ExxonMobil Production HAZOPs: A Valuable Risk Assessment Tool to Improve Process Safety

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Presentation Objectives

• Review Objectives of HAZOP Program
• Review Background and Drivers
• Review HAZOP Process
• Discuss Key Items for a Successful HAZOP
• Review Key Learnings from HAZOPs
Objectives of a HAZOP

• Stands for HAZard and OPerability Review

• Hazard Identification/Evaluation Method Focused On "Process" Related Hazards (Temperature, Pressure, Level, etc.)

• Team Based Activity

• Systematic, Detailed Review of Piping and Instrument Diagrams (P&IDs) (equipment based) and other Safety/Operability Issues (e.g. human factors, procedures)
Study on *Low Frequency/ High Consequence* Incidents Resulted In the Following Recommendations Regarding HAZOPs:

- Improve the quality & consistency of HAZOP Studies
- Conduct retrospective HAZOPs of existing major facilities*
- Conduct HAZOP of new facilities ~1-2 years after start-up

* Major Facility is defined based primarily on volume throughput along with other parameters (H2S, pressure, location, etc.)
EMPC Knowledge Based HAZOP Process

- Global HAZOP Coordination by Production Engineering – Houston
- Define HAZOP Documentation and Participant Qualification Requirements
- Implement strict criteria for HAZOP Leader / Facilitator who guides HAZOP
- Staff HAZOP Team and Leader from Global Organization (cold eyes participants)
- Develop Charter with Scope, Team members, etc. well in advance
- Conduct HAZOP Training on Front End of HAZOPs
- Production Unit Operations Technical Managers responsible for PU coordination and follow-up of HAZOP findings
HAZOP Team

• Team Make-up (4-6 people full time)
  ➢ Leader (10+ year facility engineer)
    • KB HAZOP experience
    • knowledgeable on GPs/design practices
    • Trained and knowledgeable in risk assessments
  ➢ Facility Engineer familiar with facility
  ➢ Experienced Operations Representative familiar with facility
  ➢ Project Representative (on new facilities)
  ➢ Scribe
  ➢ Other part time members as needed (machinery, materials/corrosion, I&E, maintenance, SHE, etc.)
  ➢ Less experienced engineers attend as a learning experience
Knowledge Based HAZOP Process

- Visit Facility - overview of facility, walk around, discussion of operations issues
- Review incidents/near misses/events
- Go through Piping & Instrumentation Diagrams (P&IDs) system by system

- Detail review of piping, valves, PSVs, instrumentation, and equipment
- Check design against *Upstream HAZOP Reference List* (Safety & Env. parts of Global Practices)
- Identify "Findings" with associated hazards, and develop suggested actions
- Risk prioritize Findings using risk matrix
- Teams of 4-6 full time people
- Length of Full HAZOPs: typically 4-7 weeks (~ 5 P&IDs/day)

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HAZOP Charter – A Key Planning Tool

• HAZOP Charter is developed by Leader in conjunction with the site well in advance of HAZOP

• Contents of Charter include:
  – Objectives (why conduct a HAZOP?)
  – Scope (what will be reviewed)
  – Boundaries (what will be excluded)
  – HAZOP methodology to be used
  – Team make-up - team leader, scribe, and full and part-time participants, and qualification summary for each participant
  – Documents required for the HAZOP
  – Location(s) - note that site visits may be incorporated into the HAZOP review
  – Preliminary schedule
  – HAZOP reporting format
  – HAZOP deliverables
Key Items for Success

**Disciplined Process**
- Clear Charter with scope approved in advance
- Centralized Coordination by Production Engineering
- Database of findings with categorization
- Learnings shared on Intranet

**Qualified Resources**
- Leader - strict qualifications required
- Experienced, Knowledgeable, Diverse Team
- Cold Eyes persons
- Project participant on new facilities

**Preparation/Documentation**
- Process / Equipment Data: Accurate and available
- P&IDs: Accurate and up-to-date (as built)

*HAZOPs are an excellent training mechanism for engineers and operations personnel*
**Key Common Findings from HAZOPs**

**DOCUMENTATION**

- Lack of clear documented *Key Operating Envelopes*
  - "Safe Operating Envelope" - limits of equipment (e.g. PSV settings)
  - "Optimized Operating Envelope" - desirable range to optimize production, minimize fuel consumption, minimize off-spec, etc.
  - Should include operating envelopes in procedures
**Key Common Findings from HAZOPs, cont.**

**DOCUMENTATION**

- **Management of Changes (MOCs) are not always fully closed out (e.g. drawings and procedures not always updated)**

- **Key Facility Studies/Information not always current/available**
  - PSV/Flare studies/basis, SIL studies, equipment data sheets/information
  - For new facilities - issue is often documentation "handover" from Project (missing, unorganized, not current, etc.)

- **Flare Systems not always fully analyzed for "expansions/add-ons"**
  - Potential for insufficient relief/flare capacity

- **Package Units often do not have sufficient information to fully HAZOP**
  - Examples include - lube oil systems, seal gas systems, glycol regenerators, chemical injection skids
  - Package units can have unidentified hazards (improper materials, insufficient pressure ratings of valves, etc.)
  - Projects aware of and have same issue
DESIGN

• Double Block and Bleed (isolation) valving sometimes does not meet global design practices requirements
  ➢ Concern is lack of positive isolation of equipment especially during maintenance
  ➢ Opportunities exist to clarify requirements in Global Practices (in progress)

• Alarm Management
  ➢ High alarm rates (above recommended level of 6-12/hr) & inadequate alarm prioritization
  ➢ Potential for overloading of operator and missing of critical alarms
  ➢ Being worked in Alarm Management Network

PROCESSES

• Lack of a Robust Structured Car Seal Valve Program
  ➢ Car sealed (locked) valves often required to prevent an overpressure situation (and potential incidents)

• Preventative Maintenance not consistent with SIL and other studies (HIPPS systems, critical SDVs, etc) (e.g., devices not tested at adequate frequency, complete loops (including SDVs) not fully function tested)

• Lack of Dead Leg Inspection Program
  ➢ Dead legs often source of accelerated corrosion and potential leaks
Resources to Conduct/Follow-up HAZOPs

- **Approximate 1 FTE to conduct HAZOP**
  - 5-6 people for 6 weeks (2-3 sessions)
  - Leader will need 8-10 weeks (for planning and report prep)

- **Drawing/Documentation preparation**
  - Can vary widely depending on condition/accuracy

- **HAZOP Follow-up**
  - Effort can range significantly depending on findings
  - PUs encouraged to focus on Higher/Medium Risk findings
  - Many items can be closed-out by locating/updating documentation (e.g. PSV studies, testing records, equipment data sheets, etc.) - consultants often used to help close out items
HAZOP Follow-ups

• Individual Production Units responsible for stewarding HAZOP Follow-up items
  – Most use common database to track and manage

• Higher Risk Findings (and summary stats on Medium Risk) reviewed with senior management on a regular basis

• Centralized Functions involved in selective higher priority Follow-Ups