

INCIDENT INVESTIGATION: QUALIFIED, QUANTIFIED AND SIMPLIFIED!!

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EXAMPLE 1



BYRON BEATTIE - BACKGROUND

☐ + 30 years in EHS

☐ Environment Health Safety Consultant

☐ Completed over 330 EHS incident investigations

☐ HAZWOPER trainer

☐ Mgmt. System Auditor EHS Management

☐ Training includes Apollo RCA Superuser, Incident Investigation Analysis

☐ Registered OSHA Industry Outreach Trainer (10/30 hour), Forklift, HAZWOPER trainer

☐ ISO14001/9001 Lead and Internal Auditor

☐ Industry Experience

☐ Chemical, coatings and paint process mfg.

☐ Automotive parts mfg. (stamping, assembly, painting, welding, rubber mfg., electronics)

☐ Metal fabricating / enhancement (shot and laser peening, sanding, drilling, grinding, thermal spray, etc.)

☐ Plastic bottle mfg. (injection and blow mold operations, packaging)

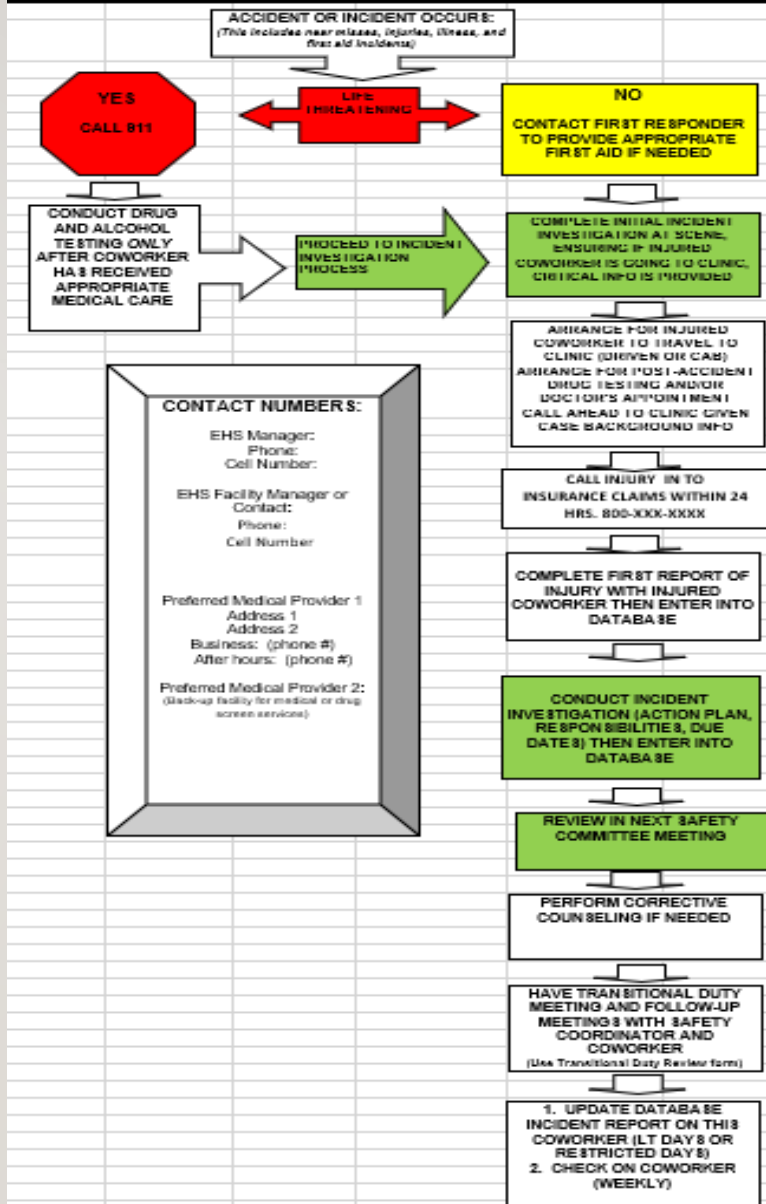


AGENDA

KEEPING IT SIMPLE

- A. Neutralize immediate/persistent threats to the environment, safety and health
- B. Determine the depth of the investigation
- C. Demonstrate your and the team's robust involvement through personal engagement
- D. Reviewing and utilizing the 5 why problem-solving process as a structured investigation tool for multiple uses (hands on demonstration)
- E. Be able to utilize and analyze several types of sub investigative methods to support such a process
- F. Best ways to identify hazard control measures, appropriate responses to prevent reoccurrence and follow up
- G. Communicate to key leaders
- H. Celebrating the Win!

INCIDENT INVESTIGATION PROCEDURES/FLOWCHART

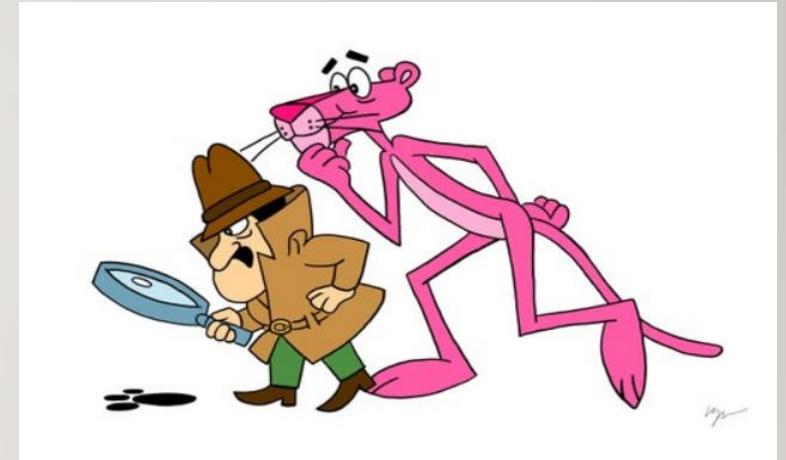


A. INVESTIGATIVE DEPT

HOW IS YOUR INCIDENT INVESTIGATION AWARENESS?

“QUALIFIED”

- Organizational culture is seen as a critical factor in achieving corporate performance and safety goals, such as the reduction of recordable and lost-workday injury rates.
- Incident investigations is one element of that effective safety culture. Including the process of documenting, analyzing, and addressing an incident that results in a near miss or first aid as well as recordable injuries or fatalities.



A. INVESTIGATIVE DEPTH

WHY HAVE A GREAT (NOT GOOD) INVESTIGATIVE PROCESS

“QUALIFIED”

- It is a conduit supporting your 4 primary pillars of your safety program:
 - **People, Exposure Control, Mgmt. System, Promotion** (*Embracing Change*)
- Reduce or eliminate events that need to be investigated fully including:
 - Injuries (First aids, recordable and lost time injuries) and Illnesses
 - Near Misses
 - Cost of Losses
 - Ignitions
 - Property Damage
 - Demonstrates the company's commitment to health and safety
 - Promotes positive workplace morale
- Needing to complete an effective accident investigation, to reduce or eliminate that event from reoccurring
- Completing the investigation - **being consistent**
- Establishing an attainable, viable and closeable corrective action plan
- Engaging facility group to complete the investigation
- Getting your safety committee(s) involved in the process and or the follow-up

B. ISOLATE AND NEUTRALIZE THREATS INITIAL RESPONSE

- After an accident occurs, the initial response should be as follows:
 - Get treatment for individuals that may be injured.
 - Secure the site
 - initiate interim controls
 - Assure the safety of others
 - Initiate chemical spill release control and containment plan
 - Initiate the investigation



C. TEAM INVOLVEMENT

WHO TO INVOLVED IN ACCIDENT INVESTIGATIONS? EXAMPLE 2

- Dependent on the severity
 - Person involved
 - Witnesses
 - Supervisor (s)
 - Contractors (if involved in incident) and or maintenance staff
 - Operators with similar jobs
 - Safety committee members
 - Environmental Health and Safety contact
- Management involvement and support
- All employee engagement - post communication posting / discussion
- Establish the baseline – reduce / eliminate (failure) events from initiating



C. TEAM INVOLVEMENT

INFORMATION GATHERING - EQUIPMENT AND ITEMS TO SUPPORT THE INVESTIGATION

- Good things to have and use
 - Camera
 - Take pictures
 - Ensure all items in the area are review for involvement
 - Measuring tape
 - Barricade tape
 - Plastic vials with caps
 - Graph paper
 - Batch or job tickets
 - SDS (if chemical related)
 - Accident investigation forms – first report of injury, witness statements, incident investigation form
 - Others(?)

NEW SDS FORMAT

By June 1, 2015, chemical manufacturers, importers, or other employers preparing a safety data sheet (SDS) must format it using consistent headings in the following 16-section sequence.

Section 1 Identification—includes product identifier, manufacturer or distributor name, address, phone number, emergency phone number, recommended use, and restrictions on use

Section 2 Hazard(s) identification—includes all hazards regarding the chemical and required label elements

Section 3 Composition/information on ingredients—includes information on chemical ingredients and trade secret claims

Section 4 First-aid measures—includes important acute or delayed symptoms or effects and required treatment

Section 5 Fire-fighting measures—lists suitable extinguishing techniques, equipment, and chemical hazards from fire

Section 6 Accidental release measures—lists emergency procedures, protective equipment, and proper methods of containment and cleanup

Section 7 Handling and storage—lists precautions for safe handling and storage, including incompatibilities

Section 8 Exposure controls/Personal protection—lists OSHA's PELs, threshold limit values (TLVs), appropriate engineering controls, and PPE

Section 9 Physical and chemical properties—lists the chemical's characteristics

Section 10 Stability and reactivity—lists chemical stability and possibility of hazardous reactions

Section 11 Toxicological information—includes routes of exposure, related symptoms, acute and chronic effects, and numerical measures of toxicity

Section 12 Ecological information*

Section 13 Disposal considerations*

Section 14 Transportation information*

Section 15 Regulatory information*

Section 16 Other information—includes date of preparation or last revision

*Notation concerning Sections 12 to 15: OSHA will not enforce the information requirements in Sections 12 to 15; however, the SDS must include at least the heading names for those sections.



C. TEAM INVOLVEMENT

INFORMATION GATHERING - ATTENTION TO THE DETAIL – QUANTIFIED

➤ Inspect the accident site and note information such as:

- Positions of injured workers
- Equipment and materials being used
- Safety devices in use
- Position appropriate guards
- Positions of controls of machinery
- Damage to equipment
- Housekeeping of the area
- Weather conditions
- Lighting levels
- Noise levels



➤ Gather information:

- On procedures and rules for the area
- On maintenance records and equipment involved
- By taking photographs and making diagrams
- From employees

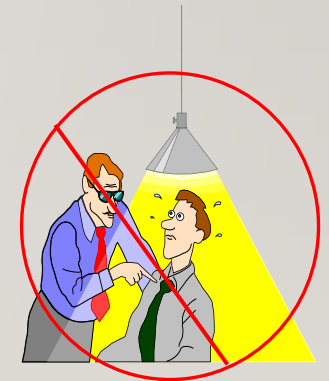


C. TEAM INVOLVEMENT

INFORMATION GATHERING – INTERVIEWS (KEY INGREDIENT!!)

