Risk: The Human Factor
Reducing Error & Influencing Behavior

Paul A. Zoubek, CSP, CIH, CESCP
Zoubek Consulting, LLC
paul@zoubekconsulting.com
619-677-8682
May 7, 2024

Zoubek Consulting, LLC
Workplace Safety Solutions

Agenda

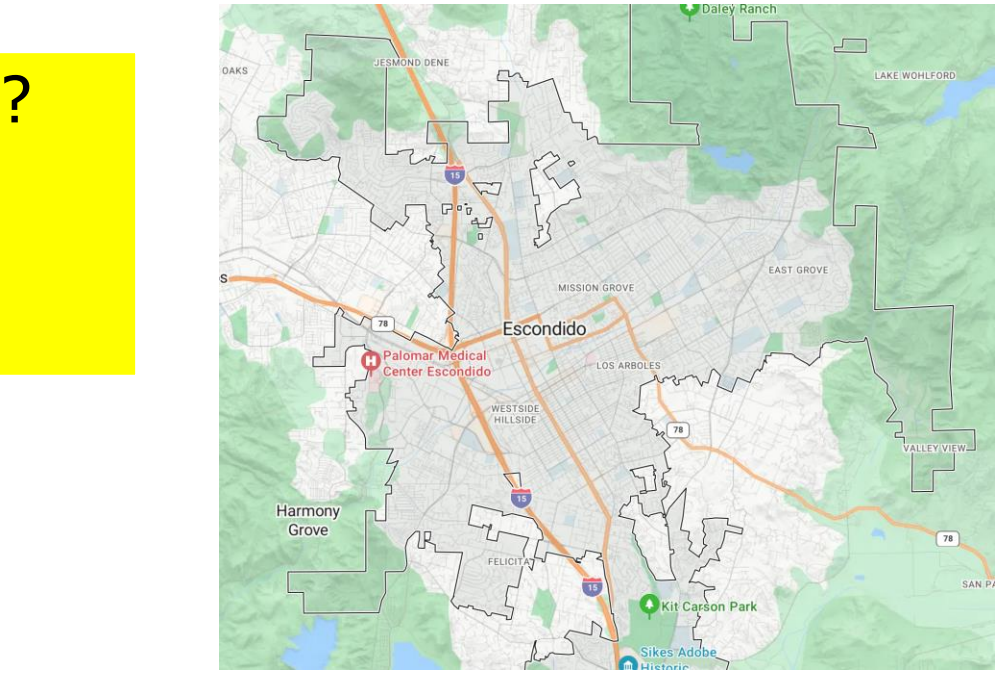
- Review Risk Assessment Procedures
- Understanding human factors
- List error precursors
- Reduce error through human performance tools

Agenda

- Lecture & Group Questions (example)

Where is this years PDC?

a. Oceanside
b. Escondido



Agenda

- Role Playing (example)

A series of connected vehicles that run along a railway track

a. Train
b. Airplane

0

"Those who don't know history are doomed to repeat it."

- *Edmund Burke, English Philosopher*

By learning from past mistakes - we can learn to recognize potential hazards and prepare ourselves to provide protection against those hazards in the future.

Crash of PSA 182

- PSA 182 crash in North Park in 1978
- Mid-air collision resulting from pilot error.
  - Failure to keep visual distance from Cessna aircraft as instructed by ATC.
    - May have resulted from distraction in cockpit.
  - Death of 142 people.
    - Many were PSA employees.

What variables are used in the definition of risk?

a. Likelihood
b. Consequences
c. Both Likelihood & Consequences

Risk Assessment Procedure

ANSI B11.0 Uses 4X4 Matrix

Likelihood of Occurrence of Harm	Consequences of Harm			
	Catastrophic	Serious	Moderate	Minor
Very Likely	High	High	High	Medium
Likely	High	High	Medium	Low
Unlikely	Medium	Medium	Low	Negligible
Remote	Low	Low	Negligible	Negligible

ANSI Z10 Uses 4X5 Matrix

Likelihood/Probability of Occurrence or Exposure			Severity of Injury or Illness			
			Catastrophic (CAT) Death or permanent total disability (Unable to return to work)	Critical (C) Disability in excess of 3 months Hospitalization of at least 3 people per event	Marginal (M) Minor injury, lost workday incident	Negligible (N) First aid or minor medical treatment
			4	3	2	1
Frequent (F)		5	High 20 Operation not permissible	High 15 Operation not permissible	Serious 10 High Priority Remedial Action	Medium 5 Take Remedial action at appropriate time
Probable (P)		4	High 16 Operation not permissible	High 12 Operation not permissible	Serious 8 High Priority Remedial Action	Medium 4 Take Remedial action at appropriate time
Occasional (O)		3	High 12 Operation not permissible	Serious 9 High Priority Remedial Action	Medium 6 Take Remedial action at appropriate time	Low 3 Risk Acceptable, Remedial action discretionary
Remote (R)		2	Serious 8 High Priority Remedial Action	Medium 6 Take Remedial action at appropriate time	Medium 4 Take Remedial action at appropriate time	Low 2 Risk Acceptable, Remedial action discretionary
Improbable (I)		1	Medium 4 Take Remedial action at appropriate time	Low 3 Risk Acceptable, Remedial action discretionary	Low 2 Risk Acceptable, Remedial action discretionary	Low 1 Risk Acceptable, Remedial action discretionary

NFPA 70E Uses 2X2 Matrix

Likelihood of Occurrence of Harm	Severity of Harm	
	Energy ≤ 1.2 cal/cm^2	Energy > 1.2 cal/cm^2
No	Low	Medium
Yes	Medium	High

There is an infinite number of Risk Assessment Procedures but all address Likelihood & Consequences

Risk Assessment Procedure

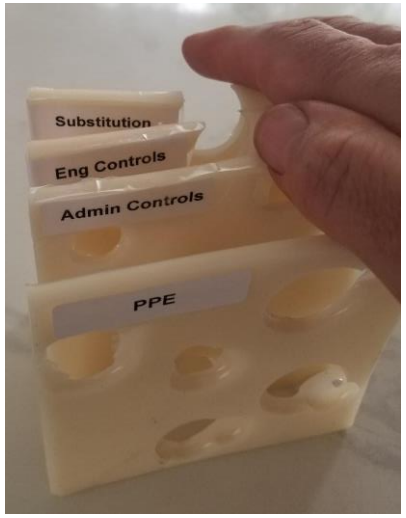
- **Likelihood (Probability):** Looks proximity to task, frequency of task, etc.
- **Consequences (Severity):** Looks at injury severity potential (first aid, disabling injury, fatality).
  - Related to energy level.
- **Acceptable Risk:**
  - Level of human and property loss that can be tolerated by an organization **(Risk Appetite)**.
  - Note there no zero risk unless a hazard is eliminated.
  - Risk can be mitigated through control measures.

