Slide 1

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Hazard Analysis Lessons Learned

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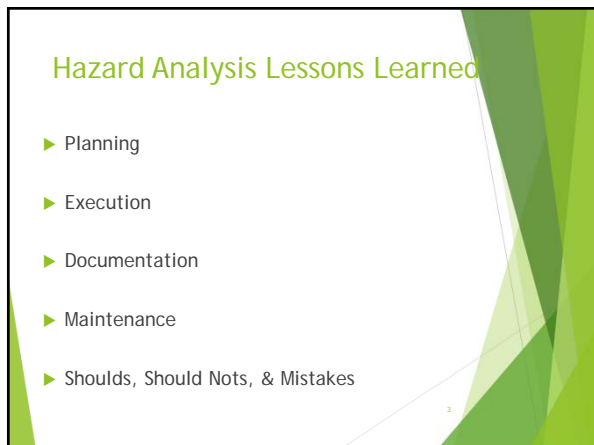tsstirrup@parvaticorp.com
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Parvati Consulting LLC
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Monday, August 27, 2018
@ 11:30am – 12:30pm

Slide 2

History Channel Video

▶ Pepcon Factory Explosion
  ▶ May 4, 1988
  ▶ Modern Marvels Engineering Disasters Link (10:28) -
    https://www.youtube.com/watch?v=r7nizHnIvyM

  ▶ Episode 8 Link (44:31 – Start @ 35sec)
    https://www.youtube.com/watch?v=8db0DEzHB9M

Slide 3

Hazard Analysis Lessons Learned

▶ Planning

▶ Execution

▶ Documentation

▶ Maintenance

▶ Shoulds, Should Nots, & Mistakes

Slide 4

HA Lessons Learned – Planning

▶ Never Enough Time to Complete
  ▶ Preparation, Analysis, & Documentation

▶ Stakeholder Buy In
  ▶ Scope
  ▶ Schedule
  ▶ Budget
  ▶ Approval Points

▶ Use Dedicated Workshop Facilitator
▶ Use Dedicated Workshop Scribe

Slide 5

HA Lessons Learned – Planning

▶ Select Appropriate Technique
  ▶ Motivation
  ▶ Types of Results

  ▶ Available Information / Lifecycle of Project
  ▶ Complexity & Size
  ▶ Perceived Risk

  ▶ Resource Availability
  ▶ Management Preference

Slide 6

HA Lessons Learned – Planning

▶ Adjust Team Members Based on Complexity of Operation
  ▶ Minimum ~ Analyst with Operations/Peer Review
  ▶ Maximum ~ Divide & Conquer

▶ Few Team Members With Prior Experience
  ▶ Initial Training for Team on Technique & Expectations
  ▶ Expect Re-Training/Calibration During HE
  ▶ Hard for Team Members to Grasp Brainstorming with No Restrictions

HA Lessons Learned – Planning

- Define Receptors
  - Worker, Collocated Worker, Public
  - Environment
  - Mission / Monetary Loss
  - Public Perception

- Use of Reference
  - Regulatory Requirements
  - Consensus Standard
  - Company Policy

HA Lessons Learned – Execution

- Respect Team Leader Responsibilities
  - Required to Take On Process
    - Review, Documentation, Factual Accuracy, Comment Resolution & Concurrence
  - In Addition to Workshop/Meetings

HA Lessons Learned – Execution

- Formal Hazard Identification
  - Checklists
  - Documentation Reviews
    - P&IDs
    - Process Flow Diagrams
  - Physical Walkthrough

HA Lessons Learned – Execution

- Breakdown Workshop Into Facility/Process/Hazards
- Create Worksheets Based on Checklist
- Pre-populate (Seed) HE Table
  - Recommend Few Across & Many Down
  - Facility/Process ~ Event, Hazards, Consequence, Controls
- Finish Brainstorming Events (Down) in Workshop

HA Lessons Learned – Execution

- Facilitator/Analyst Completion of Workshop Tables
  - Common Event Language ~ Develop Write Ups for Events
  - Common Control Terms ~ Develop Standard List
  - Ensure Consequences Are Comparable Throughout ~ Develop Standard List
- Factual Accuracy of Tables by Select Team Members