QUANTIFIED

- Injured Employee and Witness Interviews
 - Put the employees, who are probably upset, at ease
 - Emphasize the real reason for the investigation, to determine what happened and why
 - Let the employee talk, you listen
 - Confirm that you have the statement correct
 - Try to sense any underlying feelings of the employee
 - Make short notes only during the interview
 - Ask open ended questions (NOT “yes” or “no” answers).
 - Use probing questions to get more information (FILL IN THE GAPS).
 - Ensure robustness – repeat back lines to reduce the gaps in the story or subevents which are not clear/vague
 - The fuller the story line the better the understanding of the timeline and the process that caused the incident
 - ***Make the employees feel that they are part of the solution***
- Individual vs. Group Think Discussion – *what’s best?*



C. TEAM INVOLVEMENT

INFORMATION GATHERING - GROUP FACILITATION / THINK PRIMARY STEPS "STRENGTH IN #S" "SIMPLIFY"

- Be Familiar with the RCA Method
- Manage the Group – Keep team members and discussion on track !
- Starting the Meeting
- Facilitators Responsibilities
- Performing the Analysis
 - *Suspend judgment of all input*
 - *Maintain a positive bias about the all statements*
 - Place all proposed causes on the chart – do not filter what is stated
 - Collect all the information the chart requires
 - Put up a lot of causes (USE THE **PARKING LOT** 😊)
 - Don't skip the baby steps – look for causes between the causes
 - If you can't place a cause ask "what did it cause?"



C. TEAM INVOLVEMENT

COMMON TRAPS - OBSTACLES TO GROUP FACILITATION / THINK "SIMPLIFY"

- Consensus
 - Build it
 - Plan for it
 - Or if the question is one of risk, or a better solution then vote might be appropriate
- Experts
 - Great to effectively problem solve BUT ALWAYS ASK FOR EVIDENCE
 - ...~~In my expert opinion~~ = ask for examples
- Narrow Minded Thinking
 - As a facilitator = Avoid challenge the group
 - The common belief is that if no one in the group knows the answer, then there is no answer
- Groupthink = relinquishing individuality = look for it and mitigate it

C. TEAM INVOLVEMENT

GATHERING INFORMATION - GROUP FACILITATION – PRIMARY STEPS

- **Complete the Story Line**
- The Chart will Determine Value
- Ensure there is appreciative understanding at each step
 - List all primary effects
 - Create the chart – list all stated causes
 - Identify effective solutions list all stated solutions
- Solution criteria will sort out most effective solutions
 - Appreciate, but challenge Solution Killer statements
 - Appreciate who has control and include them in the problem-solving process
- Review the facilitation guidelines before every meeting
 - Share relevant and appropriate guidelines with the team



C. TEAM INVOLVEMENT

REVIEWING CAUSES & CONTRIBUTING FACTORS OF ACCIDENTS TO ENSURE COMPLETENESS

SIMPLIFY – SEE FORM



Accident Causation Model

1. Tasks
2. Material
3. Environment
4. Personnel (Manpower)
5. Management

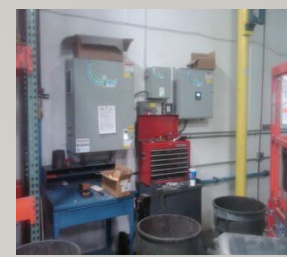
C. TEAM INVOLVEMENT

REVIEWING CAUSES & CONTRIBUTING FACTORS OF ACCIDENTS TO ENSURE COMPLETENESS

SIMPLIFY – SEE FORM

Accident Causation Model

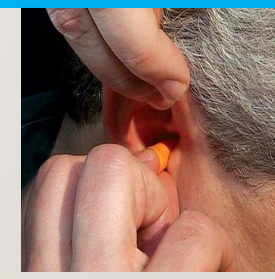
1. Tasks



2. Material

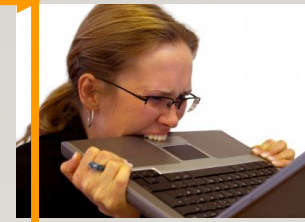


3. Environment



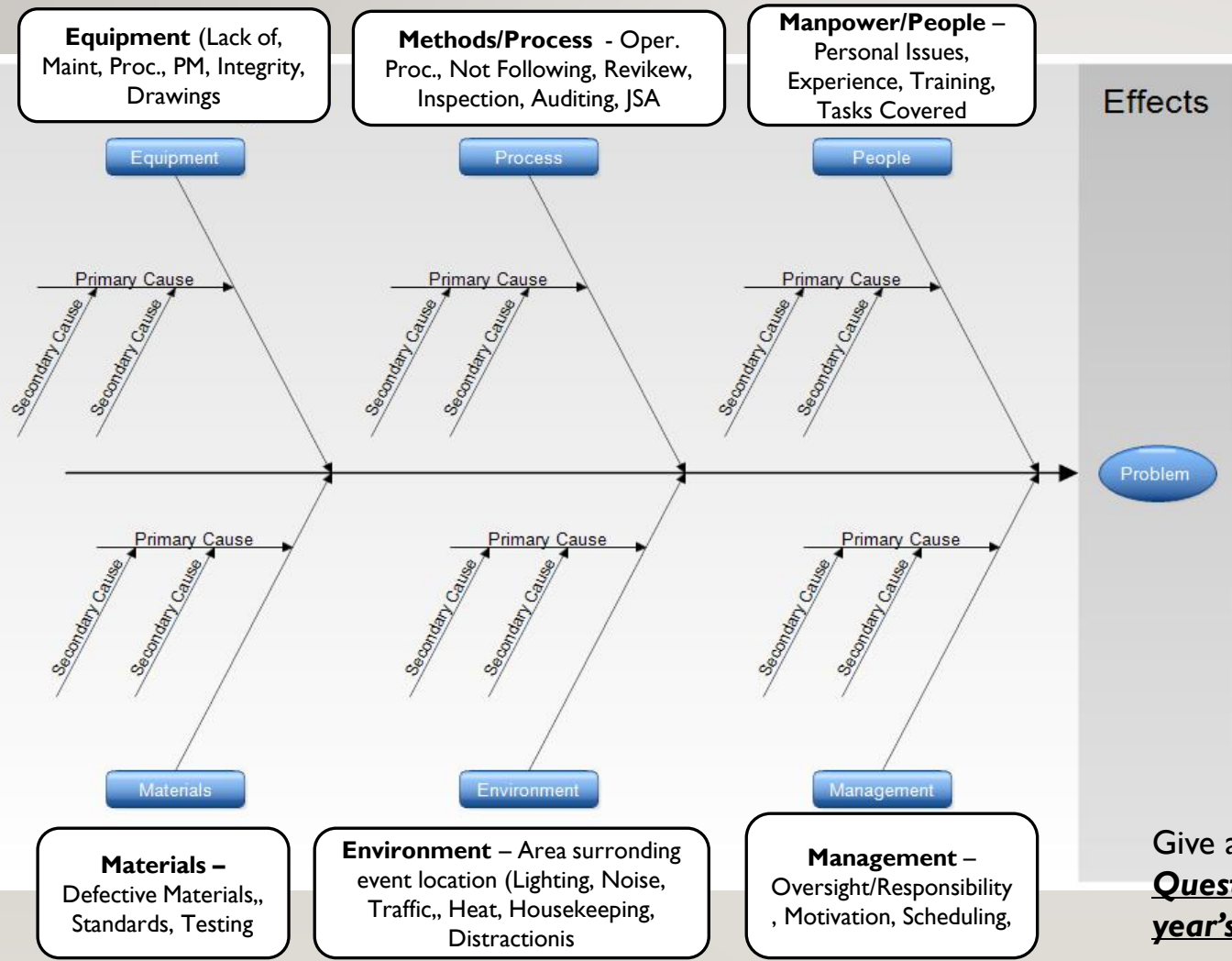
4. Human Factors

5. Management

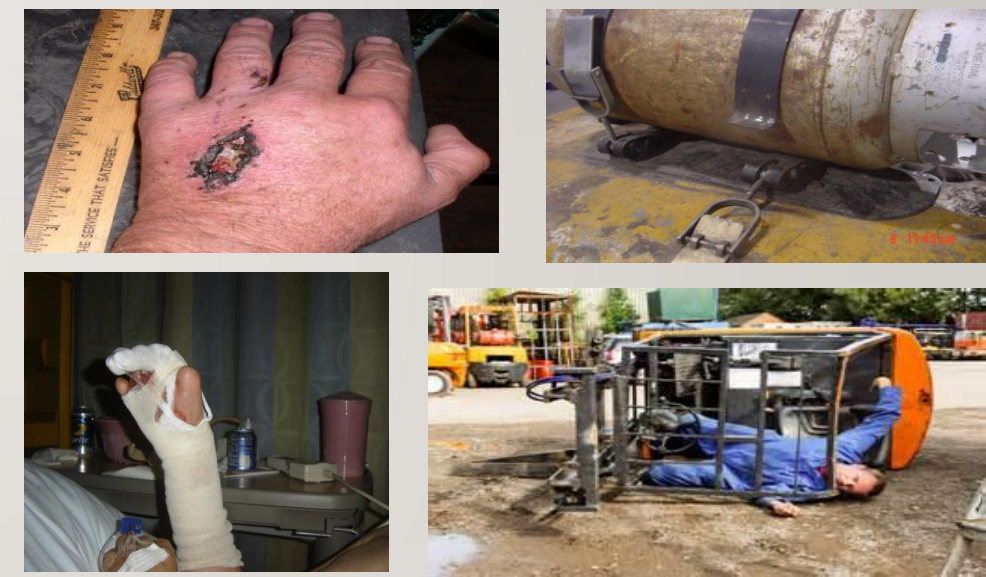


👉 CAUSE AND EFFECT –COMPLETING THE PUZZLE, AND BRIDGING BETWEEN STORYLINE ROBUSTNESS AND CONTRIBUTING FACTOR CLARITY 👉

Fishbone Diagram



Cause and Effect – Complete this Fishbone, **ensure at least 4 contributing factors are identified**, place in **Blue** as a contributing factor, place as **Red** as root cause(s) when asked – **if this subevent occurred by itself, would injury/event have occurred?**



Give as much detail as possible, think of it as a historical cataloging of the event – **Question: with this information could you recreate this event tomorrow or year's time?**

C. TEAM INVOLVEMENT – FACILITATOR’S RESPONSIBILITIES

REVIEWING THE ILLUSION OF A SINGLE REALITY

Reviewing the illusion of a single reality

- Belief is a single reality cause most arguments
 - Learn to appreciate understand all perspectives
- A single reality is an illusion
 - Effective problem solvers must recognize this illusion
 - We are view the world differently
 - Identical perspective ae not physiologically possible
- Common sense is an illusion
 - The notion of “common sense” is the product of known and repeatable cause and effect relationships
 - Sense is only “common” when we are share an understanding of the effect of the same cause relationships

Avoid going directly to solutions!

- What
 - Primary Effect(s)
- When
 - Chronological Timing
 - Relative Timing
- Where
 - Specify location
 - Relative “Where”
- Significance
 - Question the process
 - Be specific
 - Relationship to Primary Effect
- Why not ask WHO?