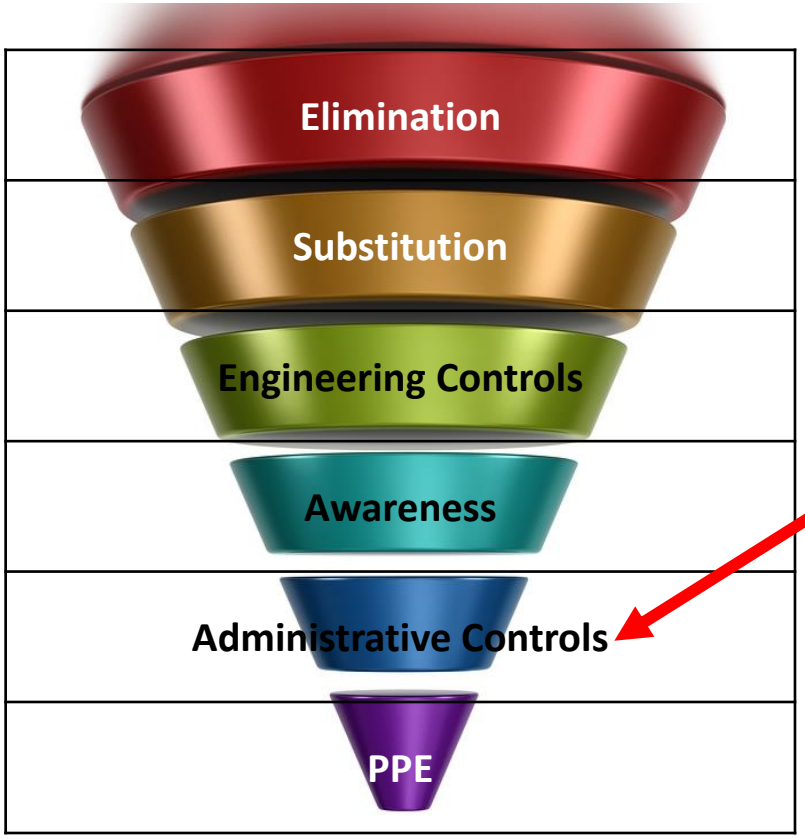
Risk Assessment Procedure

Acceptable Risk is determined by:

a. Cal/OSHA
b. The Employer

Risk Treatment considers Hierarch of controls





Addressing human error is good risk assessment practice and is mentioned in several safety guidance standards:

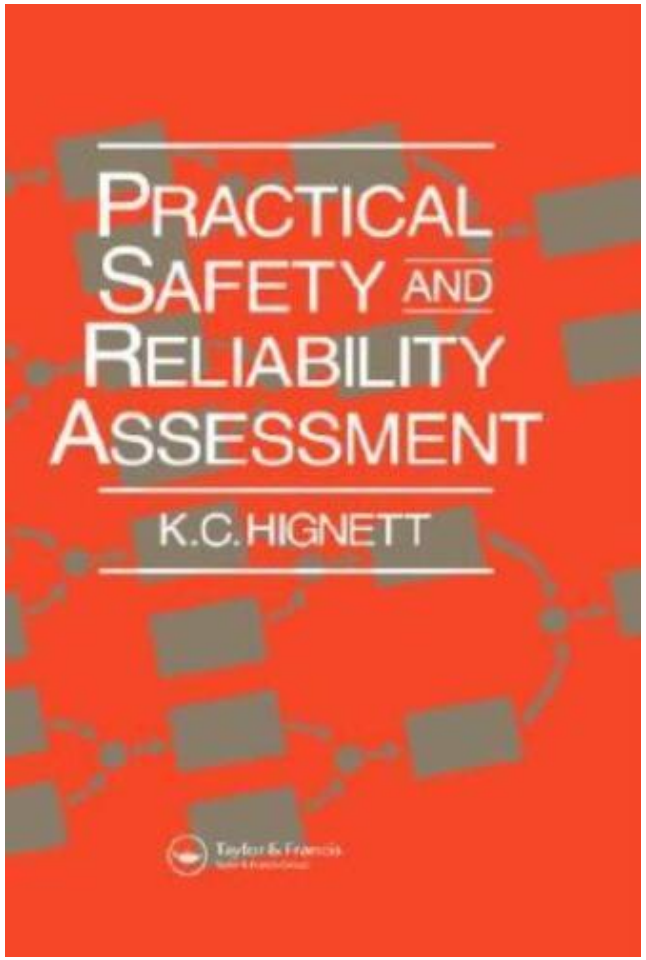
a. Yes
b. No

Risk Assessment Procedure

- The risk assessment procedure shall address the potential for *human error* and it's negative consequences on people, processes and the work environment.

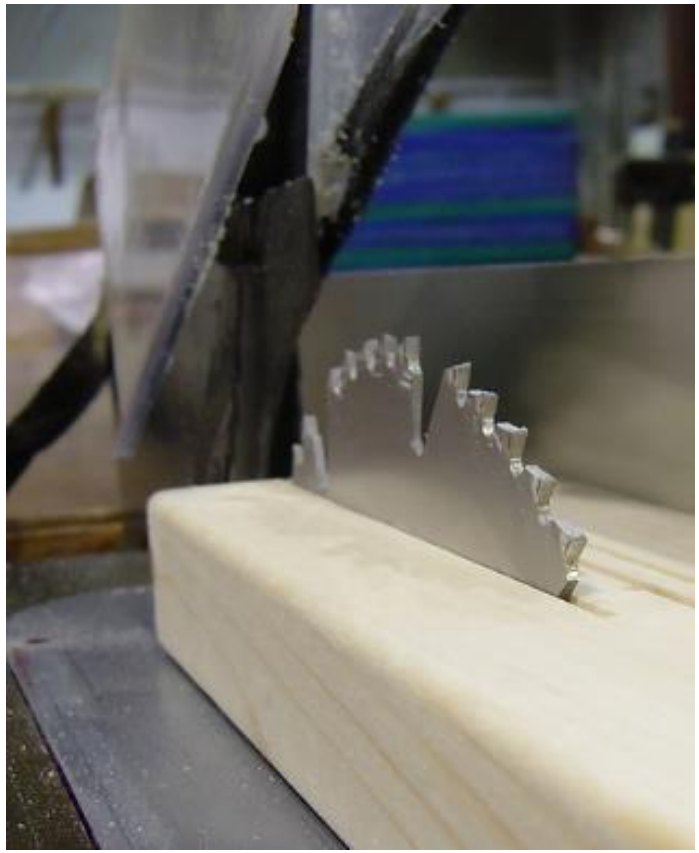
Risk Assessment Procedure

- Human error assessment and reduction technique (HEART) as published *A Guide To Practical Human Reliability Assessment*
  - Application to ergonomics



