



## Backhoe Boom Collapses Endangering Workers

### Purpose

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To share “lessons learned” gained from incident investigations through a small group discussion method format.

To understand “lessons learned” through a Systems of Safety viewpoint.



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### Lessons Learned

### Volume 10, Issue 32

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## Background Information

Before beginning this Lessons Learned, please review this and the next page which contain information that will introduce the concepts of Lessons Learned and Systems of Safety.

Creating a safe and healthy workplace requires a never ending search for hazards that sometimes are not obvious to us. These hazards exist in every workplace and can be found by using various methods. Lessons Learned are just as the name suggests: learning from incidents to prevent the same or similar incidents from happening again.

**Systems Are Not Created Equal: Not equal in protection and not equal in prevention.**

Using our Systems Focus to uncover system flaws or root causes is only one part of controlling hazards. We also need to look at the systems involved to decide on the best way to deal with the problem. The most effective way to control a hazard is close to its source. The least effective is usually at the level of the person being exposed. The system of safety in which the flaw is identified is not necessarily the system in which you would attempt to correct the flaw.



Major Safety System	Design & Engineering	Maintenance & Inspection	Mitigation Devices	Warning Devices	Training & Procedures	Personal Protective Factors
Level of Prevention	Highest—the first line of defense	Middle—the second line of defense			Lowest—the last line of defense	
Effectiveness	Most Effective	←————→				Least Effective
Goal	To eliminate hazards	To further minimize and control hazards				To protect when higher level systems fail
<b>EXAMPLES OF SAFETY SUB-SYSTEMS**</b>	<b>Technical</b>	Inspection and Testing	Enclosures, Barriers Dikes and Containment	Monitors	Operating Manuals and Procedures	Personal Decision-making and Actions HF
	Design and Engineering of Equipment, Processes and Software	Maintenance	Relief and Check Valves	Process Alarms	Process Safety Information	Personal Protective Equipment and Devices HF
	Management of Change (MOC)**	Quality Control	Shutdown and Isolation Devices	Facility Alarms	Process, Job and Other Types of Hazard Assessment and Analysis	Stop Work Authority
	Chemical Selection and Substitution	Turnarounds and Overhauls	Fire and Chemical Suppression Devices	Community Alarms	Permit Programs	
	Safe Siting	Mechanical Integrity	Machine Guarding	Emergency Notification Systems	Emergency Preparedness and Response Training	
	Work Environment HF				Refresher Training	
	<b>Organizational (must address a root cause)</b>				Information Resources	
	Staffing HF				Communications	
	Skills and Qualifications HF				Investigations and Lessons Learned	
	Management of Personnel Change (MOPC)				Maintenance Procedures	
	Work Organization and Scheduling HF				Pre-Startup Safety Review	
	Work Load					
	Allocation of Resources					
	Buddy System					
	Codes, Standards, and Policies**					

HF - Indicates that this subsystem is often included in a category called Human Factors.

\* There may be additional subsystems that are not included in this chart. Also, in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.

\*\* The Codes, Standards and Policies and Management of Change subsystems listed here are related to Design and Engineering. These subsystems may also be relevant to other systems; for example, Mitigation Devices. When these subsystems relate to systems other than Design and Engineering, they should be considered as part of those other systems, not Design and Engineering.

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### **Lessons Learned Statement**

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Inadequate training and a failure to follow manufacturer's guidelines led to the collapse of a backhoe, which could easily have resulted in an injury. *Systems of Safety* are utilized to prevent this type of incident.

A failure in the **Design and Engineering System of Safety** allowed the backhoe to be built with no secondary locking device to hold the pivot pin in place if the keeper pin was missing.

Failure to follow lubrication and maintenance recommendations for a backhoe led to the loss of a retaining pin and resulted in a boom failure. There was no action taken within the **Maintenance and Inspection System of Safety** to ensure that site procedures adequately matched those recommended by the manufacturer.

The **Training and Procedures System of Safety** for operators should include visual checks to ensure all securing mechanisms are complete and operable prior to proceeding with use of the equipment. This could best be achieved with proper training and a pre-startup checklist. An equipment Operator's Manual for any equipment should always be available to be referenced by the operator.

## Discussion

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Two mechanics were given a work order to remove/demolish an old monitoring station building, which was a wood frame structure approximately 20 ft. by 20 ft. The front-line manager recommended they use the plant backhoe for the job. After the backhoe was in position, the operator began to raise the boom and stretch the bucket outward into position. During this maneuver, the boom collapsed on the right side leaving the backhoe disabled. The operator immediately shut the equipment down and inspected the boom arm. He discovered that a pin had slipped out of the boom.

