WEBINAR SERIES

Webinar Starts at 08:00 PT

Please call (877) 532-0806 if you are having technical issues.

The background music may be used to adjust your audio volume.
COMMON CAUSES IN HAZOP APPLICATIONS

Carine M. Black
Risk Management Professionals
(949) 282-0123
(877) 532-0806
www.RMPCorp.com
# RISK MANAGEMENT PROFESSIONALS

## Key Services
- Process Safety & Risk Management
- Process Hazard Analysis *(PHA)*
  - What-If? Studies
  - Hazard & Operability *(HAZOP)* Studies
  - Layer of Protection Analysis *(LOPA)*
  - Safeguard Protection Analysis *(SPA)*
  - Safety Integrity Level *(SIL)* Assessment & Verification
- Process Safety Management *(PSM)*
- Risk Management Program *(RMP)*
- California Accidental Release Prevention *(CalARP)* Program
- Nevada Chemical Accident Prevention Program *(CAPP)*
- Security Vulnerability Assessment *(SVA)*
- Inherently Safer Technology *(IST)*, Hierarchy of Hazard Control Analysis *(HCA)*, Safer Technology & Alternatives Analysis *(STAA)*
- Safety & Environmental Management Systems *(SEMS)*
- Damage Mechanism Review *(DMR)*
- Safety Case

## Key Services (cont.)
- ERP Development & Emergency Preparedness Training *(NIMS-Compatible)*
- Risk-Graph and Bow-tie Analysis
- QRA Services – FTA & ETA

## Background
- Services to Process Industries, Utilities, & Government Since 1995
- International w/US Focus

## Qualifications
- Extensive Experience
- Two Decades of Risk-Based Applications
- Engineering, Safety, Security, and Emergency Response Backgrounds

## Locations
- HQ: Irvine, CA
- Houston ♦ Norfolk ♦ Walnut Creek

## Contact
- info@RMPCorp.com
- www.RMPCorp.com
- U.S. (877) 532-0806
TOPICS

• What to know about HAZOP studies and how to be prepared

• Common causes used in HAZOP studies

• Mistakes to avoid when developing HAZOP causes

• Interactive Question/Answer Session
WHAT TO KNOW ABOUT THE HAZOP METHODOLOGY AND HOW TO PREPARE
WHAT IS A HAZOP?

- HAZOP = Hazard and Operability Study

- Objective is to reduce or eliminate the risk of hazards that could impact
  - Health and Safety
  - Environment
  - Assets / Financial Impact
  - Image and Reputation
# GUIDEWORD METHOD

<table>
<thead>
<tr>
<th>DESIGN / OPERATIONS PARAMETERS</th>
<th>GUIDE WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No/Low</td>
</tr>
<tr>
<td>Flow</td>
<td>No/Low Flow</td>
</tr>
<tr>
<td>Temperature</td>
<td>Lower Temperature</td>
</tr>
<tr>
<td>Pressure</td>
<td>Lower Pressure</td>
</tr>
<tr>
<td>Level</td>
<td>No/Lower Level</td>
</tr>
<tr>
<td>Other / General</td>
<td>Impurities/Contamination, Maintenance Issues, Special Operation Issues (Startup, Shutdown, Emergency, Maintenance), General Issues</td>
</tr>
<tr>
<td>Deviation</td>
<td>Cause</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>No Flow</td>
<td>3&quot; block valve on Condenser (EC-01) drain to High Pressure Receiver (HPR-01) inadvertently closed.</td>
</tr>
</tbody>
</table>
HOW TO BE PREPARED

• Have accurate Piping and Instrumentation Diagrams (P&IDs)

• Select and highlight study nodes on the P&IDs

• Identify all causes before moving onto consequences

• Have necessary design information and other relevant resources available during the study
COMMON CAUSES USED IN HAZOP STUDIES
TYPES OF CAUSES

• Human Error
  - Not following operating procedures
  - Not maintaining equipment

• Control System Malfunctions
  - Instrument Loop Failure (transmitter fails high/low, loss of instrument air, etc.)

