure work surface could be implemented. In B-132S machine shop a worn cup wheel grinder was secured by an administrative lock until the wheel is replaced.
Observation 8 (LOI C7)	In the B511 Carpenter's shop, LOTO isolation points on the pop-up saw are not adequately identifiable despite an existing sign – "this machine has two energy

Issue type by Line Of Inquiry	Issue Description
	sources".
Deficiency 11 (LOI C7)	At B-490 on the roof at the NE corner, fans ACU 16, 17, 18, and 19 have disconnect switches used for LOTO located inside the fan enclosure, requiring removal of the access panel to operate them, where <18 inch clearance exists to pulleys and belts.
Deficiency 12 (LOI C7)	At B-490, on the roof at the West side above R-1065, fans FE14 and FE15 have their LOTO disconnects located under the mushroom head shrouds, requiring removal of the shroud to de-energize the fan and stop the exposed belt / pulley drives.
Strength 5 (LOI C7)	In B-132S machine shop a sign on the band saw blade cover read "LOTO before blade changeout".

2. Table of Contents

3. Assessment Plan

A written plan describing the elements of this Joint FAM/Line Management Assessment (JFLMA) was presented to and approved by the Worker Safety and Health Functional Area Manager on May 2, 2016. An assessment pre-brief meeting was held May 4, 2016. A final plan was approved and signed May 20, 2016. Interviews of key personnel and review of documents and records, as described in this section, occurred between May 16 and June 6, 2016.

a. Purpose

This JFLMA assesses whether field implementation of the machine guarding safety program at LLNL is in compliance with requirements described in the implementing document *ES&H Manual* Document 11.2, "Hazards – General and Miscellaneous," Section 13 Machine Guarding (Rev 18, issued Dec. 15, 2015).

b. Scope

This JFLMA assesses implementation of machine guarding as a control required by 29 CFR 1910 SubPart O, "Machinery and Machine Guarding" (1910.211 to 1910.219). Evaluation includes stationary machine tool shops and mechanical power transmission equipment operated by Facilities and Infrastructure, Engineering, NIF and Photon Sciences, Weapons Complex Integration, and Global Security directorates.

This JFLMA focused on three key areas for the machine guarding safety program. Key areas selected to serve as representative indicators of compliance are 1) operator training, 2) equipment guarding, and 3) operator work practices. This JFLMA provides a current status of these key areas for the machine guarding safety program and thus an assessment of the overall compliance. The core functions and guiding principles of the Integrated Safety Management System (ISMS) will be used as guideposts.

1) Operator Training

Core Function #1: Define the scope of work. *"Missions are translated into work, expectations are set,... tasks are identified and prioritized, and resources are allocated."*

Guiding Principle #3: Competence commensurate with responsibility. *"Personnel shall possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."*

The scope of this JFLMA includes an assessment of compliance with requirements for operator training. Training of employees according to requirements is important to ensure that equipment operators understand hazards and controls involved in their work. This JFLMA will assess whether training materials and courses conducted meet the requirements of the applicable *ES&H Manual* Document 11.2. For the machine guarding safety program reviewed, an inquiry judged whether:

- Training course materials are compliant with safety program requirements.
- All equipment operators subject to requirements are trained for the equipment and are currently qualified.

These elements reviewed are detailed in the Lines of Inquiry and Acceptance Criteria, at section c below. Documents reviewed include training materials and training records. Work observations were

conducted at active work locations, and records of recently completed work were reviewed. Interviews with equipment operators or their supervisors were conducted as part of this line of inquiry.

2) Equipment Guarding

Core Function #3: Perform Work. *"Readiness is confirmed and work is performed safely."*

Guiding Principle #6: Hazard controls tailored to work being performed. *"Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards."*

The scope of this JFLMA includes an assessment of compliance with requirements for equipment guarding. Guarding of equipment ensures that operation will not present an unforeseen hazard to the employee. This JFLMA will assess whether equipment guarding is present, in good condition, adjusted properly and effective. Inquiry will evaluate whether:

- Guarding of machine tools and equipment is present as prescribed by the machine guarding safety program.
- Guarding of machine tools and equipment is in good functional condition.
- Guarding of machine tools and equipment is adjusted properly and effective.