C. TEAM INVOLVEMENT – FACILITATOR’S RESPONSIBILITIES

EFFECTIVE EVENT BASED PROBLEM SOLVING

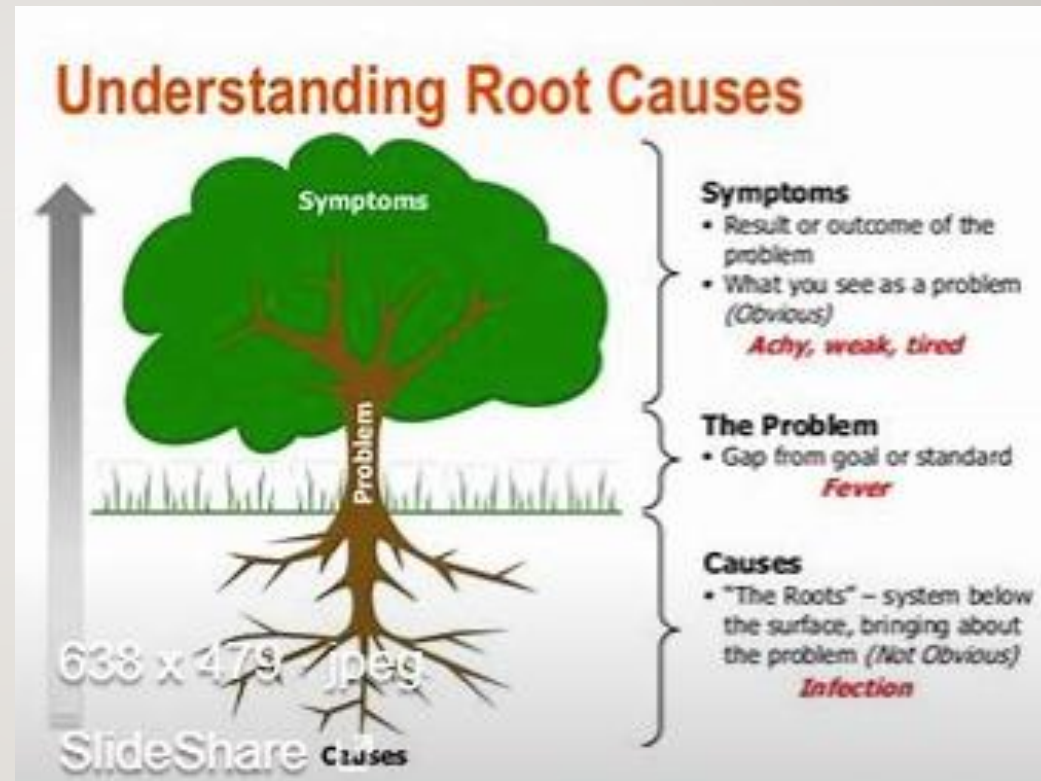
- Appreciative Understanding
 - Involve all stakeholders
 - Abandon the Right Answer mind set
 - Embrace our ignorance
- Know What We Are Solving
 - Agree on the problem
 - Understand our goals
 - Align your goals with the problem
 - Write down the problem statement
- Create a Common Reality
 - Manage storytelling
 - Manage categorial thinking
 - Ask why until we reach our point of ignorance
 - Create chart or graphic representation (post it notes)



- Solution Based on Known Cause and Effect Relationships
 - Align solutions with causes
 - Fix the cause not the blame
 - Stick to your graphic representation as your solution platform!!
- Event based Problems
 - Problems of the past such as an unacceptable event
 - These have no right answer – good, better, best
 - The purpose of event-type problem solving is to move on the current unacceptable state of condition to a desired condition of state
 - To ensure effective solutions analysis is required

STEP 3 – ANALYSIS AND ROOT CAUSE ANALYSIS (RCA)

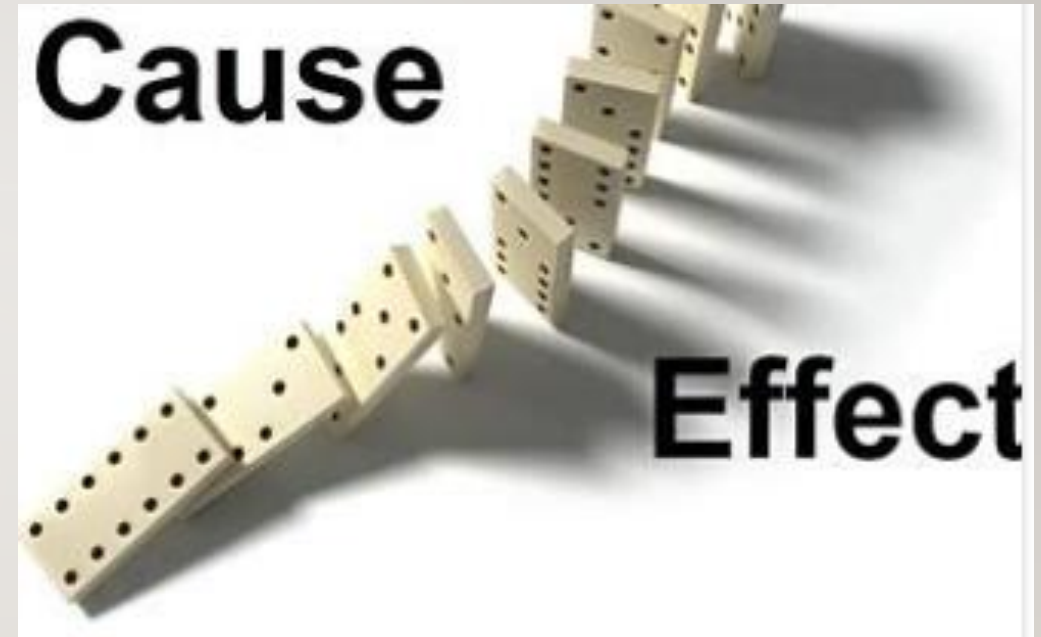
- **Root Cause Analysis (RCA)** is a systematic approach to identify the true root causes of a problem. RCA helps identify what, how and why something happened, thus preventing recurrence.
- In order to do an effective **Root Cause Analysis (RCA)** you will need information from the incident. This may include developing a sequence of events and evidence collected such as: DCS data, procedural steps that actually occurred or were missed, and witness statements.



STEP 3 – ANALYSIS & CONCLUSION

THE 4 STEP RCA METHOD

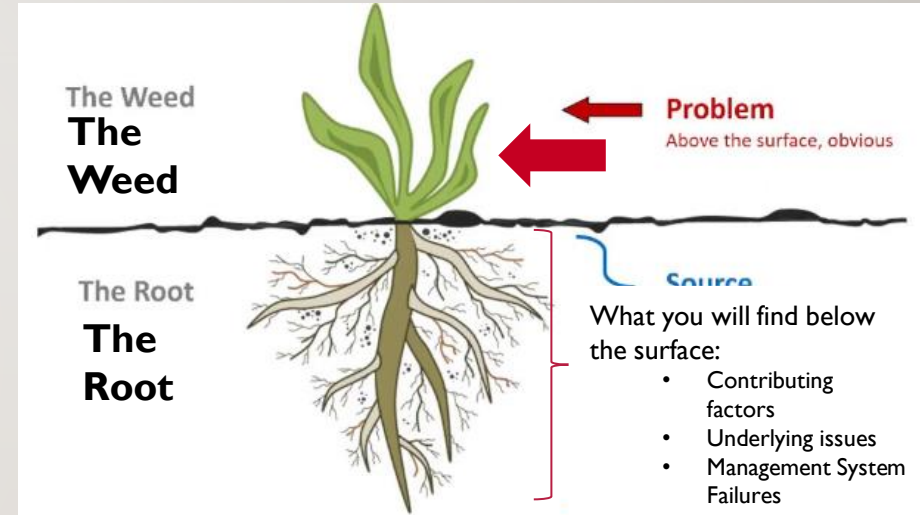
- Define the Problem
 - What
 - When
 - Where
 - Significance
- Creating a Chart
 - Determine causes relationships
 - For each effect “Cause by what?”
 - Look for causes in actions and conditions
 - Provide a graphic representation
 - Connect causal elements with valid cause and effect relationships
 - Support all causes with evidence



STEP 3 – ANALYSIS & CONCLUSION

WHAT IS A “ROOT CAUSE”

- **Root Cause** is the fundamental breakdown or failure in the management system and/or equipment failure, and when resolved, prevents a recurrence of the problem.
- It is important to consider all possible “what”, “why”, and “how” questions to discover the root causes(s) of an incident.
- Only when investigations are able to identify why an event or failure occurred will they be able to specify workable corrective measures that prevent future incidents.



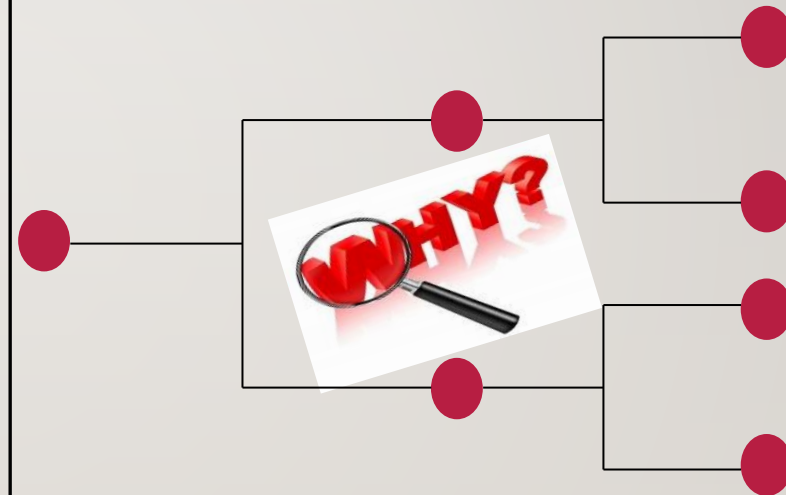
STEP 3 – ANALYSIS & CONCLUSION

WHAT IS “5 WHY” ANALYSIS

What is “5 Why”?

“5 *Why*” is a problem solving approach used to help move past seeing symptoms of a problem and getting to the root cause of the problem.

It has been found that by the time you ask why 5 times, and get 5 well considered answers, you can normally see where the problem originated, therefore enabling you to focus on the root cause rather than the symptoms of a problem.



STEP 3 – ANALYSIS & CONCLUSION

HOW TO COMPLETE A SIMPLE “5 WHY” WITH **ONE** ROOT CAUSE – EXAMPLE 1

Step 1

Define the problem. What is the problem you are trying to prevent?

Step 2

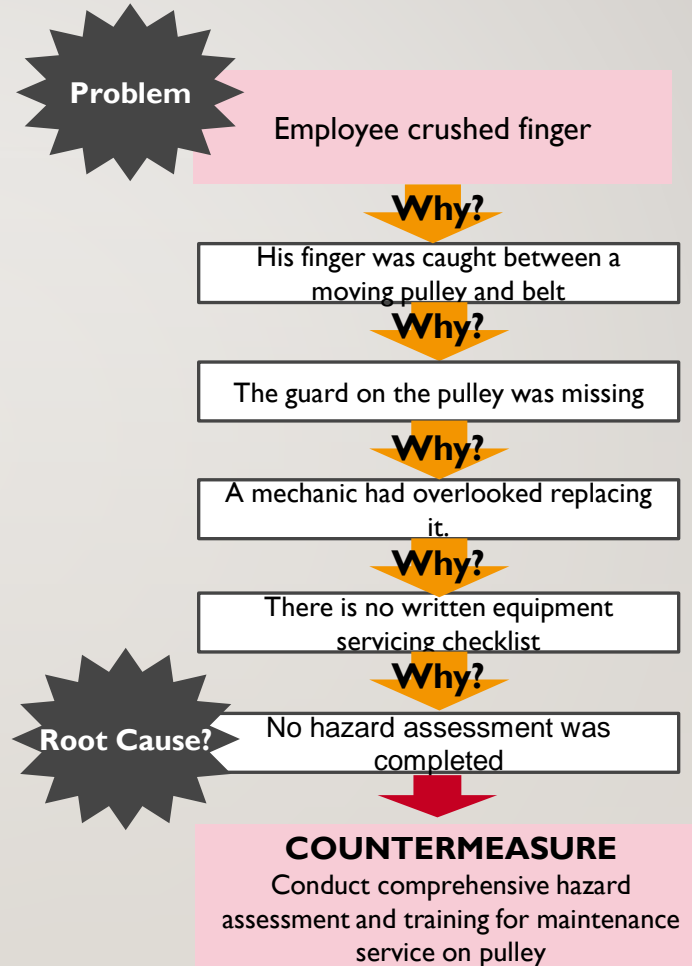
Ask “why the problem happened” and document in a simple format.

