Development of a Process Safety-Based, Process Design RAGAGEP for Midstream Facilities

August 17 - 21

Hilton Americas and
George R. Brown Convention Center

Personal Biographies

- Sam Aigen, CCPSC
  - Carnegie Mellon University 2008 – Chemical Engineering
  - ExxonMobil – Beaumont Refinery / Research & Engineering Office
  - AcuTech – PHA/LOPA, Audit, QRA/FSS, PSM Program Development

- Ali Peters
  - Colorado State University 2012 – Chemical Engineering
  - ZAP – Process Design
  - MPLX – Project Management/ Process Safety
  - Targa – Operations Engineering

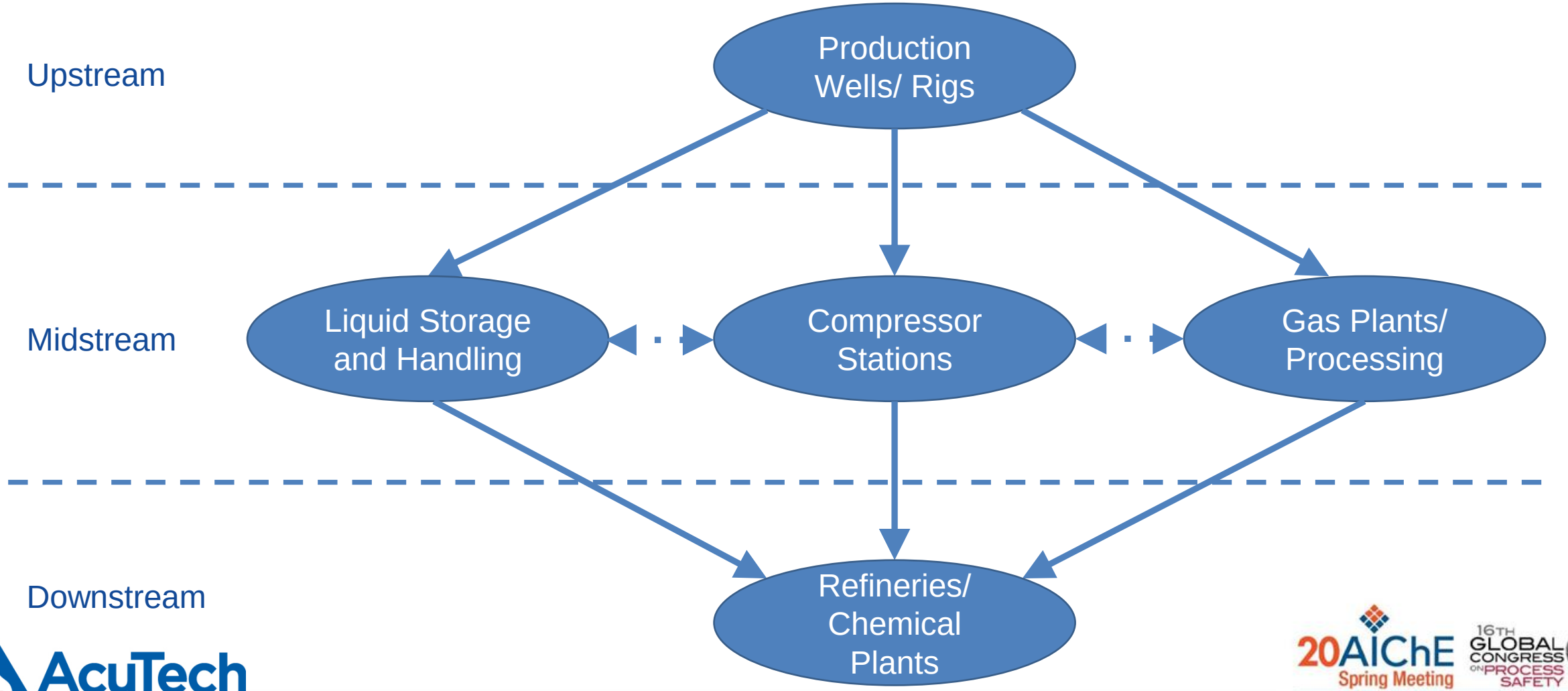
Agenda

- Midstream and PSM
- RAGAGEP vs. Internal Standard
- MidstreamCo Case Studies
- Using Internal Standards to Develop a RAGAGEP

