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TEXAS A&M ENGINEERING EXPERIMENT STATION

Development of an effective procedure writers guide using a human factors and regulatory compliance approach

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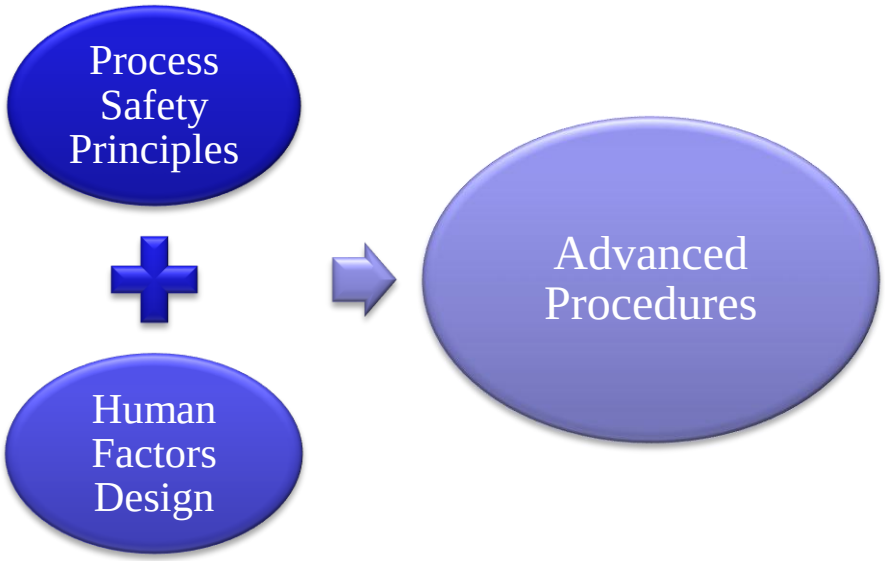
Introduction

- Major incident studies indicates “human error” contributed to initiating events or was the response to it
- A systems approach to human error is necessary to improve reliability, effectiveness, and safety
- Effective procedures inherently a part of a systems approach for Error Management with High Reliability Organizations.
- Addressing how to apply this to high risk work environments with collaborative research with
  Texas A&M University
  Mary Kay O’Connor
  Process Safety Center and
  Ergonomics Center



Problems & Challenges with Procedures

- 2004—Five facilities reviewed (Bullemer & Hajdukiewicz)
  - 30% of all reports had procedural operations as cause (8% of financial losses)
- 2013—32 incident reports reviewed (Bullemer)
  - 8% of major incidents had procedural operation as root cause
- Types of Operation Errors
  - Omission of a step that should be performed
  - Proceeding to an inappropriate step because of a condition mismatching
  - Execution of an action that should not be performed
- Some Causes of Errors
  - Place keeping
  - Concurrent execution of multiple procedures
  - Need for interpretation of procedures and intervention while continuing to monitor and control other systems
  - Operator has to rely on memory regarding status or limits information

Procedures are not used because:		% Respondents Agreeing
Accuracy	…they are inaccurate	21%
	…they are out-of-date	45%
Practicality	…they are unworkable in practice	40%
	…they make it more difficult to do the work	42%
	…they are too restrictive	48%
	…too time consuming	44%
	…if they were followed to the letter, they could not get done in time	**62%**
Optimization	…people usually find a better way to do the job	42%
	…they do not describe the best way to carry out the job	48%
Presentation	…it is difficult to know which is the right procedure	32%
	…they are too complex and difficult to use	42%
	…it is difficult to find the information you need in the procedure	48%
Accessibility	…it is difficult to locate the right procedure	50%
	…people are not aware that a procedure exists for the job they are doing	57%
Policy	…people do not understand why they are necessary	40%
	…no clear policy on when they should be used	37%
Usage	…experienced people don't need them	19%
	…people resent being told on how to do their job	34%
	…people prefer to rely on their own skills and experience	**72%**
	…people assume they know what is in the procedure	**70%**

Source: Interviews with 400 plant operators and managements. Human Reliability Associates, Ltd.

Research Focus

- Current writer's guide based on expert judgment and company's internal report
  - Not empirical findings from human performance research
- To reduce risk, and improve efficiency, effectiveness, and safety the following is needed:
  - Development of procedure creation and validation framework that will improve operator performance
  - Development of writer's guide to facilitate effective communication of information to operators.
  - Procedure development practices incorporating findings from human performance and human factors research to improve the current practices in the industry

Work Description

- Literature review and survey on procedure regulations, standards, and guidance
- Development of preliminary writers' guide based on human factors and performance literature
- Analysis on a representative sample of procedures from energy/ chemical industries
- Survey users regarding problematic elements regarding procedure use and delivery environments (energy and chemical workforce)
- Empirical evaluations to develop a framework of systematic procedure development approach
- Integration of procedure framework into procedures software and writers' guide

Phase I

- Regulations and standards
  - Summarize those for procedures across industries (ISO, EPA, OSHA, SEMS, NRC, INPO, & SEVESO)
  - Find common elements and ideas
  - Identify human factors and performance implications for the regulatory elements
- Procedures writers' guides
  - Summarize current practices for procedure writing
  - Identify empirical research that provides guidelines to writers
- Deliverables: Writers guide for procedures1.0