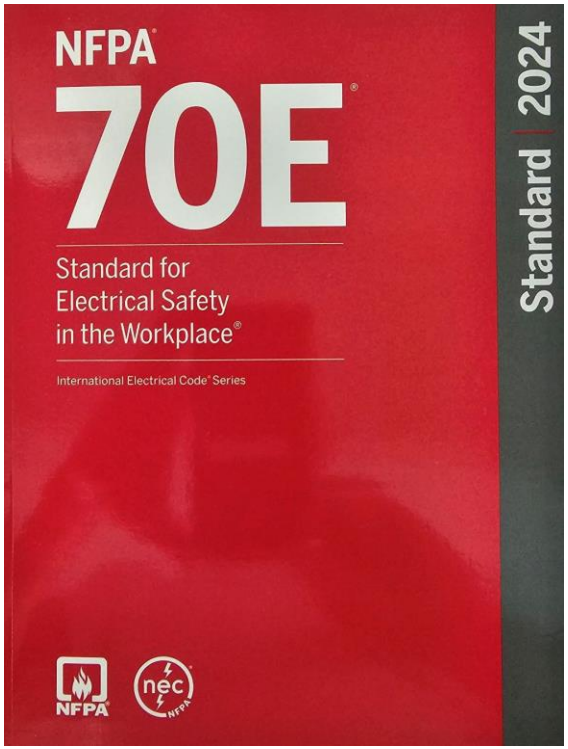
Risk Assessment Procedure

- ANSI B11 for machine guarding mentions addressing error as part of risk assessment process.



Risk Assessment Procedure

- NFPA 70E risk assessment process requires addressing human error



*"If you say that **to error is human**, you mean that it is natural for human beings to make mistakes."*

**COBUILD Advanced English Dictionary*

Human Factors

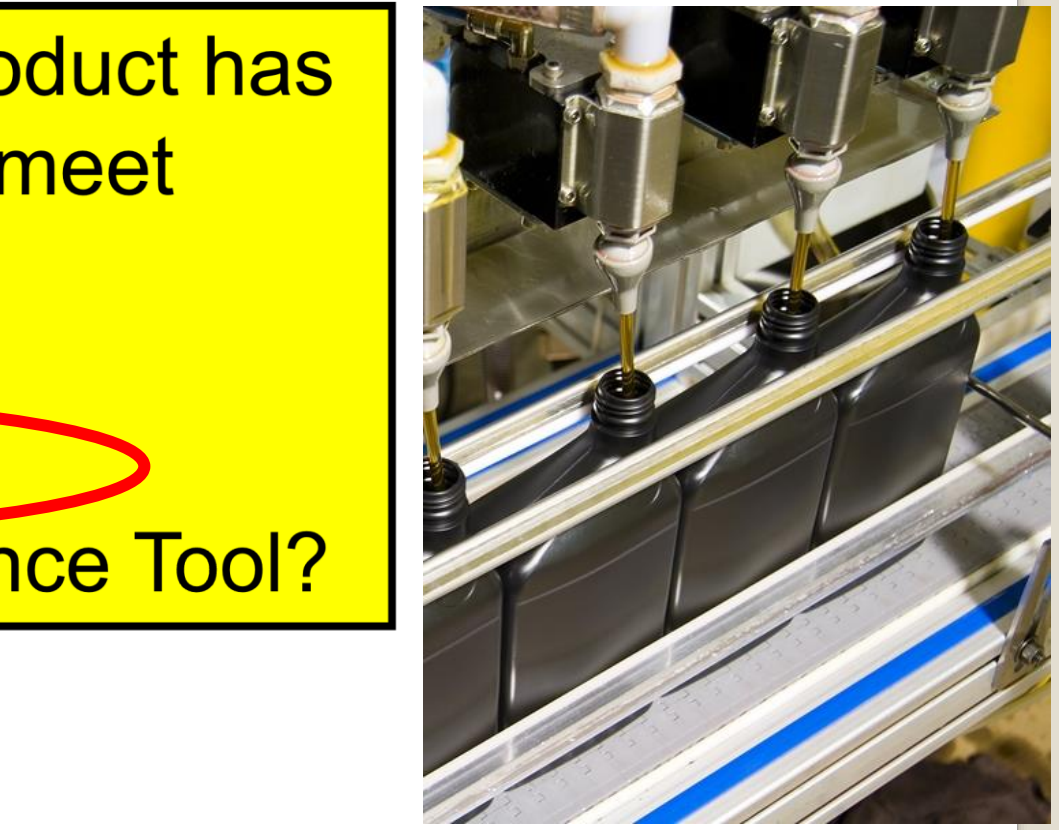
- People are not perfect.
- Human error is predictable, manageable, and can be prevented.
- Organizational factors greatly influence individual behaviors.
- Positive reinforcement helps people achieve higher levels of performance.
- An understanding of why past errors happened can help us prevent future ones.

Human Performance & Workplace Electrical Safety (NFPA 70E (2024 Edition), Annex Q)

Error Precursors	**Human Performance Tools**
Unfavorable conditions the increase the probability of error	Reduce the likelihood of error when applied to error precursors

Supervisor says “Product has to get out quickly to meet customer demand”

a. Error Precursor?
b. Human Performance Tool?