These elements reviewed are detailed in the Lines of Inquiry and Acceptance Criteria, at section c below. Documents reviewed include guarding requirements in the applicable LLNL documents. Observations of work areas and interviews with and work observations of equipment operators and their supervisors were conducted as part of this line of inquiry.

3) Operator Work Practices

Core Function #4: Perform work within controls. *"Readiness is confirmed and work is performed safely."*

Guiding Principle #7: Operations authorization. *"The conditions and requirements to be satisfied for operations initiated and conducted shall be clearly established and agreed upon."*

The scope of this JFLMA includes an assessment of the current state of operator work practices related to machine and equipment guarding. Operator work practices play a critical role in eliminating or mitigating machine and equipment hazards. This JFLMA will assess whether operator work practices contribute to safe work conditions. Inquiry will evaluate whether:

- Operators follow machine-specific procedures for operation and maintenance.
- Parts holding devices are available and used where needed.
- Operators inspect equipment for guarding and report deficiencies.
- Operators prevent entanglement and wear PPE.

These elements reviewed are detailed in the Lines of Inquiry and Acceptance Criteria, at section c below. Documents reviewed include records of machine-specific procedures and IWSs. Observations of work areas and interviews with and observations of operators and supervisors were conducted as part of this line of inquiry.

c. Lines of Inquiry and Acceptance Criteria

The following lines of inquiry and acceptance criteria were used in this assessment:

A. Employee Training			
Lines of Inquiry		**Data gathering method**	**Acceptance Criteria**
A1	Are training materials compliant with requirements?	Review current training materials for web-based course and for Instructor Led Training (ILT) courses. Interview MTOS instructors or designee. *HS5410-W, MTOS or PE or LTRAIN equivalent.*	Verify that the training requirements identified in LLNL implementing documents are included in a sample of the current training materials. *Document 11.2 Section 13.0. 29 CFR 1910, Subpart O, "Machinery & Machine Guarding" (1910.211 to 219).*
A2	Are LLNL employees observed actively operating a sample of machine tools and equipment trained and currently qualified? *HS5410-W* *MTOS EN27## or PE98## or LTRAIN equivalent*	Observe a sample of equipment operation in progress and interview operators in the field. Conduct concurrently with LOI B & C. Identify active IWS, and utilize ITS records to target locations, then current work with program POCs.	Verify that equipment operators observed in the field currently engaged in equipment operation are trained and currently qualified. *Document 11.2 Section 13.0. 29 CFR 1910, Subpart O, "Machinery & Machine Guarding" (1910.211 to 219).*
B. Equipment Guarding			
Lines of Inquiry		**Data gathering method**	**Acceptance Criteria**
B1	Is required guarding present at a sample of machine tools (point of operation) and equipment (mechanical power transmission) observed in active operation?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that guarding is present at all hazardous moving parts including belts, pulleys, rotating shafts, chains sprockets, and gears and rotating saw blades and abrasive wheels.
B2	Is guarding at machine tools and equipment present at a sample of equipment observed in active operation in good functional condition?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that guarding is in good functional condition, made with materials of sufficient strength and securely fastened, and does not pose a hazard to the operator.
B3	Is guarding at machine tools and equipment present at a sample of equipment observed in active operation adjusted properly and effective?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that guarding is adjusted properly to provide effective operator protection.
B4	Do machine shops have	Observe a sample of machine	Verify that a sample of machine