Step 3

If the answer you just provided doesn't identify the root cause of the problem that you wrote down in Step 1, **ask “why” again and write that answer down.** The objective is to keep probing until a root cause has been identified.

Step 4

Go back to Step 3 until the team is in agreement that the problem's root cause is identified. Again, this may take fewer or more than 5 Why's.



STEP 3 – ANALYSIS & CONCLUSION

SIMPLE 5 WHY – EXAMPLE 2

Incident Information: Date/Time: March 1, 2024 at 9:00 AM

Location: Finished Goods Warehouse

While working in the finished goods material warehouse, a materials handling employee received a laceration to the right leg, when struck by the forks on a moving for truck.

The fork truck operator did not have a load, but was turning the corner, and maneuvering around a triple high stacked section of super sacks when they struck the employee.

Typically the stacks are only stacked two super sacks high

The warehouse was storing super sacks over it maximum capacity

There had been poor weather in the area limiting the ability of trucks to move super sacks out of the finished good warehouse and into the shipping warehouse.

The production planner and other business resources, are located at a sister facility four hours away, and are unaware of the poor weather conditions at the plant.

The super sack filling rate has not been adjusted in the last 2 weeks.



STEP 3 – ANALYSIS & CONCLUSION

IMPORTANT TIPS FOR APPLYING 5 WHY ANALYSIS



- Ensure each “**Why**” question uses the previous answer because that creates a clear link between them.
- Don’t get caught up asking five whys only. It may take just three whys and many times it could take more than five.
- Be sure to not stop at “Symptoms” continue asking why until you reach a root cause. Is this a “symptom” of a bigger issue?
- **Knowing when to stop asking “why” is the most important part of the 5 Why Analysis,** ask yourself these questions when determining when to stop asking “why”:
 - Did you identify a Management System or Equipment Failure?
 - How relevant are the questions and answers to the original problem you are investigating? Are the answers significant to your problem?
 - Is the answer, a natural stopping point that cannot be fixed by management to prevent recurrence (i.e. oxygen in the air)



POST IT NOTE EXAMPLE



D.O.I. 2/6/21
EE SALES INJURED
INSPECTING CUSTOMER'S TANK
(CLEANLINESS)

Handwritten notes on yellow sticky notes:

- ③ Full SALES TEAM ON NOISE CHECKS
- LOCATION OF DOOR (ACCESS) ALL DIFF. ③
- NEED TO DETERMINE STRENGTH IN CERTAIN SP. N. ③
- NEED ACCESS WALK UP LADDER + STAIRS ③
- ISSUE OR MIRROR FOGGING COMPANY MUST. ③
- NEED A VISUAL ③
- SCALE + SLUDGE BY HAND OR IN PLACES ③
- NEED 6 VISUAL INSPECTION ON DETERMINING SLUDGE MANUAL ③
- ③ MAKE CUT @ JOB SITE
- POSSIBLE CUSTOM BUILT AND SLIP WITH A TIE WALKING UP ELEVATED PLATFORM ③
- USE PLUMBER LINE PING CAMERA OR ③
- POTENTIAL SO FAR USE FOR IN TRENCH BUT CAN'T FOR NOISE DETECTION INSPECTION OF TANKS TO BE - 30 MINUTE TIME ③
- 5 INSAFOD NEEDS ③
- NEED GLOVE TRAILS ③
- NO PPE ASSESSMENT ③
- ③ CMC (IN TANK USED) 2 CLIMB ③
- CLOVES NEED TO BE DELETED MUST ADJUST NOISE TRAY MOUNT ③
- EE ③
- NOT WEARING CLOVES (NO CUSH.) ③
- HAND HIT ANGLE 4 ③
- INJURED HAND 5 ③
- WET SURFACE + LOGIC SCALING ③
- SCALING ③
- SPRAYING STEEL SURFACE ③
- 4 ③
- FELL FORWARD ③
- EE WEARING NOISE TANK WITH MOUNTING SHOTS ③
- ZINC SLUDGE IS SLICK ③

TYPES OF ROOT CAUSE ANALYSIS

5 WHY'S

AKA the annoying toddler approach.

Can be more or fewer than 5, you are looking for a process that failed via concise but detailed answers. Good for reactive root cause analysis.

FISHBONE (ISHIKAWA) CAUSE & EFFECT

Problem statement goes in middle (spine). Brainstorm categories of causes as the ribs, these are broad. Then break down each broad category into smaller parts. This can help eliminate unrelated factors and highlight things that are connected. Can be used proactively or reactively.

PARETO CHART

Prioritizes issues based on their cumulative effect 80% of the total problems are caused by 20% of the potential causes. More often a reactive tool than proactive.

FAULT TREE DIAGRAM (SAFETY FTA)

Uses a logic diagram to attempt to determine a specific cause for an undesired event. Great tool for proactive, preventative planning as well as reactive. Good for understanding events where multiple failures have to occur for the undesired event to happen

SAFETY FMEA

Failure Mode and Effects Analysis. Used during process design to explore potential defects or failures, best used proactively.

WHY USE THE 5 WHY FOR THE INVESTIGATION PROCESS

➤ Advantages

- Simplicity: Easy to use and requires no advanced mathematics or tools. Allows to identify cause, not just its symptoms
 - Breakdown the problem
 - Understand storyline
 - Point of occurrence identified
- Effectiveness: Helps to quickly separate symptoms from causes and identify the root cause.
- Comprehensiveness: Helps to determine relationships between various problem causes. Helps also to avoid taking immediate action without considering the real root cause of the problem
- Flexibility: Works well alone and when combined with other methods.
- Engaging: Fosters teamwork.

➤ Disadvantages

- Different people could provide different answers to which there could be a lead to multiple root causes
- Good as the knowledge and experience of the employees using it
- Counter to the disadvantages – ensure you have the right people providing the investigation review

DEVELOPING A 5 WHY STRATEGY FROM YOUR INVESTIGATION

1. Review storyline with the affected employee and witnesses
 1. Repeat / review key points to ensure all gaps are filled in
2. Repeat storyline through and including result of incident, confirming with affected employee and witness that account in factual
3. Define the problem statement, ,such as eliminate spill or injury
4. Ask the first “Why”?
5. Aske “Why” at least 4 more times.
6. Determine the countermeasures for each “Why”
7. Assignment responsibilities
8. Assign due dates of possible – close out meeting
9. Monitor progress