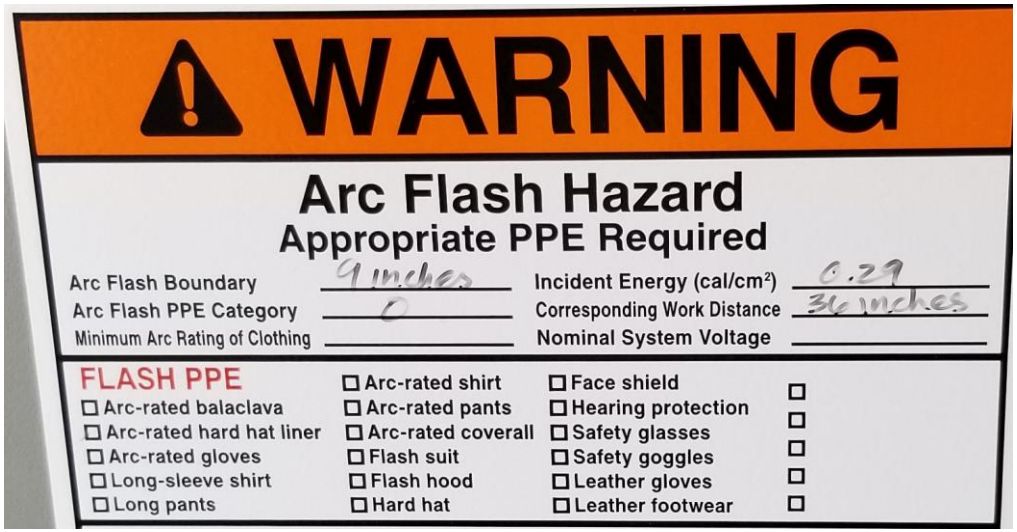


ERROR PRECURSORS

Unfavorable Conditions which increase the likelihood of error

Error Precursors

- **Task Demands**
  Exceed individual capabilities or challenge the limitations of the individual.
  Examples:
    Time Pressure
    High Workload
    Repetitive Actions
    Interpretation requirements



Task Demands

Information incomplete= worker needs to interpret information given

Error Precursors

- **Work Environment**
  Influences of the workplace conditions affect individual performance.
  Examples:
    Distractions/interruptions
    Obscure electrical configurations
    Personality conflicts

Work Environment

Distractions or interruptions

Error Precursors

- **Individual Capabilities**
  Individual characteristics do not match the demands of the specific task.
  Examples:
    Unfamiliar with task
    New task/not used before
    Lack of knowledge

Individual Capabilities

A worker is operating a new control panel. It has a lot more buttons and controls than previous

Error Precursors

- **Human Nature**

  Limitations common to all persons incline an individual to error under unfavorable conditions.

  Examples:

  - Stress
  - Habits
  - Assumptions
  - Complacency

Human Nature

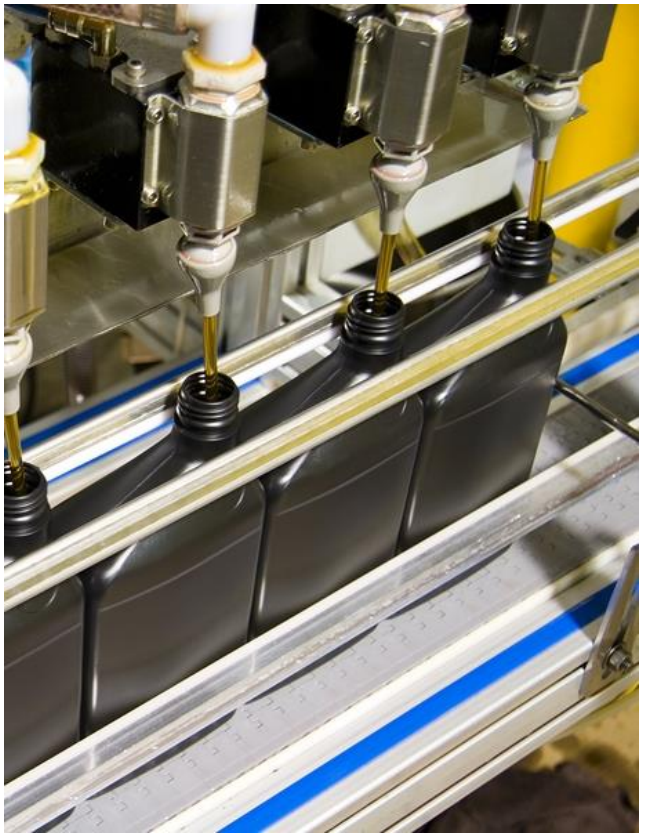
A worker has gone through classroom fall protection training, therefore he knows how to do the task safely

Let’s Role Play!

Error Precursors

"Get product out NOW! We have to meet the production quota!"

a. Task Demand
b. Human Nature



1

Error Precursors

"I have closed this disconnect 100 times and I have never been hurt."

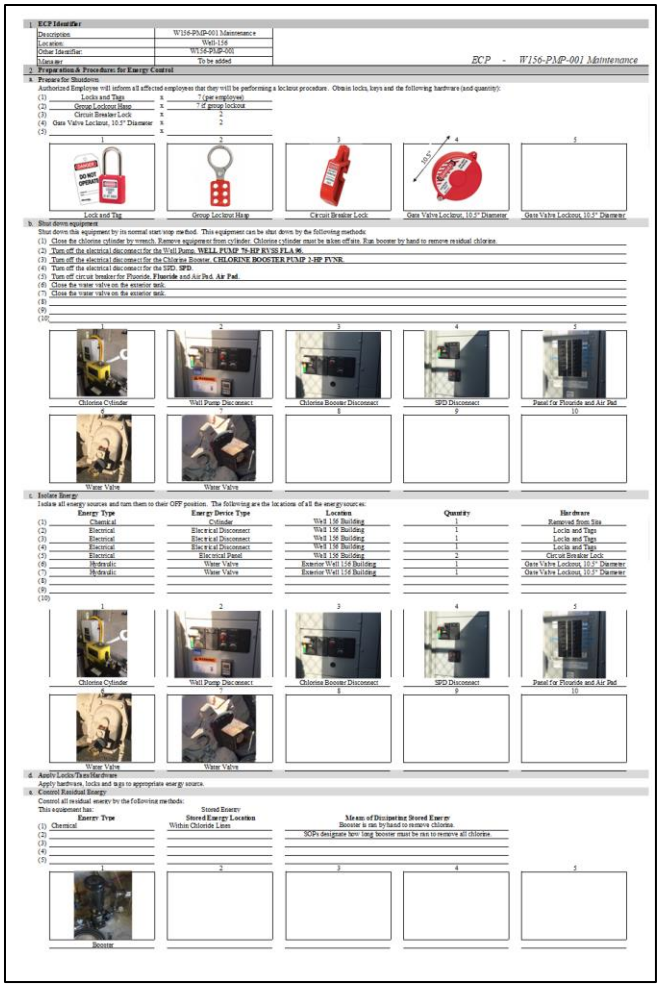
a. Human nature?
b. Individual capabilities?