	portable chip shields available where such protection is not attached to the machine?	tool shops and interview operators and/or supervisors.	shops are equipped with portable chip shields adequate to provide protection where shields are not installed on machines. *See OSHA or ANSI reference Non-mechanical hazards*
C. Operator Work Practices			
Lines of Inquiry		**Data gathering method**	**Acceptance Criteria**
C1	Are operator work practices conducted in alignment with program requirements for stationary machine tools?	Observe operator in machine tool operation and interview operator and/or supervisor.	Verify that applicable safe work practices are followed, including machine-specific procedures.
C2	Are operator work practices conducted in alignment with program requirements for mechanical power transmission equipment?	Observe operator in work involving mechanical power transmission equipment and interview operator and/or supervisor.	Verify that applicable safe work practices are followed, including machine-specific procedures.
C3	Are operators utilizing parts-holding devices as needed to prevent unintended part movement at the point of operation?	Observe a sample of machine tool shops and interview operators and/or supervisors.	Verify that operators are utilizing parts holding devices as necessary and preventing unintended part movement at the point of operation.. *See OSHA or ANSI reference*
C4	Are operators inspecting machine tools and equipment for presence and condition of guarding prior to use?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that operators are inspecting guarding for machine tools and equipment prior to use, and reporting to a supervisor if guards are found missing or defective?
C5	Are operators observed at a sample of equipment in active operation NOT wearing loose clothing, jewelry, or accessories NOR wearing unsecured long hair?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that operators are taking all necessary steps to mitigate risk of entanglement injury.
C6	Are operators wearing eye and face protection required for the machine tool or equipment?	Observe a sample of machine tool and equipment operation in progress and interview operators.	Verify that applicable PPE is worn when required.
C7	Do operators isolate and secure all energy sources by LOTO IF guards must be removed?	Interview a sample of machine tool and equipment technicians.	Verify that applicable safe work practices are followed whenever guards are removed.

d. Methodology

The assessment team developed several lines of inquiry (LOI) to investigate the three areas of interest within the scope of this assessment. The team selected these particular LOIs because they help evaluate whether or not the identified elements of the machine guarding program are being implemented, and they provide a way to judge the overall compliance of the program. Evidence was gathered by:

- Interview of key personnel, including shop supervisors, subject matter experts and trainers.
- Observation of work areas and operators at work.
- Interviews of operators and supervisors.
- Verification of field documentation where possible.
- Review of a sample of the current available training records for each IS program assessed.
- Review of a sample of the currently available IWS records.

Where multiple locations exist within one of the target directorates, the location with active work will be observed. Where a shop uses primarily power tools that are portable, these were excluded. Areas with mechanical power transmission equipment may include shaft, belt, and chain driven equipment located on roofs, in basements, equipment rooms or other secured areas. Each shop was expected to provide the opportunity to observe active work as possible.

After collecting data, the assessment team evaluated it to determine if, and to what degree, the acceptance criteria are met. Finally, consistent with PRO-0051, *Institutional Procedure for Joint Functional Area Manager/Line Management Assessment*, the team determined whether any deficiencies, observations or strengths exist in accordance with the PRO-0051 definitions:

Deficiency	A condition, event, procedure, or operation that is not in compliance with the requirements of applicable federal, state, or local laws or regulations, the LLNS Contract, or the LLNL-specific implementing procedures or manuals.
Observation	A compliant condition, event, operation, or practice that warrants action tracking or is included for trending purposes to identify future potential areas for improvement.
Strength	A compliant condition or process described as a best management practice.

A separate subcategory of observation was included within the results for each LOI, called Opportunities for Improvement (OFI). These items were not included as observations as they were considered suggestions for evaluation and are not required. They are not issues that require action or tracking, unless the directly responsible party determines there is value.

e. Schedule

Review of documents, observation of field work areas, and interview and observation of operators and supervisors occurred between May 12 and June 6, 2016.

f. Team

John Armstrong, Lead Assessor	ES&H Directorate, Worker Safety and Health Functional Area, FAM representative

Bob Dillman, Assessor	Engineering Directorate, Assurance Officer, line management representative
Warren Rued, Assessor	Facilities and Infrastructure Directorate, Assurance Officer, line management representative
Myron Reyes, Assessor	Machine Guarding Subject Matter Expert, Industrial Safety Professional, ES&H Team 2. FAM representative
Trang Ha, Shadow Assessor	LSO/NNSA Industrial Safety
Lisa Tarte, Participating Assessor	Engineering Directorate, Safety Officer, line management representative
Pamela Divoky, Participating Assessor	National Ignition Facility and Photon Science Directorate, Assurance Officer, line management representative
Daryl Gorman, Participating Assessor	National Ignition Facility and Photon Science Directorate, Safety Officer, line management representative
Donna Mailhot, Participating Assessor	Global Security Directorate, Assurance Officer, line management representative
Jeff Freeman, Participating Assessor	Weapons Complex Integration Directorate, Assurance Officer, line management representative

g. Approval and Concurrence Authorities

Prior to issue, this report shall be concurred on by Jim Merrigan, ES&H Directorate Assurance Officer, and approved and released by Steve McConnell, Worker Safety and Health Functional Area manager (WS&H FAM).