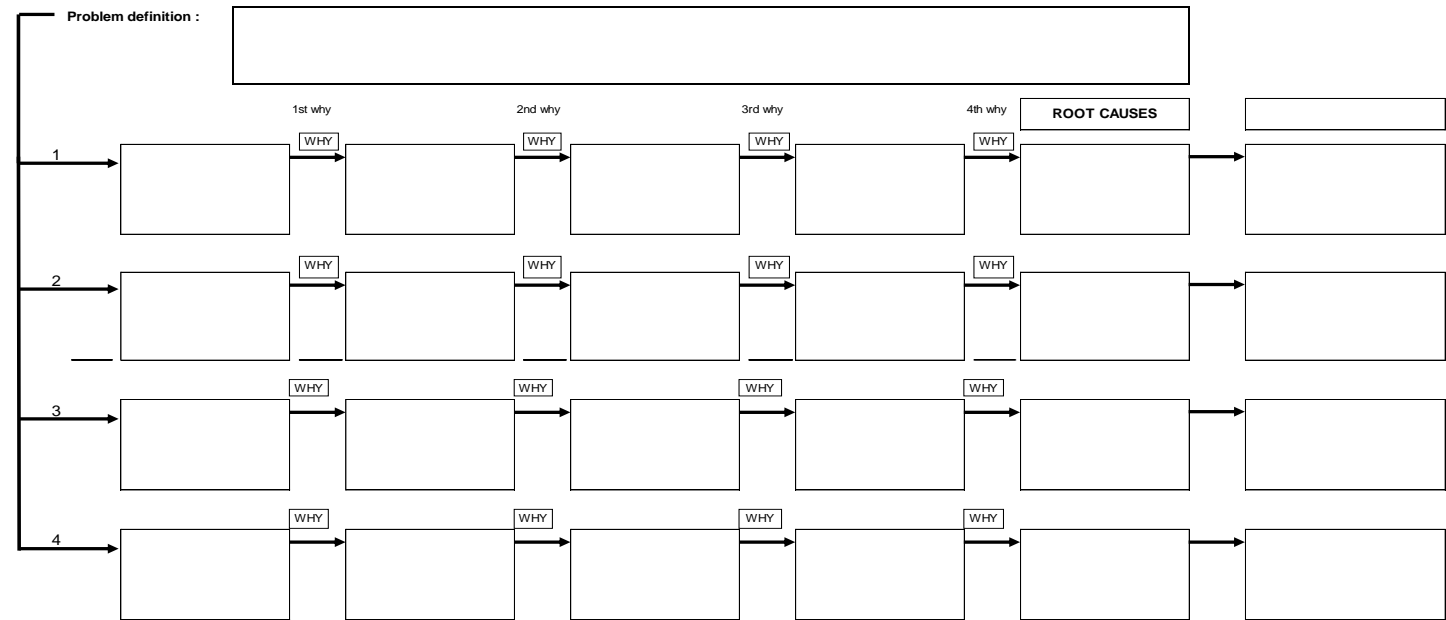
STEP 3 – ANALYSIS & CONCLUSION

5 WHY DOCUMENT

c. Team involvement

Reviewing Causes & Contributing Factors of Accidents to ensure completeness

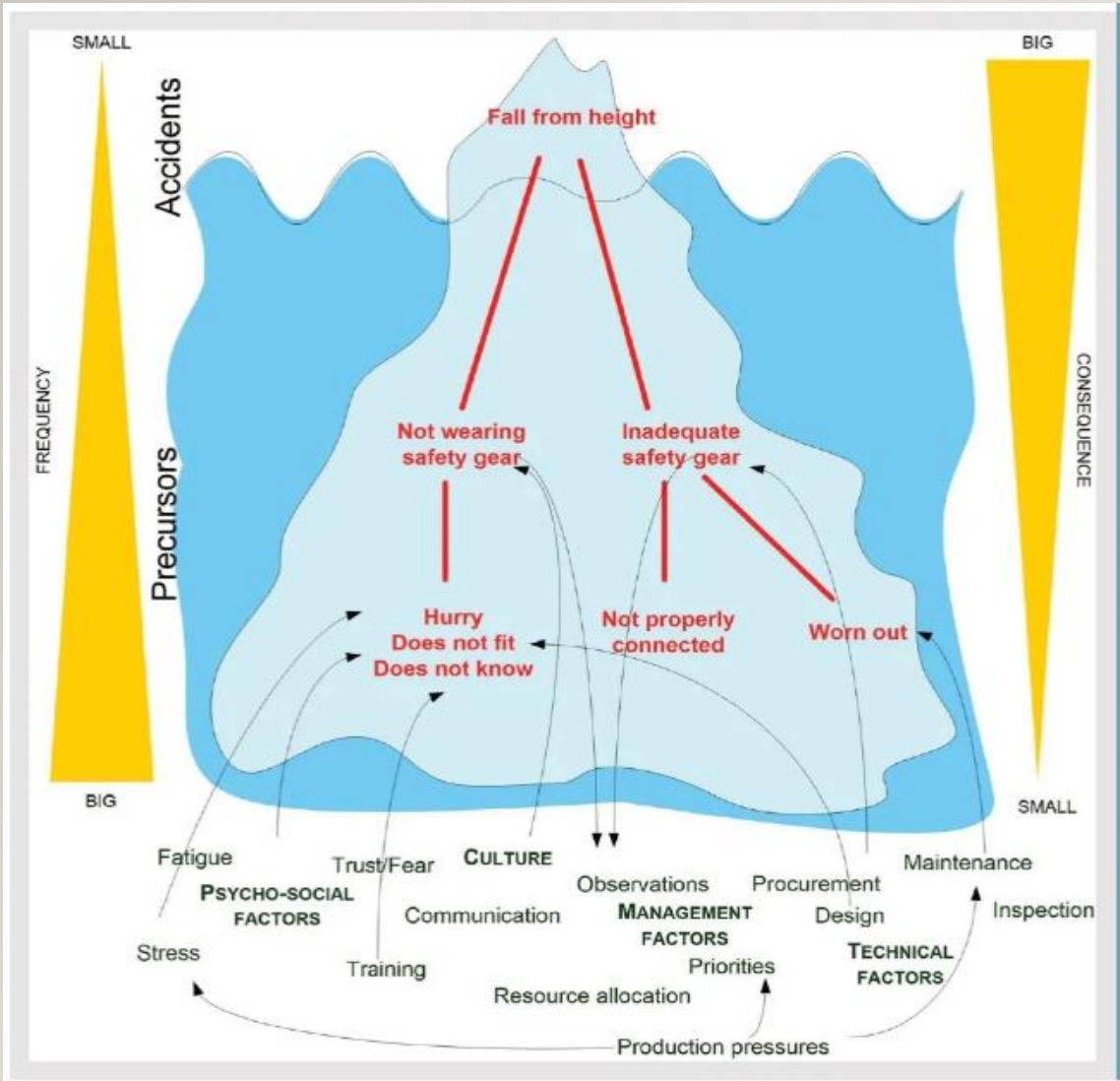
Occurrence



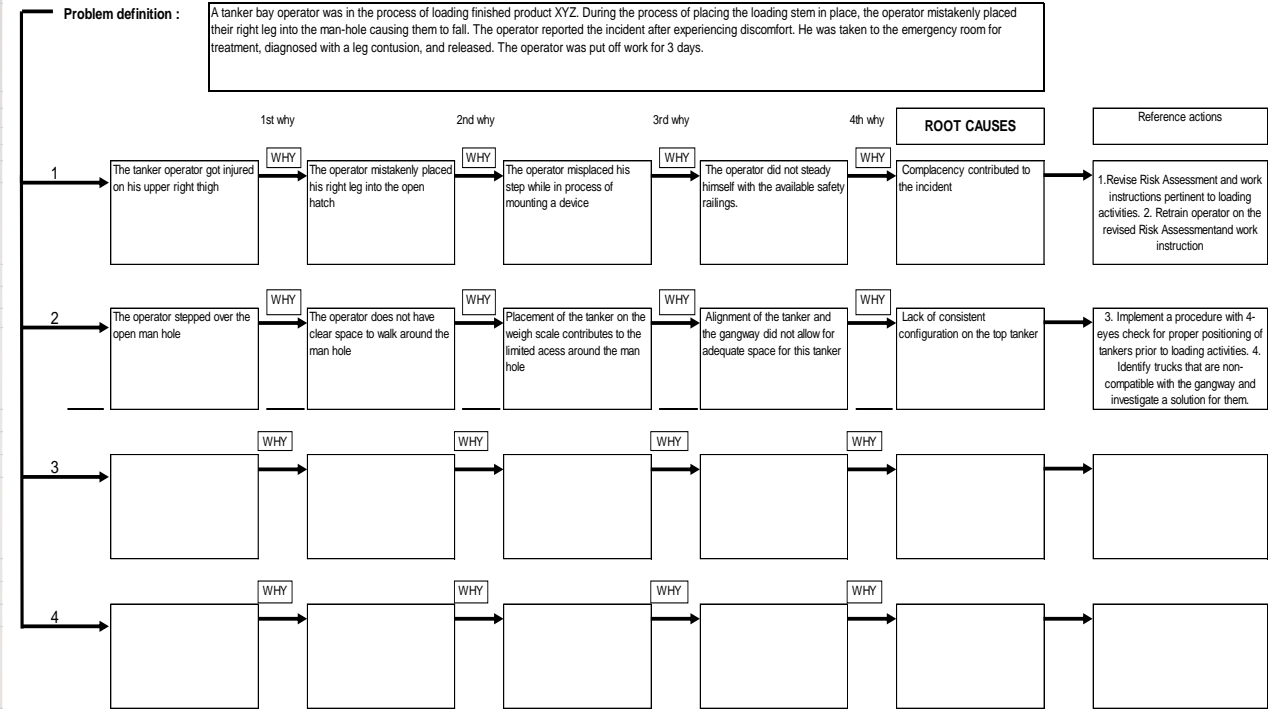
Occurrence

Reference	Potential actions	Responsible	Target date	Effective date	Result	Responsible	Date
1							
2							
3							
4							

5 WHY EXAMPLE



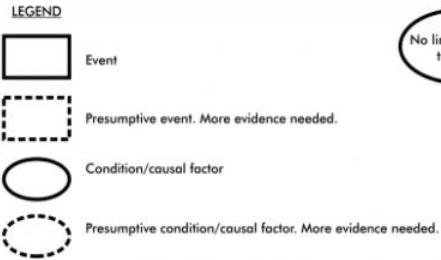
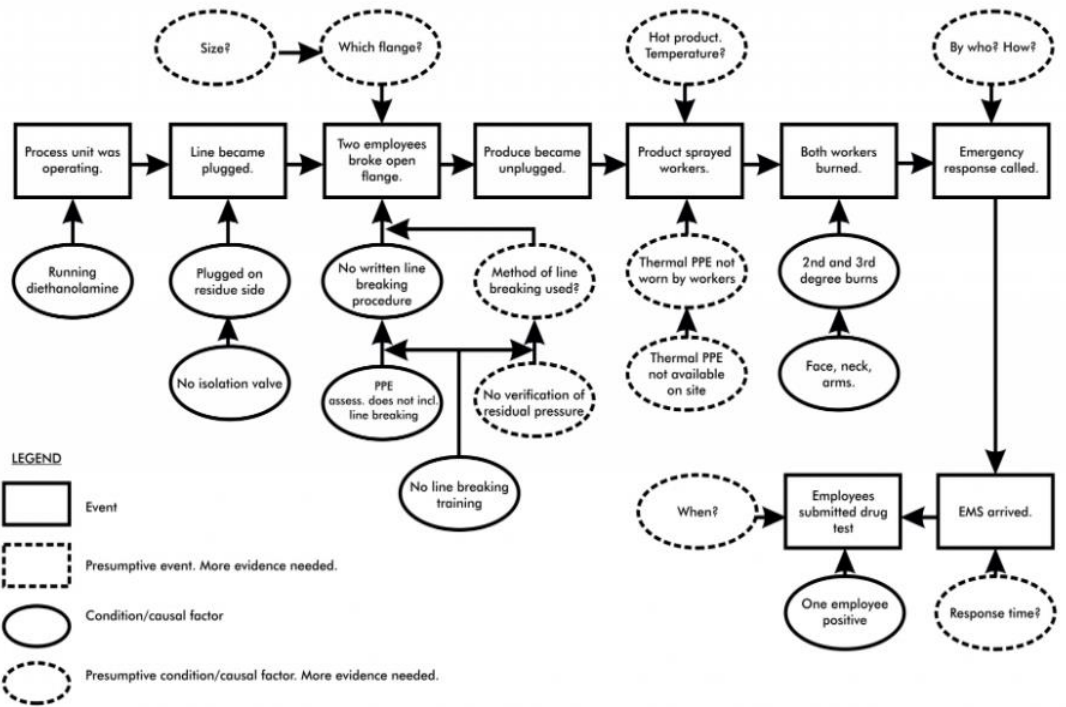
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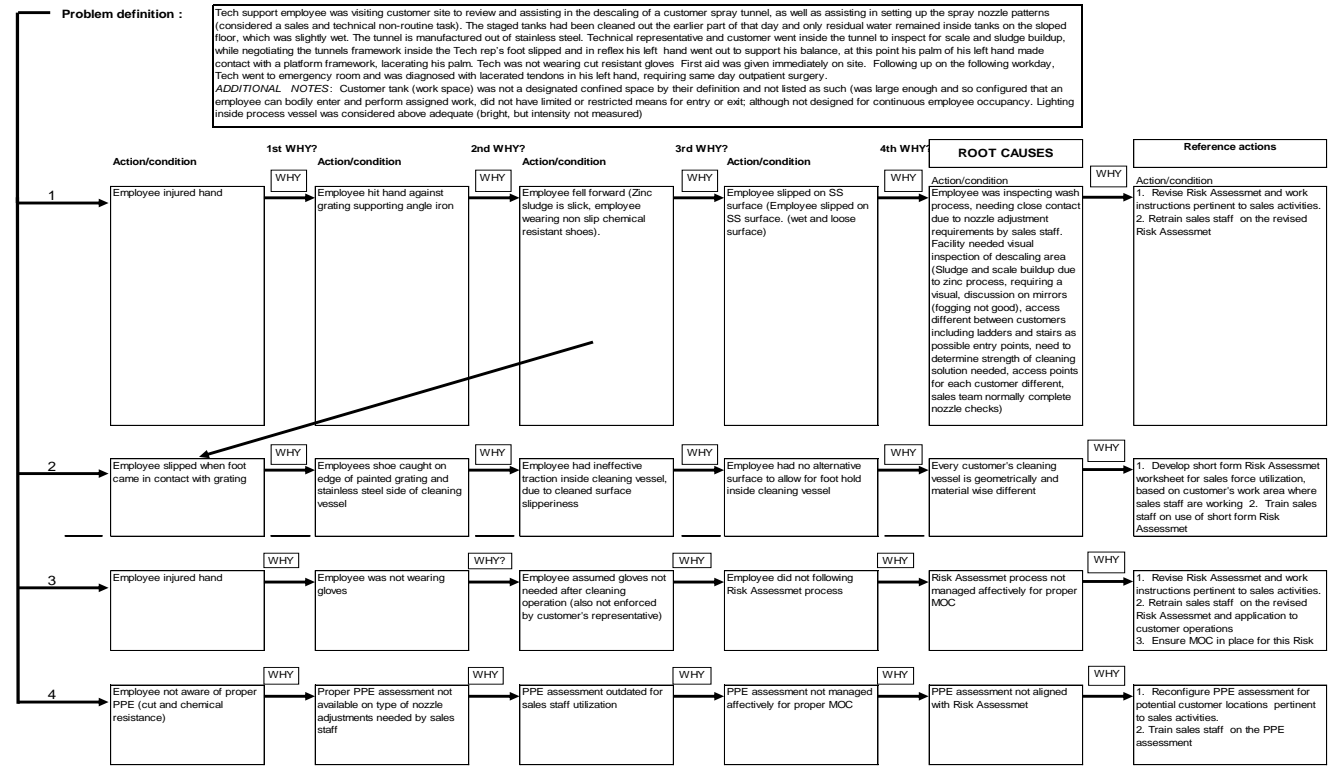
Occurrence

Reference	Potential actions	Responsible	Target date	Effective date	Result	Responsible	Date
1	Revise Risk Assessment and work instructions pertinent to loading activities	Joe Engineer	3/19/2021				
2	Retrain operator on the revised Risk Assessment and work instruction	Bob Operators	3/28/2021				
3	Implement a procedure with 4-eyes check for proper positioning of tankers prior to loading activities	Bob Operators	3/26/2021				
4	Identify trucks that are non-compatible with the gangway and investigate a solution for them.	Bob Operators	5/5/2021				