2

Error Precursors

"This energy control procedure is complicated!"

a. Task Demand?
b. Individual capabilities?

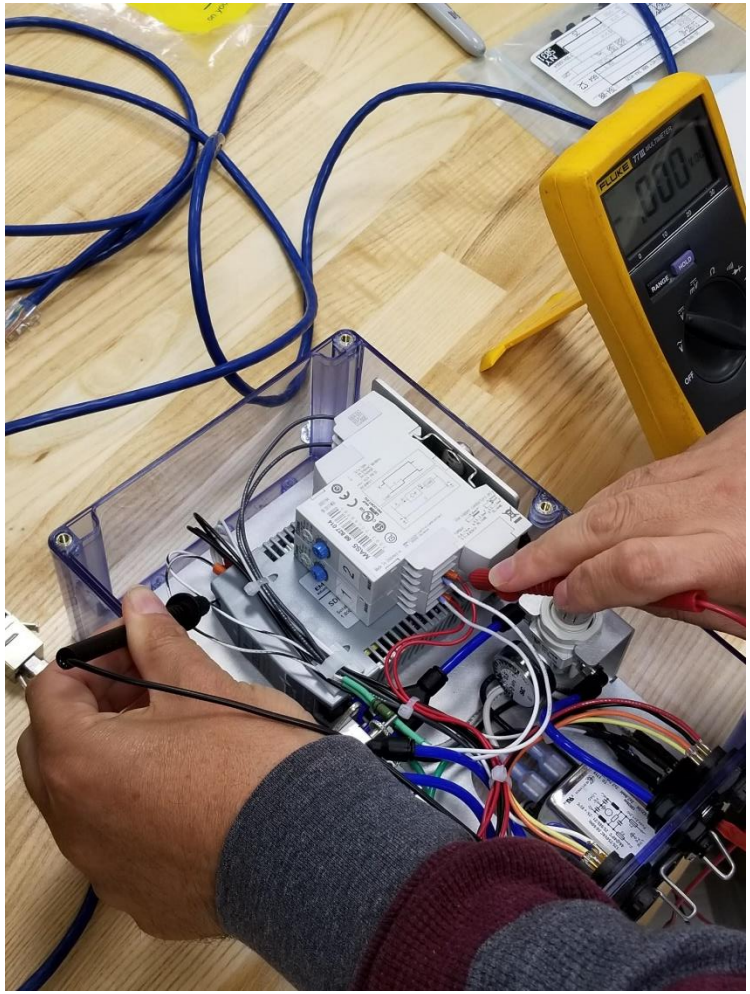


3

Error Precursors

What are you doing?

a. Individual capabilities?
b. Work environment?



4

HUMAN PERFORMANCE TOOLS

Reduce the likelihood of error

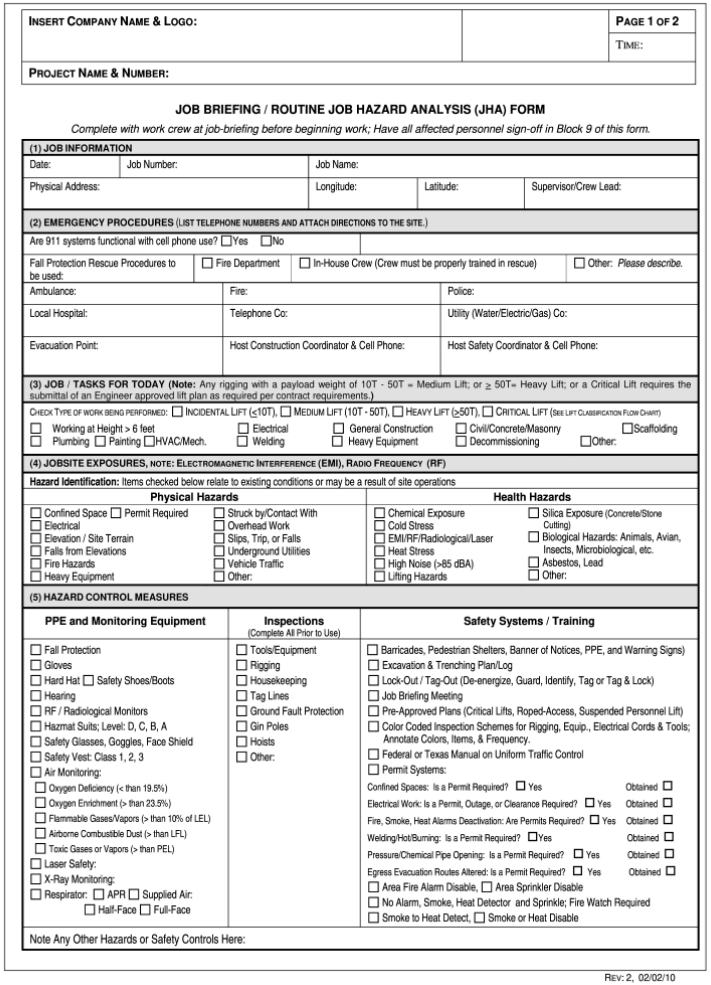
Human Performance Tools

Systems in place to mitigate worker potential to make a mistake.

a. Error Precursor?
b. Human Performance Tool?

Human Performance Tools

- **Pre-Job Briefing**
  Identify Hazards.
  Assess Risk.
  Implement Controls.



INSERT COMPANY NAME & LOGO: | PAGE 1 OF 2 | TIME:

PROJECT NAME & NUMBER:

JOB BRIEFING / ROUTINE JOB HAZARD ANALYSIS (JHA) FORM

Complete with work crew at job-briefing before beginning work; Have all affected personnel sign-off in Block 9 of this form.

(1) JOB INFORMATION

Date:	Job Number:	Job Name:		
Physical Address:		Longitude:	Latitude:	Supervisor/Crew Lead:

(2) EMERGENCY PROCEDURES (LIST TELEPHONE NUMBERS AND ATTACH DIRECTIONS TO THE SITE.)