• Mechanical Failures
  - Pressure Relief Valve fails open
  - Pump failure
  - Heat exchanger tube rupture
LOW OR NO FLOW DEVIATION

- Block valve inadvertently closed
- Control valve fails/malfunctions closed
- Control loop failure
- Pump or blower fails to operate
- Equipment plugged or fouled
HIGH FLOW DEVIATION

- Block valve inadvertently opened
- Control valve fails/malfunctions open
- Control loop failure
- Bypass valve inadvertently opened
- Pump overspeed
- Pump or blower inadvertently activated, when not needed
- Operation of pumps in parallel
REVERSE OR MISDIRECTED FLOW DEVIATION

- Look out for check valves
- Tube rupture
- Loading hose decoupling or leak / rupture
- Incorrect alignment of pump fill line
- Pressure relief valve fails open or leaks by
- Bypass valve inadvertently opened
## HIGH OR LOW PRESSURE DEVIATION

<table>
<thead>
<tr>
<th>High Pressure</th>
<th>Low Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pump overspeed</td>
<td>• Pump fails to operate</td>
</tr>
<tr>
<td>• Control valve fails open</td>
<td>• Undetected leakage</td>
</tr>
<tr>
<td>• Control loop failure</td>
<td>• Control valve fails closed</td>
</tr>
<tr>
<td>• Bypass valve open</td>
<td>• Control loop failure</td>
</tr>
<tr>
<td>• Thermal overpressure</td>
<td>• Block valve inadvertently closed</td>
</tr>
</tbody>
</table>

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HIGH OR LOW LEVEL DEVIATION

**High Level**
- Operator inadvertently overfills tank
- Faulty level measurement instruments
- Inlet block valve inadvertently opened
- Outlet block valve inadvertently closed
- Control Valve failure
- Control loop failure
- Pump overspeed / pumps in parallel activated

**Low Level**
- Operator unloading from low/empty tank
- Faulty level measurement instruments
- Inlet block valve inadvertently closed
- Outlet block valve inadvertently opened
- Control valve failure
- Control loop failure
- Pump fails to operate
# HIGH OR LOW TEMPERATURE DEVIATION

## High Temperature
- High ambient temperature
- Fouled or failed exchanger tubes
- Loss of cooling
- Temperature control valve failure
- Thermal Expansion Issues
- Cooler fan failure

## Low Temperature
- Low ambient temperature
- Fouled or failed exchanger tubes
- Loss of heating
- Temperature control valve failure
- Inadvertent activation of cooler fan
MISCELLANEOUS CAUSES

- Catalyst degradation,
- Corrosion
- Transient operation
- Loss of chemical injection
- Too much chemical injection
- Sampling
- Reaction
- Human Factors
- Loss of utilities
- Composition
EXAMPLE CAUSES
MISTAKES TO AVOID WHEN DEVELOPING HAZOP CAUSES
MISTAKES TO AVOID

• Using inaccurate P&IDs
  ▪ Causing with equipment that does not exist
  ▪ Neglecting equipment that DOES exist

• Not developing cause in a logical manner
  ▪ Not following well defined node pathways
  ▪ Repeating cause in multiple deviations (i.e. more flow AND more pressure, etc.)

• Not discussing transient operations
  ▪ Neglecting equipment used during these operations

• Ignoring previous near miss incidents
MISTAKES TO AVOID (CONT.)

• Addressing scenarios that aren’t specific and credible
  ▪ Multiple concurrent failures analyzed (double jeopardy)
  ▪ Generalizing causes

• Failing to analyze credible scenarios
  ▪ Mistaken “double jeopardy” scenario

• Not inputting enough detail into causes.
  ▪ Not including tag numbers for equipment
  ▪ Not discussing specific locations of instruments
    – Ex. FV-121, downstream of Zinc Oxide Unit (R-301, PID 1003A) malfunctions fully open, possibly due to instrumentation malfunction.
## UPCOMING WEBINARS / CONFERENCES

<table>
<thead>
<tr>
<th>Date</th>
<th>Webinar</th>
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<tbody>
<tr>
<td>October 26, 2017</td>
<td>“IIAR Standards and How They Apply to RAGAGEP – Part 5” Presented by Stephanie Smith, PE</td>
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<tr>
<td>November 7, 2017</td>
<td>“Solid &amp; Powder Dispersion Modeling in Accordance with CalARP/RMP/PSM Regulations” Presented by Nicholas E. Cabrena</td>
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<tr>
<td>January 9, 2018</td>
<td>“Common MOC and PSSR Deficiencies” Presented by Morgan McVey and Tim Lee</td>
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QUESTIONS?

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