Shale Boom and PSM

- US DOE: # oil wells 276,000 (2000) to 573,000 (2010)
- Midstream infrastructure needed to meet demand
- Enormous increase in the number of gas processing facilities

Oil & Gas Facilities



Governing Bodies Over Midstream Facilities

- Liquids Handling/ Compressor Stations/ Pipelines
  - PHMSA/ DOT
- Gas Plants/ Compressor Stations
  - OSHA PSM/ EPA RMP

RAGAGEP

- Recognized and Generally Accepted Good Engineering Practices (RAGAGEP)
  1. Widely adopted codes (NFPA)
  2. Consensus documents (ASME B31.3 Process Piping Code)
  3. Non-consensus documents (Chlorine Institute's “pamphlets")
  4. Internal standards

Internal Standards

Reasons for internal standards:

1. Translating existing RAGAGEP into corporate procedure
2. Setting design, ITPM for unique equipment (no other RAGAGEP)
3. Modifying existing RAGAGEP that doesn't address specific equipment
4. Controlling hazards better than existing RAGAGEP
5. Addressing hazards when existing RAGAGEP are outdated

Internal Standards to Improve PHA, Design

- PHA (30+ years implemented - downstream facilities)
- LOPA (10+ years implemented - downstream facilities)
- Midstream facilities:
  - Many built by upstream companies
  - Oil/gas well drilling or servicing operations → exempt?
  - Normally unoccupied remote facilities → exempt?
- Issues implementing PHA/LOPA in Midstream:
  - Study costs time
  - Recommendations cost $$
  - Consistency of recommendations = consistent facility design

Reduce Hazard Analysis Study Duration

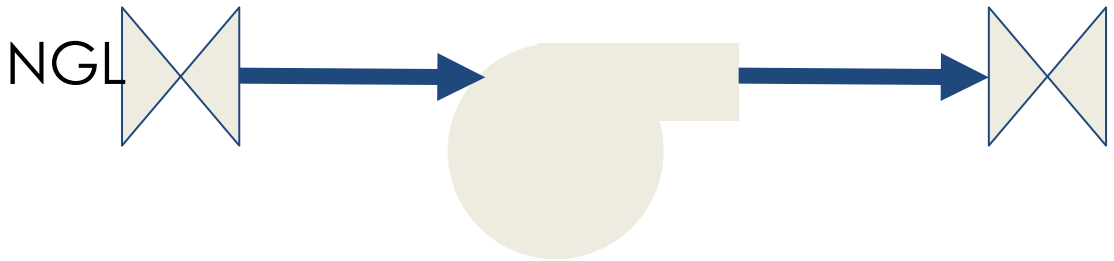
- Pace of Midstream = very fast
  - Major project in months vs. years in downstream
- Difficult to incorporate the hazard analyses
- PHA/LOPA Attendees
  - Operations
  - Engineering
  - Maintenance
  - Others
- Internal Standard → -30% PHA/LOPA study time (Midstream Co.)

Reduce Hazard Analysis Recommendation Cost

- Recommendations = capital cost + downtime
- Unnecessary recommendations = excess cost
- Missed recommendations = residual unidentified risk
- Internal standard:
  - Consistent hazard analyses → consistent recommendations
  - Consistent recommendations = targeted spending
  - Ensure high hazard scenarios protected
  - Avoid installing excessive safeguards, unnecessary cost

Improve Hazard Analysis Recommendation Consistency

- Recommendations vary
  - Team to team
  - Facilitator to facilitator
- “Why did these two identical scenarios result in different recommendations?”