Closer inspection revealed that the keeper pin<sup>1</sup> on the left boom pivot pin was missing. This allowed the pivot pin to back out of its housing, dropping the left side of the boom base. There was no other locking device on the pivot pin to prevent this.



Operators had reported high vibration of the equipment's lower end. It was felt that this was due to inexperienced operators using the backhoe and lack of lubrication causing undue wear on the equipment. The vibration was most likely the cause of the keeper pin being missing.

Operator training was very minimal and did not address issues such as pre-startup inspection and safe operation. The employer's maintenance procedures did not meet the manufacturer's guidelines. In fact, the backhoe in use was past its due date for an oil change and lube service.

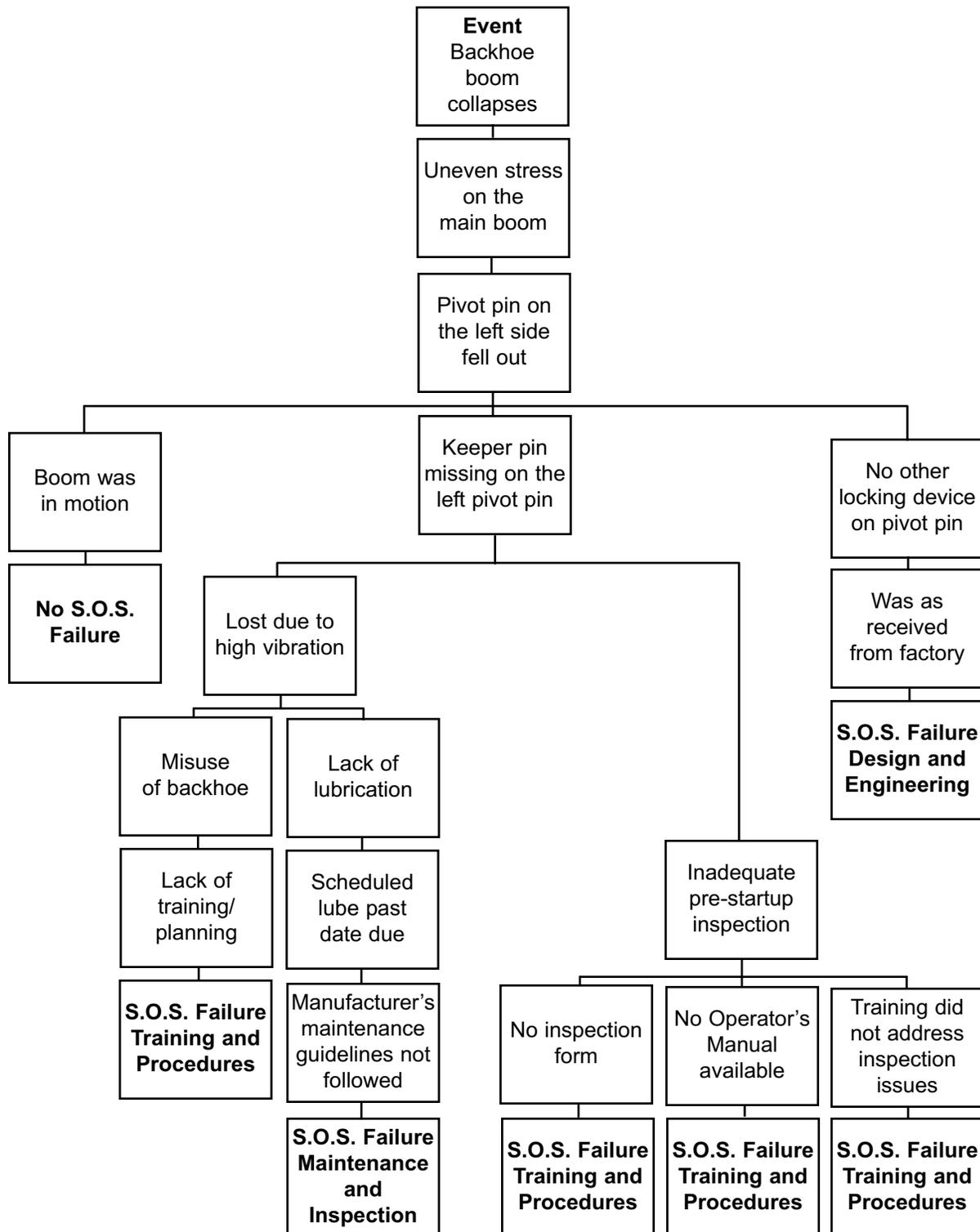
The pre-startup inspection the workers performed did not reveal the problem. This was basically just a walk-around viewing of the equipment. There was no inspection form and no operator's manual or training to show what type of things to look for.