Common Regulatory Elements

- Written procedures
  - That are accurate, clear, concise, and up to date
  - Should be clearly visible and quickly accessible
- Procedures for different activities
  - e.g., emergency vs. normal shutdown
- Effective communication of operating limits & ranges
- Effective hazard communication
  - Hazard, consequence, method to avoid, action to take
- Procedure management policies

Human Factors Implications

- Hazards communications
  - Operator needs to know hazard, consequence, and method of avoiding consequence
- Emergency vs. non emergency procedures
  - Design of procedures should likely be different
- Frequent vs. infrequent procedures
  - Design implications are likely different for complacency with frequent procedures vs. anxiety with doing new procedure
- Procedure maintenance
  - Procedures have to be there and good to establish pattern of use

General Procedure Requirements	Types of Procedures	Normal Operating limits and Ranges	Hazard Exposure	Management of Procedures
3 Elements	***7*** Elements	***3*** Elements	***6*** Elements	***2*** Elements
No Human Performance Considerations	***40*** Human Performance Considerations	***12*** Human Performance Considerations	***24*** Human Performance Considerations	***8*** Human Performance Considerations
11 Guidelines	***4*** Guidelines	***2*** Guidelines	***6*** Guidelines	***1*** Guideline
• Lower # of elements • No considerations • Most # of guidelines	• High # of elements • High # of considerations • Low # of guidelines	• Mid-range # of elements • Mid-range # of considerations • Low # of guidelines	• High # of elements • High # of considerations • Mid-range # of guidelines	• Low # of elements • Lower # of considerations • Lowest # of guidelines

Writer's guide – an excerpt

Guidance supported by empirical evidence

11. If possible, steps should include only one action.
    - Example:
        i. Use:

            Step 1: Open Valve V-01
            Step 2: Check Level gauge light L-01

        Instead of:

            Open valve V-01 and check level gauge light L-01
    - Support: As the complexity of each step (that is the number of actions or pieces of information the operator must retain in memory) increases, the number of errors and likelihood that the procedure will not be used increases (For calculating step complexity see Park, Jung, & Ha, 2001).

Writer's guide– An excerpt

Guidance not supported by empirical evidence, but by experience

1. Include relevant operating limits in procedures, including the consequences of deviation and actions to take if limits are exceeded. These limits can be presented in table format to aid in organizing the information.
   - Example:
     i. Use

Parameter	Value	Effects of deviation	Actions to correct and control
Tank Pressure	170 psi	• Potential containment failure • Hazardous leak • Product Loss	1. Shut-down process 2. Apply emergency procedures

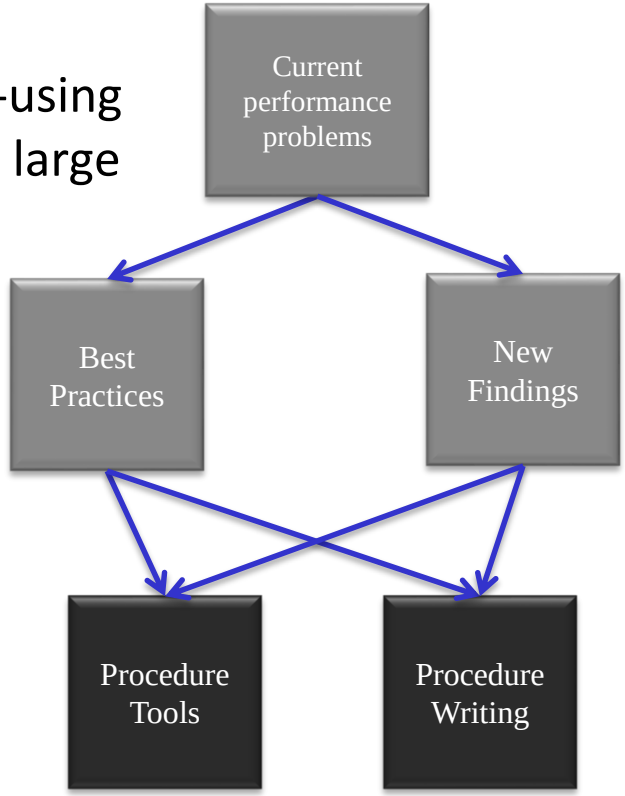
Instead of:

Operating Limits for Tank Pressure
Max Pressure = 170 psi
Effects of Deviation:
Exceeding 170 psi = Potential containment failure, hazardous leak, and product loss.
Actions to correct and control:
1. Shut-down process
2. Apply emergency procedures

- Comment: This guidance is not based on empirical evidence. The use of a table format may help organize and make the information available to the operator (La Cruz-Guerra & Cruz-Gomez, 2002; Scholtz & Maher, 2014).

Phase II

- Identify critical performance issues for procedures not provided by regulations.
  - Conduct extensive inquiry of the procedure-using work force using interviews, observations & large scale survey
  - Identify current science available to resolve issues and develop method for identifying needed unique solutions.
- Deliverables:
  - Complete writers guide for procedures
  - Electronic analysis rules library
  - SmartProcedures enhanced



Thank You