h. Assessment Response Owner

Steve McConnell
Worker Safety and Health Functional Area Manager, ES&H Directorate

i. ITS Assessment Number: 40478

4. Results

a. General

The two LOIs that address training were fully met. Of the four LOIs that address guarding, two were met and two were not fully met. Of the seven LOIs that address work practices, six were fully met, and one was not fully met.

b. Detailed Analysis of Results

The detailed analysis below reports discussion of, and acceptance conclusions for, each Line of Inquiry.

1) Line of Inquiry A1: The training requirements identified in LLNL implementing documents are included in the current training materials.

Conclusion: Acceptance criteria are fully met.

Factual Basis: All machine shops observed except for F&I B-511 and B-873 utilize Engineering directorate to supply matrixed operators.

- Machine tool operators working in or for the O&B directorate are trained and tracked for safety checkout and proficiency by a number of methods specific to their individual supervisor. It is suggested that a common method be utilized across the shops within O&B. Rather than allowing individual evolution of training and tracking, a common form or template could increase formality and consistency through standardization.

Training materials in HS5410-W, in the MTOS series, and in the EN series emphasize rules for safe operation. These safe operating rules are reinforced in on-the-job skills training and in formal testing by work supervisors. The assessment team was able to conclude that flowdown of existing training requirements to current training materials have been sufficiently analyzed and deemed compliant for HS5410-W.

2) Line of Inquiry A2: A sample of equipment operators observed in the field currently engaged in equipment operation are trained and currently qualified.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Work observations conducted per Attachment b. verified that operators were trained and currently qualified for all types of equipment and in all locations. The typical work observation found that an IWS controlled for required training, that LTRAIN tracked the required training, and that the operators could provide proof where needed that training and qualification are current. The assessment team was able to conclude that equipment operators observed in the field were trained and currently qualified, and that an effective system is in place to sustain this.

Strength 1: In the B-873 plumbing machine shop, a new Marvel band saw had been setup and operators received manufacturer training. The Marvel band saw was not yet released for work because the training was not yet complete and it was not yet secured to the floor.

3) Line of Inquiry B1: Guards are present at all hazardous moving parts including belts, pulleys, rotating shafts, chains, sprockets, and gears as well as all rotating saw blades and abrasive wheels.

Conclusion: Acceptance criteria are not fully met.

Factual Basis: Work observations conducted per Attachment b. verified that in a broad sample of equipment observed in active service, a majority had guarding installed. Observed guarding was made of materials sufficient to prevent accidental contact, and did not pose a hazard. However, there were observations of both machine tools and mechanical power transmission equipment where guarding was insufficient.

Deficiency

One table saw had no point of operation guarding. The machine tool was not observed in use, but was available for service. The table saw was tagged out-of-service immediately and the circuit breaker was

locked out by the work supervisor. OSHA requirements for general machine guarding are found at 29 CFR 1910.212 (a), General requirements for all machines, and at 29 CFR 1910.213(c)(1), Hand-fed ripsaws and (d)(1), Hand-fed crosscut table saws.

Deficiency 1: In the B-873 carpenter's shop, there was no point of operation guarding on the Delta Uni saw table saw.

Deficiency

One band saw had insufficient guarding to cover the exposed blade outside the point of operation when small parts are worked. The machine tool was not observed in use, but was available for service. OSHA requirements for general machine guarding are found at 29 CFR 1910.212 (a), General requirements for all machines, and at 29 CFR 1910.213(i)(1), Bandsaws and band resaws.

