Avoiding Quality Pitfalls for HAZOP/LOPA Sessions & Documentation
(GCPS-2019 – Paper 548413)

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Risk Management Professionals

• 39-Year Engineer – 35 in Process Safety Consulting Specializing in Hazard Analysis and QRA

• Mechanical Engineering
  ➢ BS – Duke University
  ➢ MS – Carnegie-Mellon University

• Professional Engineer – Mechanical & Chemical Engineering

• CCPS Technical Steering Committee – mid-1980s

• Past-President Southern CA Society for Risk Analysis

• Landmark Efforts
  ➢ Platform Safety Shutdown System Effectiveness Study
  ➢ Torrance Refinery Safety Advisor for MHF Conversion

• Paper & Book Publications – See www.RMPCorp.com
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- 4 Years in Process Safety Consulting Specializing in Hazard Analysis
- Expertise in HAZOP/LOPA Methodologies
- Chemical Engineering
  - BS – University of California San Diego
- Paper & Webinar Publications – See www.RMPCorp.com
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Key Topics

• Why Quality
• Defining PHA Objectives
• Planning & Preparation Essentials
• Tips for Conducting a Quality PHA
• Documentation Tips
• Priorities for the Quality Assurance Review
• Emphasis Points for Maximizing the Future Usefulness of the PHA
• Questions?
Why Quality Process Hazard Analysis is Important

Tragedies to Avoid
Evolution of SMS Guidelines & Regulations to Performance (Goal) – Based Standards

Onshore Process Safety (USA)
- 1986 – RMPP
- 1987 – CCPS
- 1990 – API RP 750
- 1992 – PSM
- 1996 – RMP

1999 – PSSDS
1991 – SEMP Concept
1993 – API RP 75
2004 – API RP 75
2006 – SEMS Concept
2009 – SEMS Prop. Rule
2010 – SEMS Final Rule
2013-2015 – 3 CSB Reports
2013 – E.O. 13650
2013/14 – OSHA/EPARFI Drafts
2014 – CCC/Cor/ISO
2015-2017 – Updated
2017/Jan – RMP Rule Updt
2017/Oct – CalARP-P4 & 5189.1 Promulgation

Offshore Safety Management Systems (USA)

1992 – UK Safety Case
2005 – UK SC Update
2009 – MODU HSE Case
2015 – Offshore Safety Directive

Offshore Safety Management Systems (UK)
Tandem Advances in Protection System Design Architectures & Analysis

Protection System Design Evolution

1986 - API RP 14C
1996 - ANSI/ISA S84.01
1999 - IEC 61508-1
2004 - IEC 61511-1
2004 - ANSI/ISA S94.00.01

Reliability Criteria & Design Architecture Specifications

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<td>(10^{-4} \leq \text{PFD}_{\text{AVG}} &lt; 10^{-3})</td>
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Voting Logic

Electronic Sensing & Sig. Processing

Single-Element Analog Devices
HAZOP & LOPA are Core Elements of Hazard Evaluation
Planning & Preparation Essentials

• **Qualified, Experienced, & Prepared:**
  - Technical Experts who Participate in all Phases of the PHA
  - Facilitator
  - Scribe

• **Quality-Checked, Complete, & Field-Verified Engineering Drawings**

• **Access to Other Key Process Safety Information**

• **PHA & Revalidation Schedule**

• **Cause Pre-Population**
Tips for Conducting a Quality PHA
Tips for Conducting a Quality PHA

• Technical Details
  ✓ Process Design/Limits & **Response to Upset Conditions**
  ✓ Overpressure Ratios
  ✓ Cause/Consequence Documentation
  ✓ Instrumentation & Setpoints
  ✓ Control & Protection System Actions
  ✓ Valve Failure Mode Clarity
  ✓ Crediting Alarms as Safeguards
  ✓ Subcomponent Failure Modes

Common Temperature Control System
(control station block and bypass valves removed)
Tips for Conducting a Quality PHA

• PHA Sessions
  ➢ PHA Team Training
  ➢ Session Length Reflecting Process Complexity
  ➢ Node Completeness Checks
  ➢ PHA Revalidation vs. Re-do
  ➢ Node Boundaries
  ➢ Avoid Repeating Scenarios
Tips for Conducting a Quality PHA

• Information Dynamics
  ➢ Information Requirements & Prioritized Action Items
  ➢ A “Parking Lot” for Resolvable PHA Issues to Streamline Efforts
  ➢ Manageable Drawing Updates – Knowing when to Stop
  ➢ Manageable Information Gaps
• Analysis Completeness
  ➢ Specific Causes, with Equipment Numbers Identified
  ➢ Identify Probable Worst-Case Consequences
  ➢ Focus on Reliable, Active, Tagged Safeguards with Sufficient Process Safety Time – Link to Cause/Consequence
  ➢ Recommendations (or gap acceptance) Whenever Clearly-Defined Acceptable Risk Level is Not Achieved
  ➢ Valid Operating Modes Addressed

• Consistency
  ➢ Risk-Ranking – Consistent & Synchronized with Scenario
  ➢ Level of Detail & Scenario Depth Pivoting on Importance
Documentation

• Usability
  ➢ Recommendations – Understandable, Self-standing, Logical, Complete

• Traceability
  ➢ Scenarios – Logically-developed, Complete, Understandable
  ➢ Block Valve Inadvertent Mispositioning
  ➢ Liberal Use of Clarifying Comments
  ➢ Risk-Ranking – Consistent & Matched With Scenario
  ➢ Clear Scope & System Boundaries
  ➢ Prolific Use of Equipment Tag Numbers & P&ID References
Priorities for QA Review

- Completeness Check – All Key Causal Events
- Probable Worst-Case Consequences
- Safeguard/IPL Verification – Especially Independence
- Scenarios – Interpretable
- Risk-Ranking – Consistent
- Clear Action Items
- Same Initiating Event, but Different Deviation – Increased potential for confusion and future misuse
Emphasis Points for Maximizing the Future Usefulness of the PHA

- Sessions
- Resources
- Documentation

Maximizing Future Usefulness
Maximizing the Future Usefulness of the PHA

- Apply Documentation Traceability Tips
- Prolific Use of Equipment Tag Numbers, P&ID References, & Cross-Referencing
- Sensible and Consistent Grouping of Scenarios
- Use Standardized PHA Approach
- Large Nodes Can Allow for a More Holistic Approach
- Qualifications and Experience of Facilitator & Team
- Consider Long-term Use & Strive for “Evergreen” Approach
- Software Longevity & Compatibility

2019 ♦ 2024 ♦ 2029 ♦ 2034 ♦ 2039 ♦ 2044 ♦ 2049 ♦ 2054