HA Lessons Learned – Execution

- Analyzing Results
  - Ranking
  - Qualitative
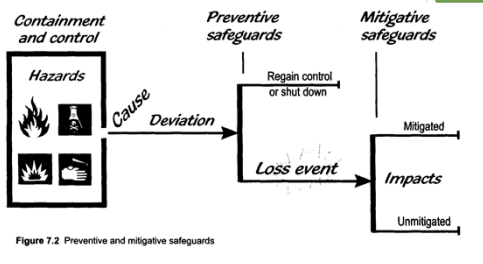 - Quantitative

HA Lessons Learned – Execution

Figure 7.2 Preventive and mitigative safeguards

HA Lessons Learned – Documentation

- Written Report Based on Technique
- Initial Conditions & Assumptions
- Unmitigated vs Mitigated Scenarios
- Define Loss Event

HA Lessons Learned – Documentation

Consequence Level	Beyond Extremely Unlikely² Below 10^{-6}/yr	Extremely Unlikely 10^{-4} to 10^{-6}/yr	Unlikely 10^{-2} to 10^{-4}/yr	Anticipated Above 10^{-2}/yr
High Consequence	III	II	I	I
Moderate Consequence	IV	III	II	II
Low Consequence	IV	IV	III	III

I = Combination of conclusions from risk analysis that identify situations of major concern
II = Combination of conclusions from risk analysis that identify situations of concern
III = Combination of conclusions from risk analysis that identify situations of minor concern
IV = Combination of conclusions from risk analysis that identify situations of minimal concern

1. Industrial events that are not initiators or contributors to postulated events are addressed as standard industrial hazards in the hazard analysis.
2. For external events, likelihood below 10^{-6}/yr conservatively calculated is "Beyond Extremely Unlikely."

HA Lessons Learned – Documentation

- Preventive vs Mitigative Controls
- Risk = Consequence x Frequency
- Recommendations
  - Control Set
  - Additional Analysis
- "Thread Analysis"

HA Lessons Learned – Maintenance

- Living Document
- Managing Change
- Periodic Reviews
- Required Updates

Shoulds, Should Nots, & Mistakes

- Document/write a complete and understandable system description
- Implement an official company-approved, documented system safety process as core value
- Involve reliability and human factors disciplines in the design process
- Train system designers and subject matter experts in system safety process
- Use a hazard checklist to identify and analyze system
- Use a qualified and experience system safety staff
- Value added process of system safety fully integrated and supported

Shoulds, <u>Should Nots</u>, & Mistakes

- Allow designers to solely implement system safety
- Assume hazards are only associated with failures
- Assume hazards checklist is all inclusive
- Assume standards are adequate for safety
- System safety is a check-the-box effort
- System safety is too expensive to implement
- Think eliminating risk eliminates hazard
- Excluding brainstorming, questions, or explanation for performing HA

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Shoulds, Should Nots, & <u>Mistakes</u>

- Not assessing hazards and/or risks at the right system level
- Not considering depth of system hazards
- Not ensuring continual training for system safety staff to always improve knowledge and skills
- Not fully understanding hazard theory and HA methods
- Not implementing a lessons learned process
- Not performing a thorough, complete – hence correct HA
- Not providing adequate resources to complete HA
- Not using a system specific HA (versus generic HA)
- Not using the right HA method

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References

- Guidelines for Hazard Evaluation Procedures "Red Book," 3rd Ed; CCPS 2008
- System Safety Analysis Handbook "Big Green Book," System Safety Society
- System Safety for the 21st Century "Green Book," Richard A. Stephans
- ANSI Z590, Prevention Through Design Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes
- MIL-STD-882E, Department of Defense Standard Practice System Safety
- OSHA 1910.119, Process Safety Management of Highly Hazardous Chemicals
- DOE-STD-3009, Preparation of Nonreactor Nuclear Facility Documented Safety Analyses
- SEMI S10-0307E, Safety Guideline for Risk Assessment and Risk Evaluation Process

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Follow Up with Parvati

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- Facility/Worker Safety
  - Redbook Training
    - Redbook Overview
    - Redbook HE Techniques
      - What-If/Checklist
      - Failure Modes & Effects Analysis
      - Hazard & Operability Analysis
      - Layer of Protection Analysis (LOPA)
      - Risk Analysis
      - Inherent Safety Reviews
  - Perform Process Hazards Analysis
  - Compliance Auditing
  - Facilitate Hazard Evaluations
  - Peer Review PHA (HI + HE)
  - STAMP/STPA
- Traditional ES&H/IH Services

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