Deficiency 2: In B-806 Bay 4 a horizontal band saw (Wells) has a maximum exposed blade about 18 inches long, with insufficient guarding to cover the blade exposed outside of the point of operation when small parts are worked.

Observation

Two observations were recorded in machine shops at belt sanders with openings in their impeller fan housing that were too large to adequately protect the worker. In both cases, the belt sander and exhaust fan were manufactured over 35 years ago. It would not be unusual that they were supplied this way, and that regulation and/or industry consensus standard did not exist at the time that addressed this. OSHA requirements for guarding at 29 CFR 1910.217 Table O-10 only apply to point of operation. In addition, 29 CFR 1910.213 (c)(1) and (d)(1) allow for ½ inch openings around fans. These machine tools were not observed in use, but were available for service.

Observation 1: In the B-383 machine shop, vertical belt sander SA25 had a fan impeller housing on the dust collection system with openings in the cover that could allow a worker's finger to contact the fan blades.

Observation 2: In B132S machine shop a belt sander SA79 fan impeller housing on the dust collection system had openings that could allow a worker's finger to contact the fan blades..

Deficiency

Three observations were recorded in machine shops that use vacuum for parts holding on lathes. At the entry of the vacuum fittings into the headstock there are rotational hazards that are unprotected. These machine tools were not observed in use, but were available for service. OSHA requirements for guarding of mechanical power transmission equipment are found at 29 CFR 1910.219 (c)(2), Guarding horizontal shafting, at (h), Keys, setscrews, and other projections, and at (i), Collars and couplings.

Deficiency 3: In B-806 Bay 2 a small lathe L185 needs a guard outside the headstock at the vacuum entry.

Deficiency 4: In B-807 a lathe L485 needs a guard fabricated to cover the outside of the headstock at the vacuum fitting entry.

Deficiency 5: In B-805 a lathe needs a guard fabricated to cover the outside of the headstock at the vacuum fittings entry.

Observation

One lathe had a guard covering the vacuum fittings where they enter the headstock, but only at the top. The OSHA requirement **1910.219(c)(2)(i)** specifies that horizontal shafting shall be protected by a "stationary casing enclosing shafting completely or by a trough enclosing sides and top or sides and bottom of shafting as location requires". This location had guarding that protected the top and sides.

Observation 3: In B-806 Bay 4 a lathe L299 has a partial guard on the top of the vacuum fitting outside the headstock that was not complete at the bottom. This covers the most likely potential point of contact at the top, but should also cover the bottom of the vacuum fittings.

4) Line of Inquiry B2: Guarding is in good functional condition, made with materials of sufficient strength and securely fastened to contain the parts in event of failure, and does not pose a hazard to the operator.

Conclusion: Acceptance criteria are met.

Factual Basis: Work observations conducted per Attachment b. verified that that no guarding was found to be in a non-functional condition. Two observations found lathe chuck shields that were intact but that had breaks or cracks that could limit their function. The assessment team was able to conclude that guarding observed for both machine tools and power transmission equipment is in good functional condition.

Observation

Two observations were recorded in machine shops at lathes that had chuck shields that were cracked or otherwise damaged and their functional capability appeared to be less than optimum. These are commonly referred to as guards, however are not rated for ballistic resistance to a catastrophic part ejection. They are more accurately called a shield because they primarily limit flying chips during operation.

Observation 4: In the B-383 machine shop, LeBlond lathe L559 had a cracked chuck shield. The machine tool was not observed in use, but was available for service.

Observation 5: In B-875 LeBlond lathe L196 had a cracked chuck shield. The machine tool was not observed in use, but was available for service.

5) Line of Inquiry B3: Guarding is adjusted properly to provide effective operator protection.

Conclusion: Acceptance criteria are not fully met.

Factual Basis: Work observations conducted per Attachment b. List of Interviews / Observations verified that a majority of guarding is effective in protecting operators. In one case a panel on a band

saw was left unlatched and slightly ajar, which was corrected on the spot. This was not discovered in other locations. The assessment team was able to conclude that outside of benchtop or pedestal grinding wheels, machine tools in active operation are being periodically inspected and adjusted by operators.