Are 911 systems functional with cell phone use? ☐Yes ☐No

Fall Protection Rescue Procedures to be used: ☐ Fire Department ☐ In-House Crew (Crew must be properly trained in rescue) ☐ Other: *Please describe.*

Ambulance:	Fire:	Police:
Local Hospital:	Telephone Co:	Utility (Water/Electric/Gas) Co:
Evacuation Point:	Host Construction Coordinator & Cell Phone:	Host Safety Coordinator & Cell Phone:

(3) JOB / TASKS FOR TODAY (Note: Any rigging with a payload weight of 10T - 50T = Medium Lift; or ≥ 50T= Heavy Lift; or a Critical Lift requires the submittal of an Engineer approved lift plan as required per contract requirements.)

CHECK TYPE OF WORK BEING PERFORMED: ☐ INCIDENTAL LIFT (≤10T), ☐ MEDIUM LIFT (10T - 50T), ☐ HEAVY LIFT (>50T), ☐ CRITICAL LIFT (SEE LIFT CLASSIFICATION FLOW CHART)

☐ Working at Height > 6 feet ☐ Electrical ☐ General Construction ☐ Civil/Concrete/Masonry ☐Scaffolding
☐ Plumbing ☐ Painting ☐HVAC/Mech. ☐ Welding ☐ Heavy Equipment ☐ Decommissioning ☐Other:

(4) JOBSITE EXPOSURES, NOTE: ELECTROMAGNETIC INTERFERENCE (EMI), RADIO FREQUENCY (RF)

Hazard Identification: Items checked below relate to existing conditions or may be a result of site operations

Physical Hazards		Health Hazards	
☐ Confined Space ☐ Permit Required	☐ Struck by/Contact With	☐ Chemical Exposure	☐ Silica Exposure (Concrete/Stone Cutting)
☐ Electrical	☐ Overhead Work	☐ Cold Stress	☐ Biological Hazards: Animals, Avian, Insects, Microbiological, etc.
☐ Elevation / Site Terrain	☐ Slips, Trip, or Falls	☐ EMI/RF/Radiological/Laser	
☐ Falls from Elevations	☐ Underground Utilities	☐ Heat Stress	☐ Asbestos, Lead
☐ Fire Hazards	☐ Vehicle Traffic	☐ High Noise (>85 dBA)	☐ Other:
☐ Heavy Equipment	☐ Other:	☐ Lifting Hazards	

(5) HAZARD CONTROL MEASURES

PPE and Monitoring Equipment	Inspections (Complete All Prior to Use)	Safety Systems / Training
☐ Fall Protection	☐ Tools/Equipment	☐ Barricades, Pedestrian Shelters, Banner of Notices, PPE, and Warning Signs)
☐ Gloves	☐ Rigging	☐ Excavation & Trenching Plan/Log
☐ Hard Hat ☐ Safety Shoes/Boots	☐ Housekeeping	☐ Lock-Out / Tag-Out (De-energize, Guard, Identify, Tag or Tag & Lock)
☐ Hearing	☐ Tag Lines	☐ Job Briefing Meeting
☐ RF / Radiological Monitors	☐ Ground Fault Protection	☐ Pre-Approved Plans (Critical Lifts, Roped-Access, Suspended Personnel Lift)
☐ Hazmat Suits; Level: D, C, B, A	☐ Gin Poles	☐ Color Coded Inspection Schemes for Rigging, Equip., Electrical Cords & Tools; Annotate Colors, Items, & Frequency.
☐ Safety Glasses, Goggles, Face Shield	☐ Hoists	☐ Federal or Texas Manual on Uniform Traffic Control
☐ Safety Vest: Class 1, 2, 3	☐ Other:	☐ Permit Systems:
☐ Air Monitoring:		Confined Spaces: Is a Permit Required? ☐ Yes Obtained ☐
☐ Oxygen Deficiency (< than 19.5%)		Electrical Work: Is a Permit, Outage, or Clearance Required? ☐ Yes Obtained ☐
☐ Oxygen Enrichment (> than 23.5%)		Fire, Smoke, Heat Alarms Deactivation: Are Permits Required? ☐ Yes Obtained ☐
☐ Flammable Gases/Vapors (> than 10% of LEL)		Welding/Hot/Burning: Is a Permit Required? ☐Yes Obtained ☐
☐ Airborne Combustible Dust (> than LFL)		Pressure/Chemical Pipe Opening: Is a Permit Required? ☐ Yes Obtained ☐
☐ Toxic Gases or Vapors (> than PEL)		Egress Evacuation Routes Altered: Is a Permit Required? ☐ Yes Obtained ☐
☐ Laser Safety:		☐ Area Fire Alarm Disable, ☐ Area Sprinkler Disable
☐ X-Ray Monitoring:		☐ No Alarm, Smoke, Heat Detector and Sprinkle; Fire Watch Required
☐ Respirator: ☐ APR ☐ Supplied Air: ☐ Half-Face ☐ Full-Face		☐ Smoke to Heat Detect, ☐ Smoke or Heat Disable

Note Any Other Hazards or Safety Controls Here:

REV: 2, 02/02/10

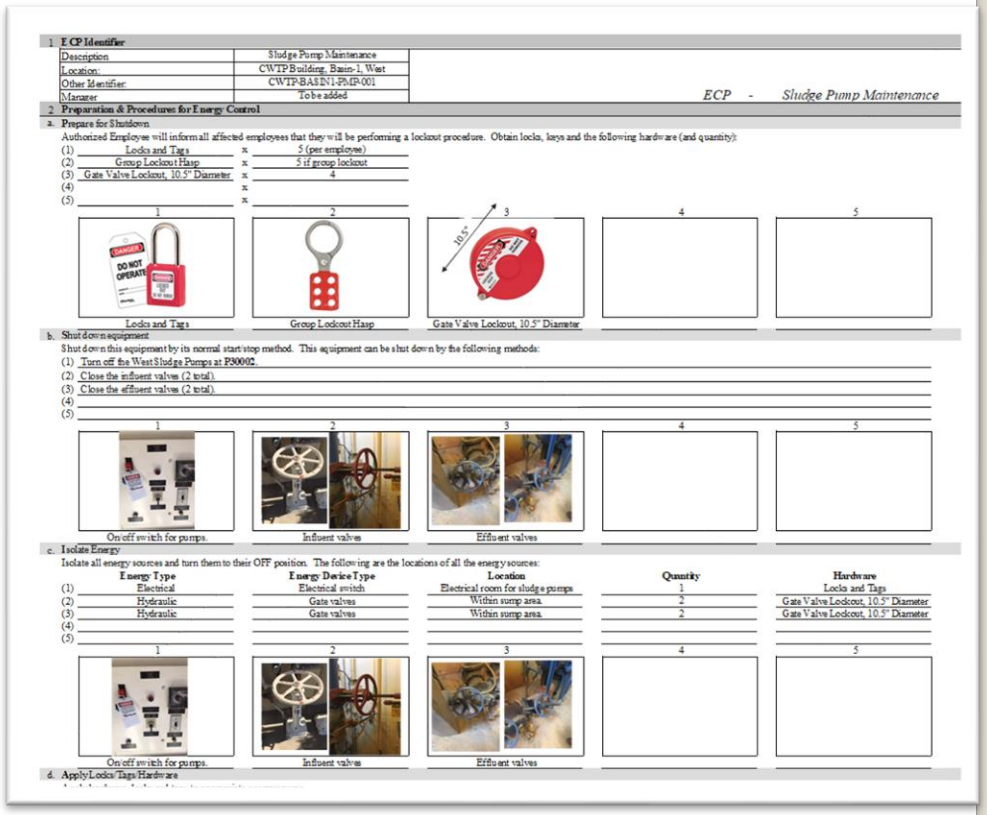
- **Job Site Review**
  Risk analysis.
  Barriers.
  Delays.

Human Performance Tools

- **Post Job Review**
  - Feedback.
  - Lessons learned.
  - Incorporation of human performance tools.

Human Performance Tools

- **Procedure use & adherence**
  - Step by step procedure read.
  - Such as:
    - Production SOP.
    - Energy control procedure.



1 **ECP Identifier**

Description	Sludge Pump Maintenance
Location:	CWTP Building, Basin-1, West
Other Identifier:	CWTP-BASIN1-PMP-001
Manager	To be added

ECP - *Sludge Pump Maintenance*

2 **Preparation & Procedures for Energy Control**

a. Prepare for Shutdown

Authorized Employee will inform all affected employees that they will be performing a lockout procedure. Obtain locks, keys and the following hardware (and quantity):

(1)	Locks and Tags	x	5 (per employee)
(2)	Group Lockout Hasp	x	5 if group lockout
(3)	Gate Valve Lockout, 10.5" Diameter	x	4
(4)		x	
(5)		x	

1 Locks and Tags; 2 Group Lockout Hasp; 3 Gate Valve Lockout, 10.5" Diameter; 4; 5

b. Shut down equipment

Shut down this equipment by its normal start/stop method. This equipment can be shut down by the following methods:

(1) Turn off the West Sludge Pumps at P30002.
(2) Close the influent valves (2 total).
(3) Close the effluent valves (2 total).
(4)
(5)

1 On/off switch for pumps.; 2 Influent valves; 3 Effluent valves; 4; 5

c. Isolate Energy

Isolate all energy sources and turn them to their OFF position. The following are the locations of all the energy sources:

	Energy Type	Energy Device Type	Location	Quantity	Hardware
(1)	Electrical	Electrical switch	Electrical room for sludge pumps	1	Locks and Tags
(2)	Hydraulic	Gate valves	Within sump area.	2	Gate Valve Lockout, 10.5" Diameter
(3)	Hydraulic	Gate valves	Within sump area.	2	Gate Valve Lockout, 10.5" Diameter
(4)					
(5)					

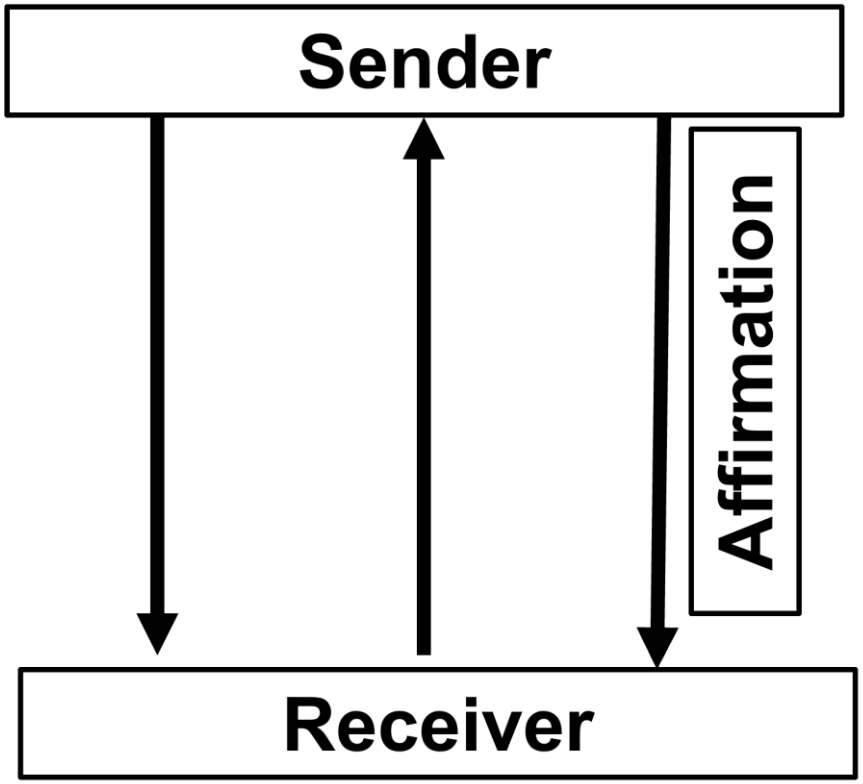
1 On/off switch for pumps.; 2 Influent valves; 3 Effluent valves; 4; 5

d. Apply Locks/Tags/Hardware

- **Self check with verbalization**
  - Verbalize intent before, during, and after task.

- **Stop**
- **Think**
- **Act**
- **Review**

- **3-Way Communication**
  - Directives are repeated by receiver back to sender.
  - Receiver is acknowledged by sender.



- **Stop when unsure**
  - Maintain a questioning attitude.

Human Performance Tools

- **Flagging & Blocking**
  - Prevent access to equipment.
  - Marker or label.

Let’s Role Play Again!

