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# A HAZOP methodology for Transient Operations

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# Presentation Overview

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# What is a Transient Operation?

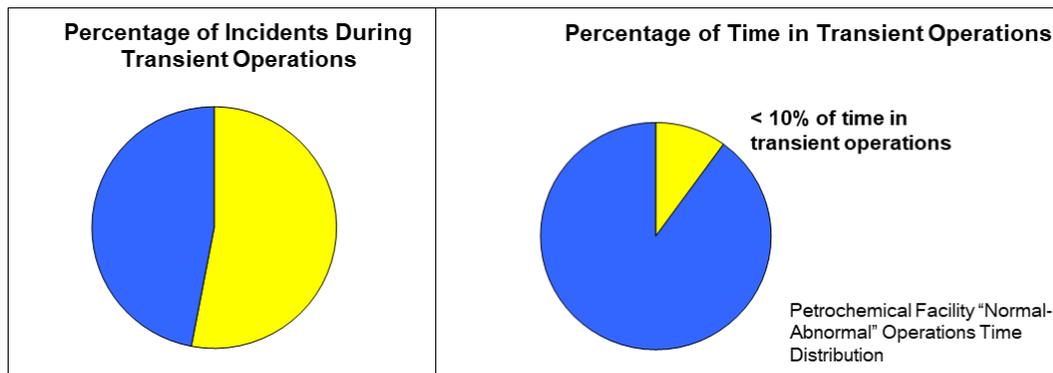
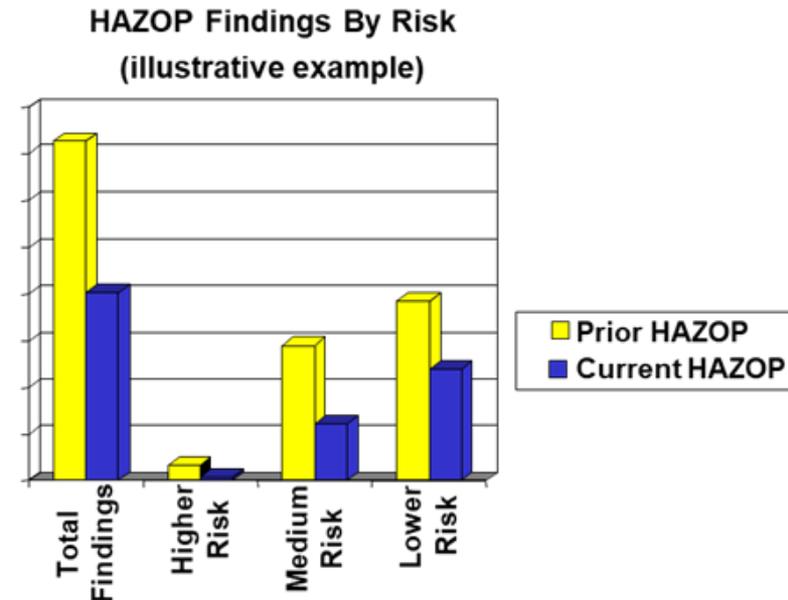
Operations included in the Transient Operation HAZOP (TOH) process:

- **Non-routine Planned Operations** that occur infrequently and have the potential for an acute loss of containment resulting in a “higher” consequence incident.
  - Startup or shutdown of a major unit
  - Startup or shutdown of major equipment within a process
  - Operating with a non-standard equipment configuration on a unit
  - Unique or unusual feedstock or grade changes
  - Clearing a plugged (blocked) line or vessel
- **Abnormal or Unplanned Operations** having the potential for an acute loss of containment resulting in a “higher” consequence incident.
  - Operations outside of the equipment’s design specifications past the point where routine corrective actions will mitigate, e.g., reactor runaway
  - Unplanned unit shutdown
  - Emergency operator actions including responses to “Critical” alarms
  - A loss of containment event

# Transient Operation HAZOP drivers

## Why HAZOP transient operations?

- Disproportionate percentage of process safety incidents occur during transient operations
- Deficiencies in procedures and employee training often cited as a root cause in industry incidents
- Increased reliability and extended turnaround intervals resulting in less familiarity with procedures outside normal operation
- Decreasing value of traditional HAZOP process after multiple cycles



Note: Derived from data within IChemE Loss Prevention Bulletin 142, "Analysis of past incidents in the oil, chemical and petrochemical industries" by IM Duguid --- an analysis of 500 incidents (15%-Shutdowns, 14%-Startups, 11%-Maintenance, 13%-Abnormal Operations)

# Transient Operations HAZOP Approach

- Focused on the identification of required unit-specific activities (tasks) and an in-depth review of the procedural controls required for the safe and successful completion of those tasks.
- Confirms that procedures exist, are adequate for higher risk transient operations tasks, and are being followed.
- Combination of knowledge, history, and guidewords used to review.
  - Clarity of task description
  - Verification that task description matches field actions
  - Verification of correct sequencing
  - Clarity of permissives
  - Equipment response to task completion, including early identification of potential process upsets or abnormal conditions
  - Adequacy of human equipment interfaces
  - Appropriate use of warnings, cautions, and notes
- Developed approach applicable as:
  - Stand alone analysis of potential “higher risk” operating tasks
  - Use in conjunction with a traditional HAZOP
  - Revalidation of traditional HAZOP given the unit qualifies