Deficiency

For mechanical power transmission equipment, motor-pump sets in an equipment room were fitted with custom fabricated guards on the drive shaft, but some were not finished or not fully secured. There is evidence that the Lab fabricated custom guarding that improved upon the manufacturer-supplied guarding. While appearing to be a strength, this effort was not completed and new guards were left unsecured, with adjacent shafts not yet improved. This may be lower priority work because the motor pump sets with shaft guarding were located in a locked equipment room, limiting exposure to escorted or permitted personnel. OSHA requirements for guarding of mechanical power transmission equipment are found at 29 CFR 1910.219 (c)(2), Guarding horizontal shafting.

Deficiency 6: At B-490 in the mechanical room at the SW corner, motor pump sets did not have custom shaft guarding secured (PHW-2-R(A), PCHW-02), or manufacturer-supplied guarding allowed excessively large gaps (PHW-1-R1(A1)).

Deficiency

Several benchtop or pedestal grinding wheels required adjustment of tongue guards and/or toolrests. These were all corrected on the spot. These machine tools were not observed in use, but were available for service. OSHA requirements for guarding of grinding wheels are found at 29 CFR 1910.215 (a)(4), Work rests, and at (b)(9), Exposure adjustment.

Deficiency 7: In the B-383 machine shop, pedestal grinder PG185 had tongue guard gaps >1/4 inch on both sides.

Deficiency 8: In the B-875 maintenance mechanics shop, Dayton grinding wheel right side had a clearance to the tongue guard >1/4 inch.

Deficiency 9: In the B-511 maintenance mechanics shop, a pedestal grinder PG17 had a left side tongue guard opening >1/4 inch.

Deficiency 10: In the B-511 maintenance mechanics shop, a pedestal grinder PG73 had a right side tongue guard opening >1/4 inch and a tool rest opening >1/8 inch.

6) Line of Inquiry B4: A sample of machine shops are equipped with portable chip shields adequate to provide protection where shields are not installed on machines.

Conclusion: Acceptance criteria are met.

Factual Basis: Work observations verified that all machine shops provided a variety of chip shields in different shapes and sizes, except for the smallest of the shops.

Observation

Where there was one smaller lathe that was typically limited to smaller size stock, no chip shields were available. When stock exceeds the limits of the chuck shield, a portable chip shield is typically employed. The chip shield is a best practice intended to minimize exposure of the operator to cutting and cleaning fluids, and to flying chips. The resident machinist promptly fabricated a portable chip shield upon request, within 24 hours.

Observation 6: In the B-490 machine shop, there was no chip shield available for the lathe or drill press.

7) Line of Inquiry C1: In machine tool operation, applicable safe work practices are followed, including machine-specific procedures.

Conclusion: Acceptance criteria are met.

Factual Basis: Machine-specific procedures are a function of familiarity with a machine tool. This is ensured through training, On-the-Job-Training, and observation for proficiency.

Observation

A large lathe has been removed from service by placement of an out-of-service sign because the supervisor describes it as "making sounds we don't like to hear". To reduce chances for accidental operation of the lathe we suggest tightening controls for operators who may not be familiar with the status of the lathe. The out-of-service sign is not a guarantee that an operator with access to the shop would not try to use it. If the switch disconnect or circuit breaker were administratively locked and/or tagged, that would provide added security against unauthorized use.

Observation 7: In B-806 Bay 2 a large lathe L8 needs more than an out-of-service sign to notify operators it is not to be operated.

8) Line of Inquiry C2: In work involving mechanical power transmission equipment, applicable safe work practices are followed, including machine-specific procedures.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Machine-specific procedures are a function of familiarity with the mechanical power transmission equipment. This is ensured through training, OJT, and observation for proficiency. Two separate instances of HVAC related work revealed that maintenance procedures were inherently hazardous due to the close proximity of energy-isolating devices to the fan or to belts and pulleys (see C7). In both circumstances, safe work practices were followed as possible, but limitations of the equipment configuration introduced unnecessary risk.