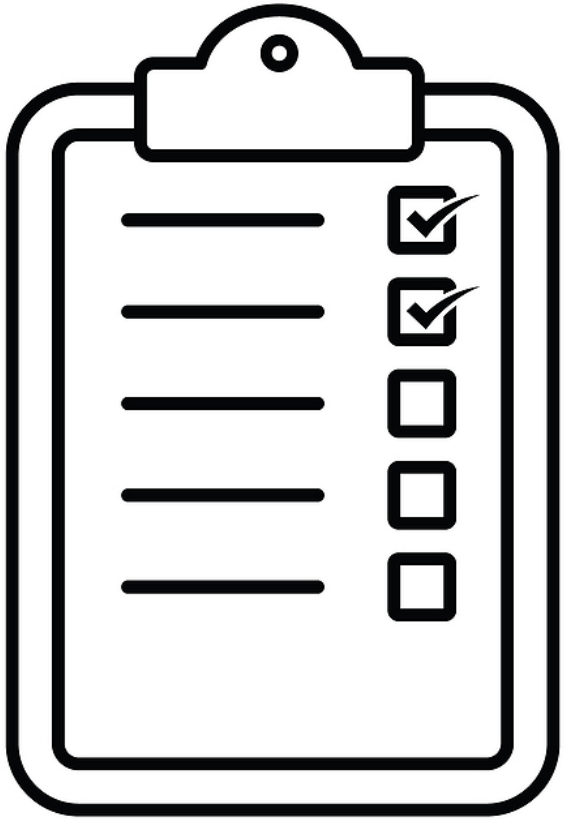
Human Performance Tools

This is:

a. Blocking
b. Post job site review

"I need to obtain my checklist to see what PPE and safety procedures are necessary for transporting this chemical"

a. Pre-Job Briefing
b. Flagging & Blocking

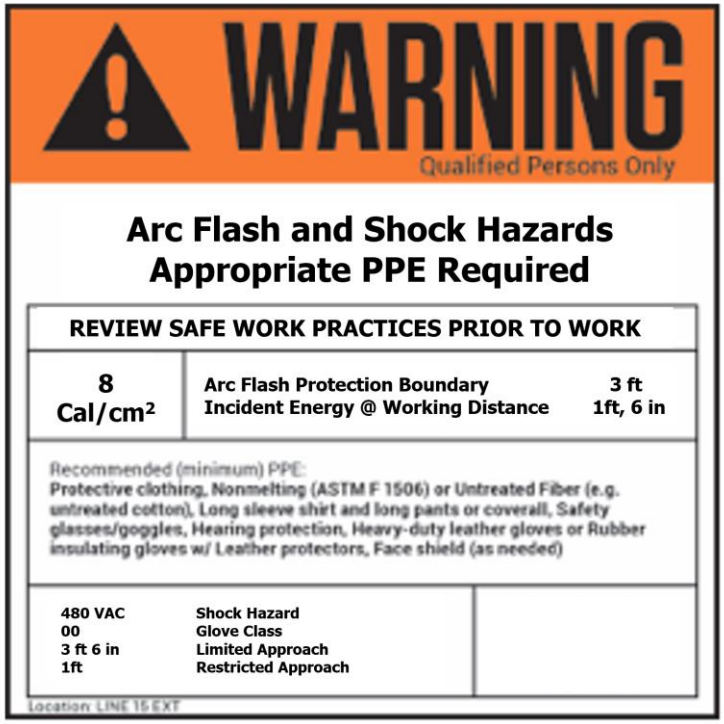


5

Human Performance Tools

"I will review the arc flash label in order to determine consequence levels for a risk assessment"

a. Job Site Review
b. Flagging & Blocking



6

Human Performance Tools

"I am at Panel 12 Bravo (12B)."

"I will close circuit breaker 4 Bravo (4B)

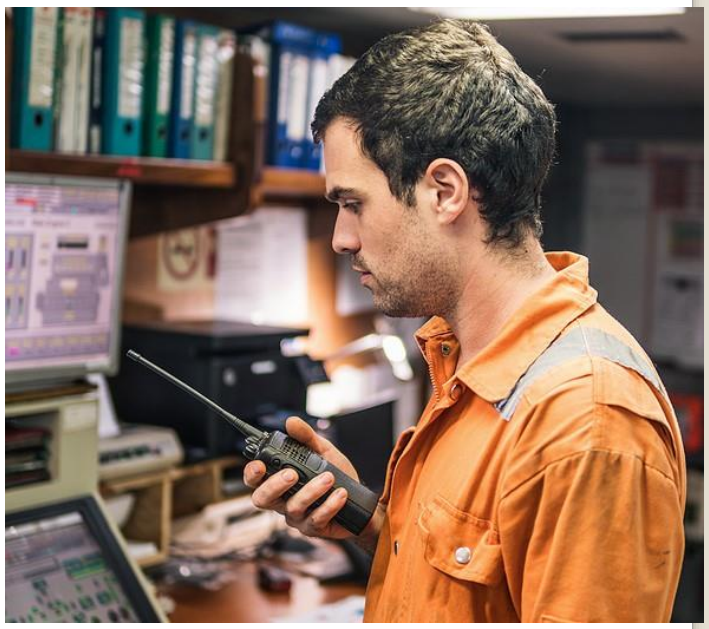
a. 3-way communication
b. Self check with Verbalization

7

Human Performance Tools

8A-”Close Disconnect 4 Bravo”
8B-”I understand, close disconnect 4 Bravo”
8A-”That is correct”

a. 3-way communication
b. Flagging



8

"I think"

"I am pretty sure"

a. 3-way communication
b. Stop when unsure

9

"I have obtained my locks and tags and will locate energy sources per procedure"

a. Job Site Review
b. Procedure use & adherence

10

"After performance of overhead crane operations, danger tape would be a better awareness barrier to keep people outside of operation areas"

a. Job Site Review
b. Post job site review

11

*"To error is human; to forgive, divine."**

*18th Century Poet:
Alexander Pope

Summary

Error Precursors	Human Performance Tools
▪ Task Demands ▪ Work Environment ▪ Individual Capabilities ▪ Human Nature	▪ Pre-Job Briefing ▪ Job Site Review ▪ Post Job Review ▪ Procedure Use & Adherence ▪ Self Check with Verbalization ▪ 3-Way Communication ▪ Stop When Unsure ▪ Flagging & Blocking