5 WHY EXAMPLE



Occurrence Sales, DOI 2/6/2019 Lacerated Hand While Visiting Customer



Occurrence Sales, DOI 2/6/2019 Lacerated Hand While Visiting Customer

Reference	Potential actions	Responsible	Target date	Effective date	Result	Responsible	Date
1	Reviewed incident with employee, including need for reviewing customer PPE requirements, completing Risk Assessment task if customer Risk Assessment not acceptable	Sales, EHS	2/10/2021	2/10/2021	Completed	Jim. Dale	2/10/2021
2	Risk Assessment had not been updated for visual inspection of tank tasks, Review previous injury at Chemetal Blechley, short form Risk Assessment review - Update overall Risk Assessment for sales staff required to complete customer washer inspection, Develop short form Risk Assessment for customer specific hazards and associated risks,	Sales, EHS	3/5/2021	3/5/2021	Review former incident in 2020 UK sales	Jim. Dale	3/5/2021
3	Complete team PPE assessment with support from glove manufacturer (Ansell)	Sales, EHS	3/15/2021	3/15/2021		Jim. Dale, Bob Joe	3/15/2021
4	Correct PPE was not utilized during operation - 1. Review chemical and cut resistant glove needs, 2. Ensure inventory updated with glove requirements 3. Ensure sales staff are training on associated Risk Assessment and SCP 4. Ensure sales staff receive required gloves	Team (Sales and EHS)	1. 3/8/21 2. 3/21/21 3. 3/8/21 4. 4/1/21			1. Team being established 2. C. Keeter 3. C. Keeter 4. M. Evans	1. 3/8/21 2. 3/21/21 3. 3/8/21 4. 4/1/21
5	Review PPE Assessment and Risk Assessment process with sales staff and support EHS team, ensure process in place for auditing Risk Assessment process and inclusion of MOC process	C. Keeter, B. Beattie	4/1/2021	4/15/2021		C. Keeter, B. Beattie	4/1/2021

SOLVING SAFETY PROBLEMS UTILIZING A PARETO CHART

1. Identify and List Problems

- Write out a list of all of the problems that you need to resolve.
- Where possible, gather feedback from team members.

2. Identify the Root Cause of Each Problem

Next, get to the root cause of each problem. Techniques such as the 5 Whys, Cause and Effect Analysis, and Root Cause Analysis are useful tools for this.

3. Score Problems

Now, score each problem that you've listed by importance. The scoring method that you use will depend on the sort of problem that you're trying to resolve.

For example, if you want to improve profits, you could score problems by how much they cost. Or, if you're trying to improve customer satisfaction, you might score them based on the number of complaints that you've received about each.

4. Group Problems Together

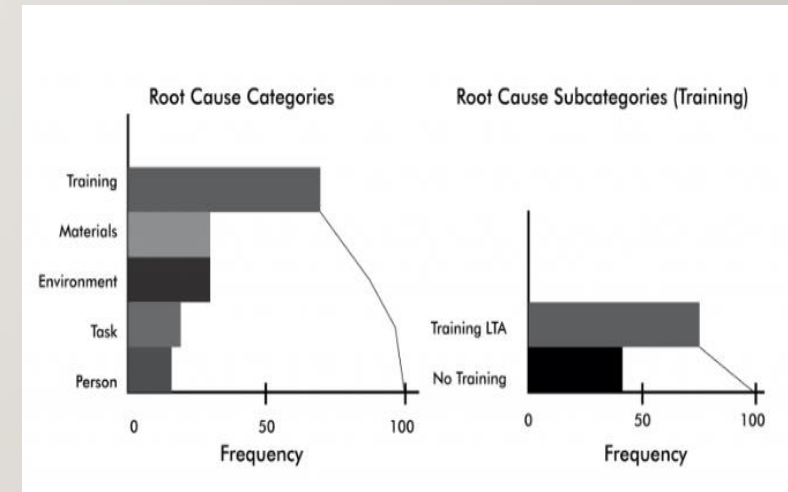
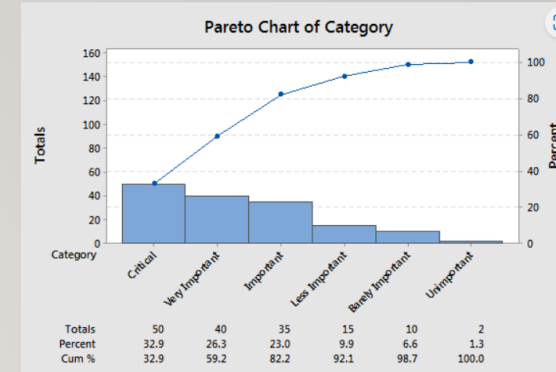
Use the root cause analysis that you carried out in Step 3 to group problems together by common cause. For example, if three of your problems are caused by lack of staff, you could put these into the same group.

5. Add up Scores for Each Group

Now, add up the scores for each group that you've identified. The one with the top score should be your highest priority, and the group with the lowest score your lowest priority.

6. Take Action

Finally, it's time to take action! Your highest scoring problem will likely have the biggest payoff once fixed, so start [brainstorming](#) ideas on how to solve this one first.



You may find that your lowest-scoring problems aren't worth bothering about, particularly if they are very costly to fix.

Use your Pareto Analysis to save your energy and resources for what's important!

STEP 3 – ANALYSIS AND CONCLUSION

SAFETY FMEA (FAILURE MODE EFFECT ANALYSIS)

Reviewing the effects of component failure and occurrence of failures in the process

Steps	Explanation
1. Select a process to analyze	Choose a process that is known to be problematic in your facility or one that is known to be problematic in many facilities
2. Charter and select team facilitator and team members	Leadership should provide a project charter to launch the team. The facilitator is appointed by leadership. Team members are people who are directly involved in the process to be analyzed.
3. Describe the process.	Clearly define the process steps so that everyone on the team knows what is being analyzed.
4. Describe the process	Clearly define the process steps so that everyone on the team knows what is being analyzed.
5. Pick which problems to work on eliminating	The focus of improvements will be on those problems that happen quite often and/or or have a significant impact on resident safety when they do occasionally occur.
6. Design and implement changes to reduce or prevent problems	The team determines how best to change the process to reduce the risk of residents being harmed.
7. Measure the success of process changes	Like all improvement projects, the success of improvement actions is evaluated.

**Failure Mode and Effects Analysis (FMEA)
Risk Priority Number (RPN)**

SEVERITY x OCCURRENCE x DETECTION = RPN
rating per criteria: 1–10 (1 = low, 10 = high)

Severity	Occurrence	Detection
Based on the effect of a failure mode	Based on the mechanism of failure	Based on the current process controls
Encompasses what is important to the industry, customers or company	How frequently the problem is likely to occur	How easily the problem can be detected and acted upon before it has happened
e.g. safety standards, damaged reputation, loss of business	the probability of a failure occurring during the expected lifetime of the product or service	do not overestimate due to random quality checks

FAILURE MODE AND EFFECT TABULATION SHEET

Item Ident. Code	Component Description	Failure or Error Mode	Effects On:		H R A Z A I R N D G	Prob. of Failure		R A T I N G	C R I T I C A L I T Y	Failure Detection Method(s)	Compensating Provisions and Remarks
			Other Components	Whole System		INT. YRS.	DUR. HRS				
1	Supply tank	Tank Leak Gross Failure of TANK	None	Fire or Environmentally Severe Fire	2	1000	*	-7	-5	Initial inspection	Annual inspection OK
2	Drum Fill valve	Fails open Fails closed	Overflow None	Fire or Environmentally Severe Fire can't fill drums	2	65	*	-9	-6	Annual inspection	Operator closes valve #16
		External leak	None	Fire or Environmentally Severe Fire	2	350	*	-7	-5	Operator observation	Operator closes valve #16
3	Conservation Vent	Plugged Fails open Flash arrestor screen missing	TANK pressure not limited Waste Nitrogen	Tank capture equipment problem Fire could propagate into tank	3	100	4000	-3	0	Annual inspection	
4	Supply valve	Stuck open Fails closed	Overfill TANK can't fill TANK	Fire or Environmentally Severe Fire TANK runs empty	2	10	*	-5	-3	Annual inspection Operator observation	N ₂ inerting provided Close Valve #14 quickly

Area _____ Process Toluene Drum Filling Date _____
By _____ Sheet 1 of 4

STEP 3 – ANALYSIS & CONCLUSION

HAZOP (HAZARD AND OPERABILITY STUDY)

Review each part of the process to discover how deviations in how the process was design could occur, and then determine if the effects/consequences of the occurrence is hazardous

HAZOP EXAMINATION RECORD

Guide Word	Deviation	Consequences	Cause	Protection	Recommended Action
Other than	Failure in instrumentation		TV1 opens + overcools reactor		No hazard
More of	High temp	Slow over-heating-possible rupture	Loss refrigeration equipment for cooling water	Relief valve only	See "No Flow" Consider hi Temp alarm on supply.
Less of	Low temp.	Vessel cools- reaction slows	Refrigeration set point operator error.		No hazard Operability problem.
		Possible freeze up Cause for "No Flow"	Low ambient temp.	High temp alarm relief valve	See "No Flow" Consider using a brine coolant

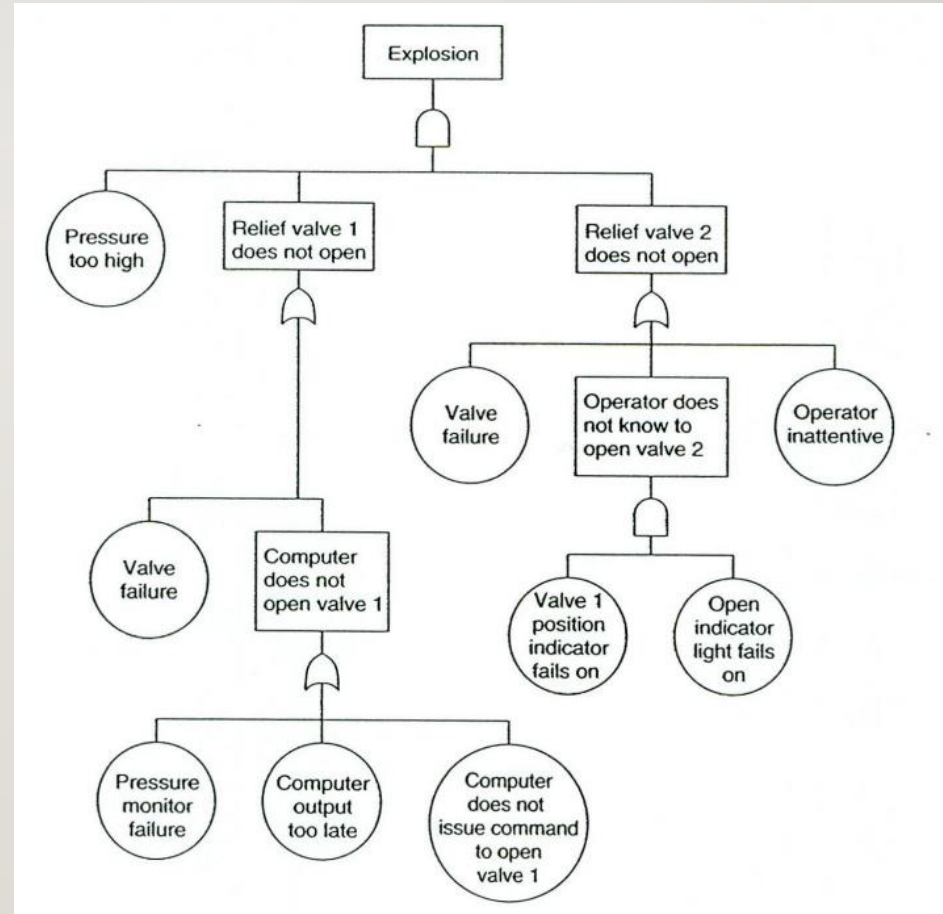
Line or Vessel: Chilled (5°C) cooling water to reactor jacket Page 4 of 4
 Design Intention: to cool the reactor contents and control temperature of exothermic reaction.