9) Line of Inquiry C3: A sample of machine tool shops shows operators are utilizing parts holding devices as necessary and preventing unintended part movement at the point of operation.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Work observations verified that all machine shops provided a variety of vises, clamps, and other parts holding devices. Associated point of operation devices such as fences, guides, and push sticks were readily available.

10) Line of Inquiry C4: A sample of machine tool and equipment operation shows operators are inspecting guarding for machine tools and equipment prior to use, and reporting to a supervisor if guards are found missing or defective.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Work observations verified that a number of machine tools have been removed from service, when operation, including guarding were identified as requiring adjustment, improvement, or replacement. Visual inspection of guarding by a machine tool operator prior to use are not documented. Maintenance / inspection performed by Engineering Machine Tool Services as a Preventive Maintenance on a project/task charge back basis is conducted, typically annually.

Strength

Machine tool equipment that was in need of replacement or improvement was tagged out-of-service and locked out to prevent operation until work is completed and the equipment released for work.

Strength 2: In B-132S machine shop a tapping tool was tagged as Out-Of-Service until a secure work surface could be implemented.

Strength 3: In B-132S machine shop a worn cup wheel grinder was secured by an administrative lock until the wheel is replaced.

11) Line of Inquiry C5: A sample of machine tool and equipment operation shows operators are taking all necessary steps to mitigate risk of entanglement injury.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Work interviews and observations conducted per Attachment b. verified that operator work practices to eliminate potential for entanglement are the norm. Professional pride, combined with supervisor oversight, serve to preclude any acceptance of loose clothing, hair, jewelry or accessories such as badges. Where long sleeves are present during operation of machine tools with rotating hazards, the sleeves are kept tight or rolled up to ensure they stay out of any "catchable edge".

12) Line of Inquiry C6: A sample of machine tool and equipment operation shows applicable PPE for eye and face protection are worn when required.

Conclusion: Acceptance criteria are fully met.

Factual Basis: Work interviews and observations conducted per Attachment b. verified that operator work practices utilize eye protection at all times with safety glasses, and face shield when sparks or

particulate is thrown. Availability of such personal protective equipment was verified, and usually found immediately next to the point of use.

One observation occurred in multiple shops which may deserve follow up, but was not a part of this assessment. All shops had some compressed air available to be used with a nozzle for cleaning. Many nozzles were identified with excess pressure relief to limit delivery pressure. It was not clear in all cases if compressed air was restricted to no greater than 30 psig at the nozzle and no greater than 100 psig at the regulator.

13) Line of Inquiry C7: Applicable safe work practices are followed whenever guards are removed.

Conclusion: Acceptance criteria are not fully met.

Factual Basis: Work interviews and observations conducted per Attachment b. verified that operator work practices for guard removal in a machine shop demonstrate understanding of the hazards involved. A majority of the panel removal for maintenance purposes is conducted by Machine Tool Services. In case of blade change out for a band saw, operators are universally aware that LOTO is required to remove the panels that serve as guarding at the blade wheels and drive belts and pulleys. All those questioned understood that using the saw blade welder requires replacement of the panels before the band saw can be re-energized.

Strength

Signage placed directly on the band saw panel that covers the saw blade provides notice that is impossible to ignore.

Strength 4: In B-132S machine shop a sign on the band saw blade cover reads "LOTO before blade changeout".

Observation

In one instance, a pop up saw had energy isolation points that were not obvious. An electrical switch disconnect was located several feet away from the start / stop button. The quick disconnect for the pneumatic parts clamp was hidden below an on / off switch.

Observation 8: In the B511 Carpenter's shop, LOTO isolation points on the pop-up saw are not adequately identifiable despite an existing sign – "this machine has two energy sources".

Deficiency

For mechanical power transmission equipment, the rooftop fans on B-490 did not provide adequate clearance from the fans blades or the drive belts and pulleys when operating the local switch disconnect. Switch disconnects were located inside guards, requiring removal of guarding to de-energize and lockout the fan. There are externally mounted on/off buttons which normally would be used to cut power before workers open the access panels. However, in this work evolution for fans ACU 16, 17, 18, and 19, the on/off buttons did not function and workers decided that opening the panel is much more expeditious than finding and identifying the correct circuit breaker.