# Preparation

- Select the Transient Operation HAZOP (TOH) Team
  - Consistent with P&ID based HAZOP plus:
    - Leader must be trained in TOH process
    - Operations representative qualified in both field operations and control console operations (prefer 2 people; different shifts)
- Pre-selection of unit activities and related procedures
  - Start-up and Shutdown
  - Operations requiring emergency operator intervention
  - Non-routine operations with the potential for an acute loss of containment
- Assemble reference documentation
  - List of required tasks and procedures
  - Incident Reports
  - Status of Prior HAZOP (if applicable)
  - Process Safety Information (Same as for a traditional P&ID based HAZOP)
  - Employee concerns

# Establish Procedures to be Reviewed

- Conduct “kick off” meeting of Transient Operation HAZOP Team
  - Introduce scope, objectives and methodology
  - Discuss desired product
  - Review risk assessment process for SHE items
- Review incident reports and employee concerns
- Review list of unit tasks within scope of the analysis effort
- Review results of first pass screening of procedures to be included
- Evaluate “higher” risk undocumented activities with follow-up items identified as needed
- Final selection of procedures for review

# Conduct Procedural Review

- Operations representative summarizes transient operations for the team
- Using knowledge, history, and guidewords, identify procedural steps with higher consequence potential
- Review procedures for format issues (use Format Reference list)
- Using knowledge, history and guidewords evaluate the adequacy of existing controls (Hardware, Software, and Procedural)
  - Procedures rather than P&IDs walk you through the process
  - Hazards identified, explained, and adequately controlled
- Confirm warnings and cautions
  - Location
  - Content
- Evaluated procedures “highlighted” with marker
- Identify, evaluate, and document concerns
- Follow-up items marked in red on master copy of procedures
- Red-lined procedural changes captured as possible

# Example Format Issues

- Is the purpose of the procedure identified?
- Do Steps begin with action verbs?
- If there are more than three objects for the action step are they always identified in a list? If order is important, number the listed sub-steps.
- Do conditional “If” or “when” steps have an action? Is the condition always written before the action?
- Acceptance criteria and tolerance ranges:
  - Are the qualitative words minimized? e.g., “satisfactory”, “normal”, “adequate”, “as needed”, “slight”, “hot”, “cold” and others.
  - Are tolerance ranges or safe operating limits given? e.g., 90 psig (80 to 100 psig)
- Warnings, Cautions, and Notes
  - Are Warnings, Cautions, and Notes always AHEAD of the step to which they apply?
  - Do Warnings and Cautions include an action and the consequence of failing to follow that action?
- Is the "End of Procedure" Clearly Identified?

# Example Guidewords

<u>Guideword</u>	<u>Meaning Explanation</u>
Who	<ul style="list-style-type: none"><li>• Is it clear who and how many individuals are needed to perform the step? Have minimum staffing levels for this sequence been established, documented, and communicated? This is particularly important for Field /Console interaction issues. It may be obvious for the more experienced and knowledgeable individuals, but is it appropriate for the "average" operator?</li></ul>
What/Missing	<ul style="list-style-type: none"><li>• Is the broad objective stated for the series of steps? This allows the people involved to adapt to changes which might be happening vs. what the procedure writer experienced before or expects. This is where the team picks up missing steps/actions/ unanticipated situations. For example, nitrogen purge of a large flare line is not called out before commissioning.</li></ul>
When	<ul style="list-style-type: none"><li>• Is the timing or order of the task important? This comes into play if there are related parts of the unit that are being operated on by different crews. For example, one crew commissions the flare line and another is pressuring up equipment.</li></ul>
How Long	<ul style="list-style-type: none"><li>• Is the duration or length of time for an action to continue important (i.e. purging or agitation).</li></ul>

# Field Tour & Wrap-up

- Screening level unit walk through
  - Spot checks the effectiveness of SHE related management systems
    - Test the supporting systems in place ensuring transient operations are conducted in a safe and effective manner
    - Scan the unit for general process safety issues
    - Identify potential Human Factors issues which have the potential to contribute to a significant consequence event
  - Typical duration 2-4 hours
- Discuss and document any concerns as required
- Conduct “wrap-up” meeting to ensure site understands all findings
- Create Report
  - List of team members and procedures reviewed
  - Summary of significant findings
  - Follow-up items and “red-lined” procedures
  - Obtain Legal Review as required

# Implementation Status

- TOH Methodology rolled out worldwide at ExxonMobil manufacturing plants
  - Identifying findings of significance and providing value to the business
  - TOH Leaders available in all manufacturing regions and numbers growing
- The requirement for a Transient Operation focused HAZOP after the second HAZOP cycle has been integrated in the safety management system.
- The reliability management system include milestone driven application of TOH methodology
  - Turnaround planning
  - Abnormal and non-routine operations
- Approximately 1200 findings from 27 completed TOH studies analyzed for common findings and learnings
  - Content issues
  - Format issues
  - Hazards not identified, adequately explained, or controlled

# Conclusion

- The Transient Operation HAZOP methodology can be a powerful supplement to traditional P&ID based HAZOPs
- Focused on infrequently performed operations that require an increased level of human interaction with the process
  - Personnel performing in accordance to procedures is critical to safe operations
  - Procedure accuracy and clarity are paramount
- Expected outcome:
  - An in-depth fresh look at existing hazard controls for "higher risk" transient operations
  - More complete and easier to follow procedures
  - Increased operator awareness of hazards, design controls, and the potential consequences of mal-operation of the equipment
  - Increased consistency in procedural controls as well as the potential need for additional design controls for transient conditions
  - Experience in applying procedural controls that can be applied beyond transient operations
  - Fewer process safety incidents and related business losses

Questions?

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