GUIDEWORD + PARAMETER = DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	RECOMMENDATIONS
No Inlet Flow to Tank 409	Inlet line valve (x1) full closure due to human error	No flow to Tank 409 -> Low level in tank -> pump (y1) damage -> Release of flammable material	Standard Operating procedure	1. Low level alarm 2. Pump trip on low flow
More Inlet Flow to Tank 409	1. Level transmitter failure -> miscalculated time to fill -> operator opens more valve (x1) 2. Inlet line valve (x1) full opening due to human error	More flow to Tank 409 -> High level in tank -> Tank Overfill -> Release of flammable material	1. Standard operating procedures 2. Secondary Containment dike	1. Independent high-level alarm 2. Automatic Overfill Protection system
Less Inlet Flow to Tank 409	Partial closure of inlet line valve (x1) due to human error	Less flow to Tank 409 -> Low level in tank -> pump (y1) damage -> Release of flammable material	Standard Operating procedure	1. Low level alarm 2. Pump trip on low flow
More Level in Tank 409	1. Bottom Pump outlet valve (x2) full closure 2. More flow to Tank 409	High level in tank -> Tank Overfill -> Release of flammable material	1. Standard operating procedures 2. Secondary Containment dike	1. Independent high-level alarm 2. Automatic Overfill Protection system
Less Level in Tank 409	1. Bottom Pump outlet valve (x2) full opening 2. Less/No flow to Tank 409	Low level in tank -> pump (y1) damage -> Release of flammable material	Standard Operating procedure	1. Low level alarm 2. Pump trip on low flow

STEP 3 – ANALYSIS & CONCLUSION

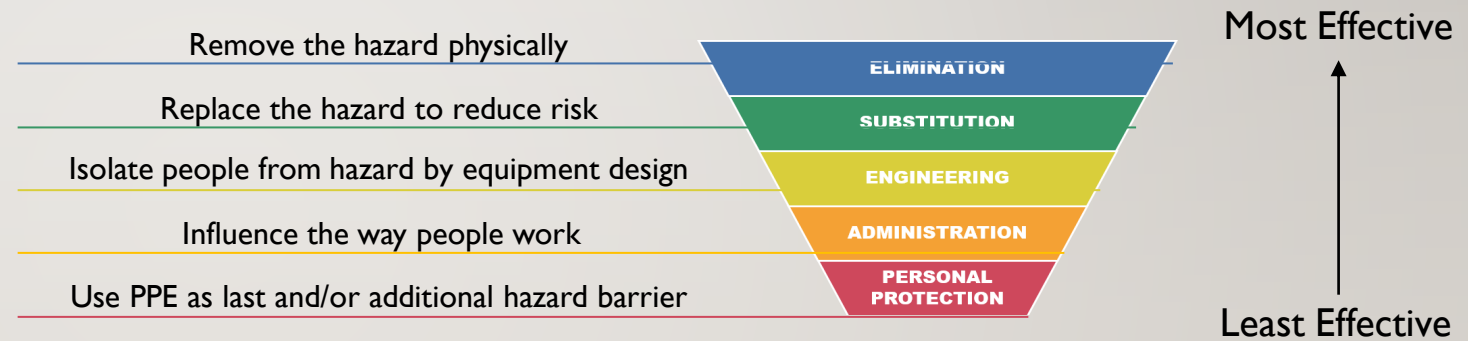
SAFETY FTA (FAULT TREE ANALYSIS)

- Reviewing the process to determine
 - the possible causes of a preselected undesired event
 - Then determine the causes
 - Then analyze the sequences of the subevents and the combination of causes that could result in the undesired top event



What is Hierarchy of Controls?

The hierarchy has **five levels of control**. The most effective level of control is at the top of the hierarchy and the least effective is at the bottom. The controls from a higher level always have priority and should be considered first during the selection process. If the proposed measures are not realistically feasible, one should go a step below and decide on possibilities at the next level of control.



What are Hierarchy of Controls?

Elimination - Physically removing the hazard is the most effective

Examples:

- Bring objects from the height to the ground to work on them
- Remove objects parked in pathways
- Ban any toxic substance in work areas
- Eliminate hazardous substance by changing chemical process (difficult to implement in existing processes, look for opportunities during process development)



ELIMINATION
Remove the hazard physically
Effectiveness ★★★★★

Administration - Strive to change the way people work

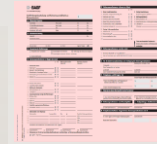
- Influence their behavior
- Administrative controls cant remove hazards

Examples: Completing work at night when fewer people are on site
Procedure changes, Employee Training, Warning signs and rules to limit exposure

ADMINISTRATION

Influence peoples' behavior

Effectiveness ★★

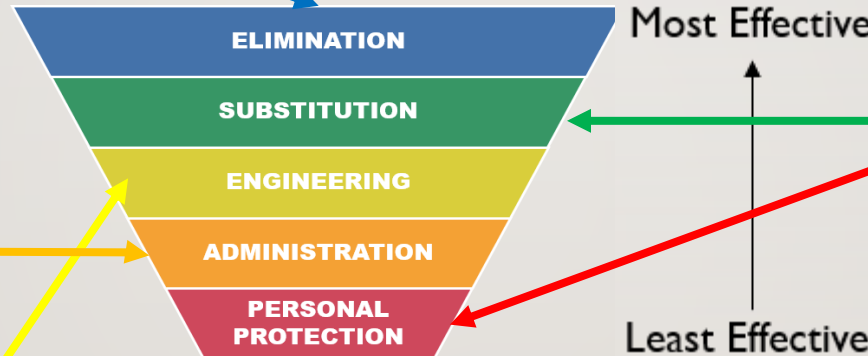


Substitution means to replace something that produces a hazard (similar to elimination) with something that does not produce a hazard or produces a significantly lower hazard.

SUBSTITUTION

Replace the hazard - reduce risk

Effectiveness ★★★★★



PPE - Least effective level of control

- High potential for damage could render PPE ineffective
- Danger of improper use
- Need for sufficient training
- Poses a burden to it's user that may cause additional health risks

PPE

Effectiveness ★



Engineering - rather isolate people from hazards.

- Separate people from hazards
- Physical barrier between personnel and hazards
- More expensive than the next lower levels
- Very effective and sustainable.
- Examples: Fume hoods, machine guards,

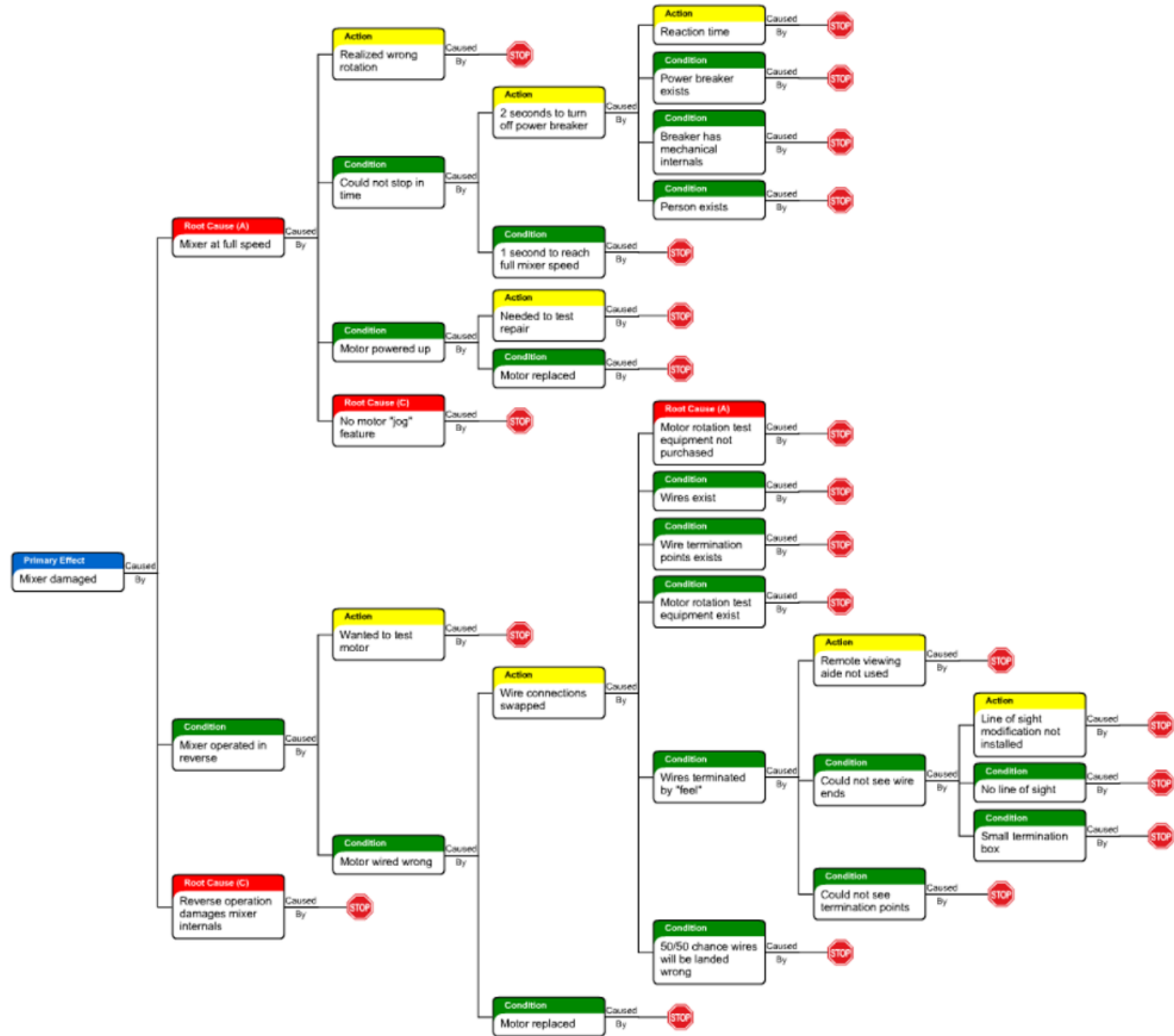
ENGINEERING

Isolate people from hazard by equipment and construction design measures

Effectiveness ★★★



ATTENTION TO DETAIL



STEP 3 – ANALYSIS AND CONCLUSION

1. Draw conclusions and make recommendations based on contributing factors and causes
2. Implement corrective actions and set a time table to complete them.
3. Actions and outcomes to consider in your investigation conclusions:
 - **Contributing Factor** - Conditions or actions that, if removed, would likely prevent (reduce or eliminate) the incident or hazard from happening, or reduce the severity of its consequences.
 - **Root Cause Myth** - the false belief that a root cause is found at the end of a cause chain or identified with a set of predetermined cause factors. Without identifying complete cause relationships it is obvious which causes Reporting Corrective can be controlled to prevent recurrence; therefore we need to understand the causal relationships first, then what can be removed or controlled, focusing instead on the solutions
 - **Solution Killers** –Judgmental statements used to kill an idea for a solution (such as “We already tried that once, it will never work . We’re too busy to do that”
 - **Story Telling** – Communication describing an event relating people, places and things in a *linear time frame* from past to present

STEP 4 - INCIDENT INVESTIGATION REPORTING

- Statement of injured or ill employee concerning the incident and injured employee information
- Witness statements
- Equipment involved
- Other factors or contributing causes
- Corrective action plan
- Review and Approval - Site management

STEP 4 - INCIDENT INVESTIGATION REPORTING

CORRECTIVE ACTIONS

Corrective actions are the written action plans to eliminate the causes of an incident, to prevent it and similar incidents from re-occurring.