Belts and pulleys must be guarded per OSHA 29 CFR 1910.219(d) and (m). OSHA requirements found at 29 CFR 1910.147, Control of hazardous energy, apply when employees are required to remove a guard or place any part of their body into an area on a piece of equipment where an associated danger zone exists during a machine operating cycle. ES&H Manual Document 11.2, Section 13.0 Machine Guarding provides requirement implementing direction:

- Guards shall not be removed for any reason unless specifically authorized in an IWS or SP.
- If guards must be removed for servicing or maintenance of equipment, all energy sources shall be secured and isolated (see DES-2401, *LLNL Lockout/Tagout (LOTO) Program*).

Deficiency 11: At B-490 on the roof at the NE corner, fans ACU 16, 17, 18, and 19 have disconnect switches used for LOTO located inside the fan enclosure, requiring removal of the access panel to operate them.

Deficiency 12: At B-490, on the roof at the West side above R-1065, fans FE14 and FE15 have their LOTO disconnects located under the mushroom head shrouds, requiring removal of the shroud to de-energize the fan and stop the belt / pulley drives.

5. Attachments

Attachment a. List of Personnel Interviewed presents the Responsible Individuals, supervisors, and operators who were interviewed. Attachment b. List of Interviews / Observations presents work observations that were conducted. In four of seven shops observed, the work area was observed in a static condition because no work was scheduled.

a. List of personnel interviewed

Name	Date Interviewed	Program Service Capacity
Pete Shoenenberger	May 12	Program Superintendent
Steve Stafford	May 12	AI
John Benedict	May 12, 24, 26	RI
Paul Ahre	May 12	Training
Mike Neylan	May 12, 24	Instructor
John McKinley	May 16	Lead Work Planner F&I
Mike Berg	May 16	FPOC
Louis Renner	May 17	WS&H FA SME
Joe King	May 23	Supervisor
Traci Bailey	May 23	Supervisor
Larry ____	May 23	Operator / Instructor
Ron Darbee	May 24	AI
Randy Aceves	May 24	RI
Jeff Warner	May 25	Supervisor
Paul Widger	May 26	RI
Rich Austin	June 2	Shop Lead

Jimmie Jessup	June 2	Operator / Instructor
Robert Bates	June 6	Supervisor / RI
Scott Dossey	June 6	Supervisor

b. List of interviews / observations

Program	Location	Date	Subject	Interviewed	Team participants
Engineering	321	May 12	MTOS training, qualification, authorization	Schoenenberger, Stafford, Ahre, Benedict, Neylan	Tarte, Reyes, Ha, Armstrong
F&I Deployed team HVAC	B490 East side roof	May 16	Mechanical Power Transmission Equipment	Berg, McKinley, Arthur, HVAC team, Pogers	Gorman, Rued, Ha, Armstrong
"	B490 West side roof	May 17	"	HVAC team, Renner	
F&I Central Dept.	B511 Carpenters shop	May 23	Machine shop	King, Bailey, Larry + 2	Rued, Dillman, Reyes, Ha, Armstrong
NIF & PS (Op by ENG)	B490	May 24	Machine shop	Darbee, Aceves,	Dillman, Divoky, Gorman, Reyes, Ha, Armstrong
Engineering	B383	May 24	Machine shop	Benedict, Neylan	Rued, Tarte, Reyes, Ha, Armstrong
F&I Central Dept. S-300	B873, B875	May 25	Machine shop	Warner	Rued, Reyes, Ha, Armstrong
Global Security (Op by ENG)	B132S	May 26	Machine shop	Benedict, Widger	Dillman, Mailhot, Reyes, Ha, Armstrong
F&I Central Dept	B511 Maint. Mechanics shop	June 2	Machine shop	Austin, Jessup	Rued, Reyes, Ha, Armstrong
WCI (Op by ENG)	B806A/B	June 6	Machine shop	Dossey, Bates	Reyes, Ha, Armstrong

Note: Participants are considered assessment "team" members even if they attended only one observation. They were not interviewed as part of those taking local responsibility for the area.