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<sup>1</sup> Keeper pin — a pin or bolt inserted in the end of a large bolt to prevent pieces held by the bolt from slipping off.

## Analysis

The **Logic Tree** is a pictorial representation of a logical process that maps an incident from its occurrence, “the event,” to facts of the incident and the incident’s root causes.



## **Recommended Actions**

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1. Replace pivot pin and keeper pin for boom.
2. Evaluate the use of a secondary locking device on the pivot pin.
3. Increase lubrication frequencies to meet the manufacturer's specifications.
4. Ensure that pivot points are greased daily.
5. Implement and train employees on individual equipment per manufacturer's specifications. This should include pre-startup inspections and possible problems that can occur.
6. Make sure that the equipment operator's manual is kept with all backhoes or other mobile equipment for the operator's reference.
7. Develop an appropriate daily pre-startup inspection form to include lubrication of weather-exposed pivot points and confirmation that keeper pins are in place.
8. Review all mobile equipment and evaluate the adequacy of the preventive maintenance for each, and determine if the manufacturer's specified usage has been violated.
9. Ensure that the right equipment is being used for all jobs.

## Education Exercise

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Working in your groups and using the Lessons Learned Statement, Discussion, Analysis and Recommended Actions, answer the two questions below. Your facilitator will give each group an opportunity to share answers with the large group.

1. Give examples of ways to apply the Lessons Learned Statement at your workplace.

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2. Of the examples you generated from Question 1, which will you pursue in your workplace? (**Note:** When we say something you may pursue, we mean a joint labor-management activity or a union activity rather than an activity carried out by you as an individual.)

## Trainer's Lessons Learned Success Inventory

Following a Lessons Learned (LL) session, **the trainer who led the LL** should complete this form. This information will: 1) Help you reflect on the successes and challenges of the session; 2) Help USW with new curriculum development; and 3) Help USW as a whole better understand how the LL Program is supporting their workers.

By reviewing LL from different sites or from other areas of their workplaces, workers are able to analyze the information and apply these lessons to their own workplaces in order to make their workplaces healthier and safer.

1. Site name (if there are participants from more than one site, please list all).

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2. Date of LL training \_\_\_\_\_
3. LL number used in today's Training \_\_\_\_\_
4. Your name \_\_\_\_\_
5. **Summary of Education Question 1:** Please summarize participants' examples of ways to apply this LL Statement to their workplace.

**Please continue on reverse side.**

- 6. Summary of Education Question 2:** Please summarize actions or recommendations participants discussed pursuing at their workplace(s).

**Thank you for completing this form.**

# EVALUATION

## Lessons Learned: Backhoe Boom Collapses Endangering Workers

Please answer the two questions below:

1. How important is this lessons learned to you and your workplace? (Circle one.) Rate on a scale of 1 to 5, with 5 being the most important.

1	2	3	4	5
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2. What suggestions would you make to improve this Lessons Learned?

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## End of Training Trainer's Instructions

Please complete the information below.

Trainer's Name \_\_\_\_\_  
(Please Print)

Date of training: \_\_\_\_\_

No. of Participants: Total \_\_\_\_\_ Hourly \_\_\_\_\_ Management \_\_\_\_\_

Location of Training: \_\_\_\_\_

USW Local # \_\_\_\_\_

Send:

1. This page;
2. The Education Exercise (page 8);
3. The Trainer's LL Success Inventory form (pages 9 and 10);
4. The evaluation for each participant (page 11); and
5. The Sign-in sheet (page 13) to:

<p><b>If you are a TOP Site (excluding DOE TOP Sites)</b></p>	<p><b>Send to: Steve Cable 2915 Gradient Drive St. Louis, MO 63125</b></p>
<p><b>All other sites (including DOE TOP Sites)</b></p>	<p><b>Send to: Doug Stephens United Steelworkers 3340 Perimeter Hill Drive Nashville, TN 37211</b></p>

Thank you for facilitating the sharing of this  
Lesson Learned with your coworkers.



**SIGN-IN SHEET**      *(Please print clearly.)*

**Class Title:** \_\_\_\_\_ **Class Completion Date:** \_\_\_\_\_

**Location (City, State)/Facility:** \_\_\_\_\_

**Grant Program:** \_\_\_\_\_ **Dist. & LU #:** \_\_\_\_\_

**Instructors: 1)** \_\_\_\_\_ **2)** \_\_\_\_\_

**3)** \_\_\_\_\_ **4)** \_\_\_\_\_ **5)** \_\_\_\_\_

**Name (print first and last)**

**Check one:**

		<b>Hourly</b>	<b>Management</b>
1			
2			
3			
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