- To be effective, corrective actions must include all of these components
 - A responsible person [competent for the task(s)]
 - Schedule / target date for completion
 - Specific actions to eliminate gaps between what happens now & what needs to happen in the future.

OWNERSHIP AND ACCOUNTABILITY

- Corrective Actions must have ownership and due dates
- Do not assign ownership to departments



STEP 4 - INCIDENT INVESTIGATION REPORTING

IDENTIFYING EFFECTIVE SOLUTIONS AND SUBMITTING THE REPORT

- Prevents Recurrence
 - Prevents and mitigates this problem
 - Prevents similar problems
- Its within your control
 - You, department, facility, company, industry
 - Common sense – nature is often not within your control
 - Facilitator – doesn't own it!!!!
- Meets your goals and objectives
 - Goals - (You department, facility, company, industry))
 - ROI
- DOESN'T CAUSE OTHER PROBLEMS



Value in communicating with

- injured worker
- Investigative team
- Facility population
- Facility management
- Outside 'the facility (for larger companies
- Ultimately
 - Reducing the potential of the event reoccurring
- Celebrating the Win!



STEP 4 - INCIDENT INVESTIGATION REPORTING

IMPLEMENTING AND TRACKING SOLUTIONS

THE IMPORTANCE OF CONTRIBUTING FACTORS AND ROOT CAUSES

- Place in a traceable location
 - Action tracker for facility or investigations
 - % completion (SMART)
 - Safety committee meeting minutes
 - Summary in monthly reports



6 EFFECTIVE STEPS TO A STRONG ACCIDENT INVESTIGATION

(ID THE PROBLEM, CLARIFY THE PROBLEM, BREAK DOWN THE PROBLEM, ID CONTRIBUTING FACTORS)

1. ISOLATE THE AREA

- a. Make sure you have all the items, activities and personnel that were involved in the incident.
- b. Get treatment for individuals that may be injured. Assure the safety of others, (live wires, etc.) . Stop added hazards.
- c. Secure the site, prevent tampering with evidence. Initiate interim controls. Initiate the investigation.
- d. Determine the depth of investigation the particular incident warrants.

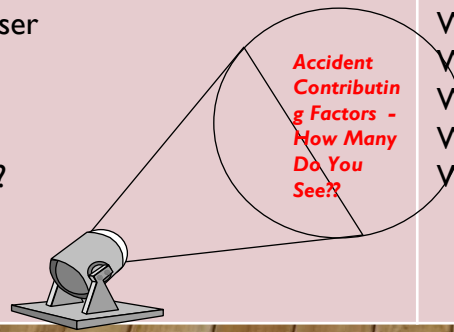
2. GATHER THE INFORMATION – TELL THE STORY

- a. Identify and document the steps leading up to and including the incident (include issues or conditions that might have influence, breakfast, checking in, emotional stability, etc.).
- b. Put in times of sub events, product numbers, machine numbers, temperature, pressure, speed, amperage, to assist in filling in the information gap – read the story back to the employee to fill in those gaps – similar accidents?
- c. Interview witnesses. Take photos. Review machine logs. SDS. PM OK? If you looked at this in 6 mos.-same result?

3. COMPLETE A 5 WHYS TO ESTABLISH CAUSE AND EFFECT

Example 1 – Tape dispenser lacerated employee behind machine

Why was employee behind machine? Retrieve fallen tape dispenser
Why did tape dispenser fall? Not enough shelf space
Why employee trip? Tripped over cord on floor
Why was cord on floor? Cords were too long for machines?
Why was cords too long for machines? Came with the machine?
Why did it come with the machine? Part of the machine spec



Example 2 - Tool cart contusion on employee

Why tip over? Caster diameter too small
What wheels too small? They were made in maintenance
Why maintenance made small wheels? Followed engineering specs
Why did engineering spec small wheels? Didn't ID it as a hazard
Why didn't engineering ID it as a hazard? No risk assessment training

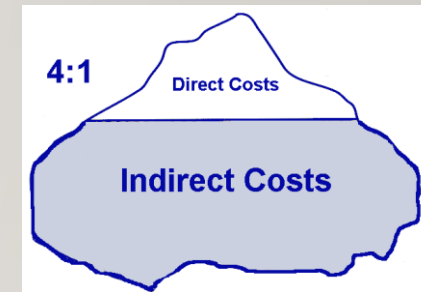
6 EFFECTIVE STEPS TO A STRONG ACCIDENT INVESTIGATION

4. IDENTIFY THE CORRECTIVE (COUNTER) MEASURES

- a. Remember – you are trying to reduce and eliminate the injury or event from reoccurring.
- b. Should be action / verb oriented.
- c. Not uncommon to have 4-6 corrective measures for the injury.
- d. Make sure to include human factors (fatigue), unsafe procedures as well as unsafe conditions to correct.

5. ESTABLISH RESPONSIBILITIES AND DUE DATES

- a. Ensure you have enough steps – especially if you need to further investigate (research design, develop training, etc.).
- b. Ensure the right person to complete the task, and there is supporting resources.
- c. Ensure enough is available to complete steps.
- d. Review similar operations, different shifts, different operators – can the event/injury repeat itself? Setup lessons learned and communicate to all employees (*summarize and post investigation results*).



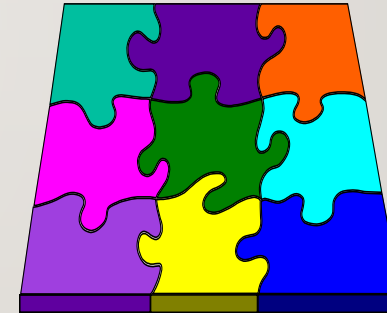
6. THE SAFETY COMMITTEE IN POST INVESTIGATION ACTIVITIES & MONITOR RESULTS UNTIL CLOSURE

- #1 Add corrective measures to safety committee meeting minutes until complete.
- #2 *In 30 days*, Safety Committee reviews recordable investigations,
- #3 Reviewing / updating related safety process maps or other flow docs
- #4 Reviewing / updating related risk assessment documents

EFFECTIVE ACCIDENT INVESTIGATION

COMPLETING THE PUZZLE

- We complete investigations to assist in reducing and or eliminating the events surrounding the injury or event from re-occurring
- Completing the investigation – **tell and communicate** the storyline, identify **all** the hazards involved in the injury
 - **Make sure there is a complete story (fill in the gaps!)**
 - Utilizing the **5 whys** until you exhaust all answers
 - Develop an **injury cause and effect** - have 4-5 contributing factors for the event
 - First report of injury
 - 5 Why Investigation form)
 - Update any other hazard identified / risk control documents
 - Update WIs and SOPs
 - Complete training
 - Ensure you have an effective action plan tracking system that is timely and effective
- **Engage your safety committee in the investigations – add all action plan items to safety committee meeting minutes**



Division	38-0	Job Title	O/H Racker
Date of Review	08/29/2013	Updated	
Employee(s) Interviewed: Faline Smith			
Risk Assessment Team Members: Lisa Chehab/ Theresa Overcast/ James Pool/ Lynette Tysar			
Comments: In regards to injury of employee tripping <i>Remember to transfer information below to EHSF 17.2 to complete assessment</i>			

Task: Pull cart full of parts next to line
Task Hazard: Push cart into person or self/ Or strain
Control Measure in Place: Proper Training and awareness

Task: Push empty cart away
Task Hazard: Possible push into person or equipment
Control Measure in Place: Proper training

Repeat

Division	04-0, Windsor, CT	Job Title	Preventing eye injuries
Date of Review	6/25/12	Updated	
Employee(s) Interviewed: All 1 st & 2 nd Shift operators and Management			
Risk Assessment Team Members: Frank Febo, Fred Montalvo, Felix Santiago, Jack Connelly			
Comments: Several precautions have been taken toward preventing eye injuries <i>Remember to transfer information below to EHSF 17.2 to complete assessment</i>			

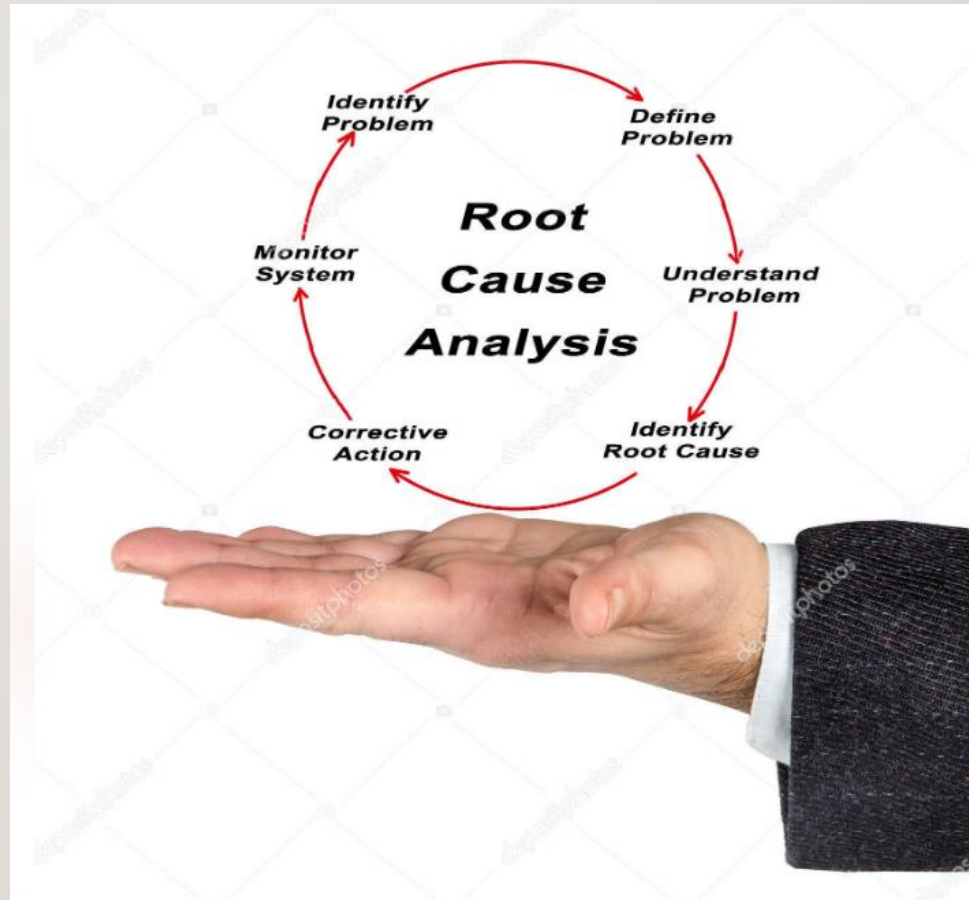
Task: (Open machine doors to setup, change or rinse parts.)
Task Hazard: (Eye injury from shot or glass media splashing up or falling from above into safety glasses)
Control Measure in Place: (Personnel Training Record to rinse with low water pressure and not to wipe eye area with body parts or clothing that may hold media)

Task: (Wearing old style safety glasses)
Task Hazard: (Eye injury from shot or glass media falling from above into safety glasses)
Control Measure in Place: (Replaced Employees old style safety glasses that had open area above.)

Task: (Wearing new style safety glasses)
Task Hazard: (Reduced risk of eye injury from shot media falling from above into safety glasses)
Control Measure in Place: (Employees instructed to use new style safety glasses with brims on top to help prevent media entering.)

Task: (Wearing new style safety glasses and a baseball cap)
Task Hazard: (Greatly reduced risk of eye injury from shot media falling from above into safety glasses)
Control Measure in Place: (Employees instructed to use baseball caps and new style safety glasses to help prevent media entering.)

QUESTIONS ??



Techniques to Improve Your Incident Investigation Process

Thanks for your participation!

Is your awareness better now?

(Awareness exercise 3)