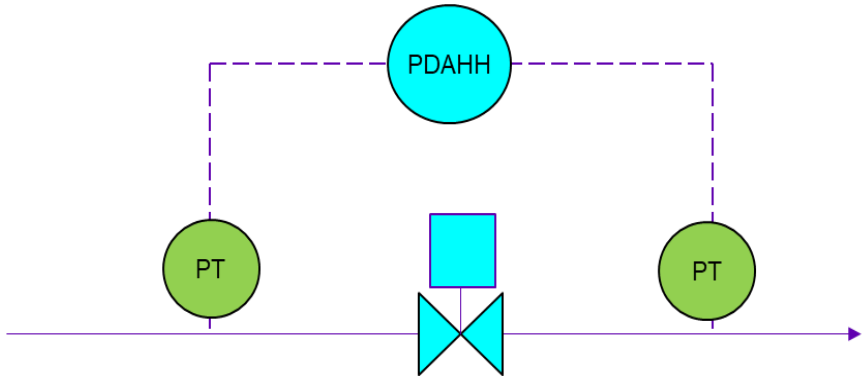


Case Studies to Develop Internal Standard

- We will discuss how MidstreamCo. chose to develop its own internal standard to control hazards more effectively than available codes and consensus/ non-consensus documents.
- MidstreamCo used this internal standard to improve consistency in its PHAs but also saw other benefits

Emergency Isolation Valves

- ***Cause**:* Station isolation valve is opened after shutdown
- ***Consequence**:* High dP across the valve results in pipe vibration and subsequent LOC
- ***Safeguards**:* local dP gauge, dP permissive, manual latching solenoid
- ***MidstreamCo**:* Recommended dP permissive
- ***Proposed RAGAGEP**:* Any means to read dP across station isolation valve, or be able to manually stop the valve from opening if pipe vibration is noticed

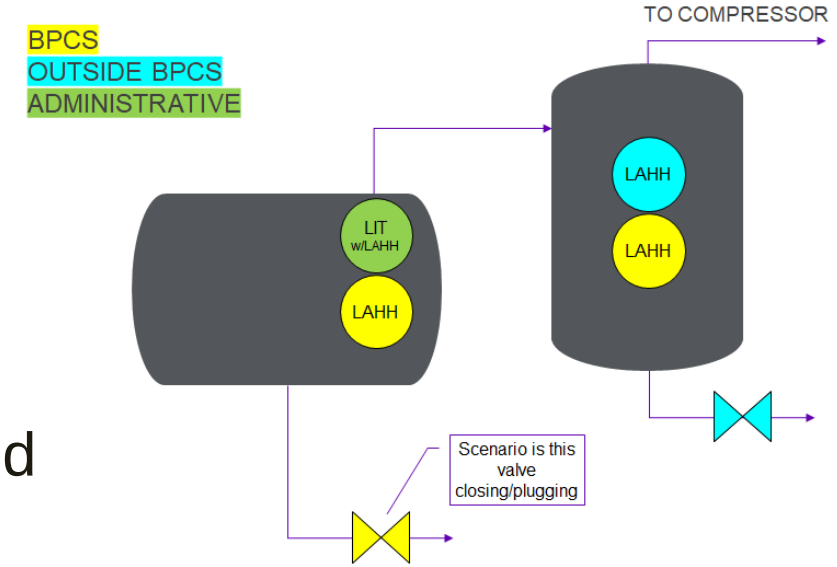


Reciprocating Compressors

- Sending liquids to reciprocating compressors can cause catastrophic equipment failure and loss of containment
- MidstreamCo analyzed several cases and categorized them into three main cause/consequences:
  - Case 1 - sending bulk liquids instantaneously to compressor inlet
    - For example - liquid slug at plant inlet
  - Case 2 - liquid carryover to compressor inlet
    - For example - Chiller overfills and causes a continuous flow of liquids to compressor inlet
  - Case 3 - liquid entrainment
    - For example - inlet scrubber valve fails to dump

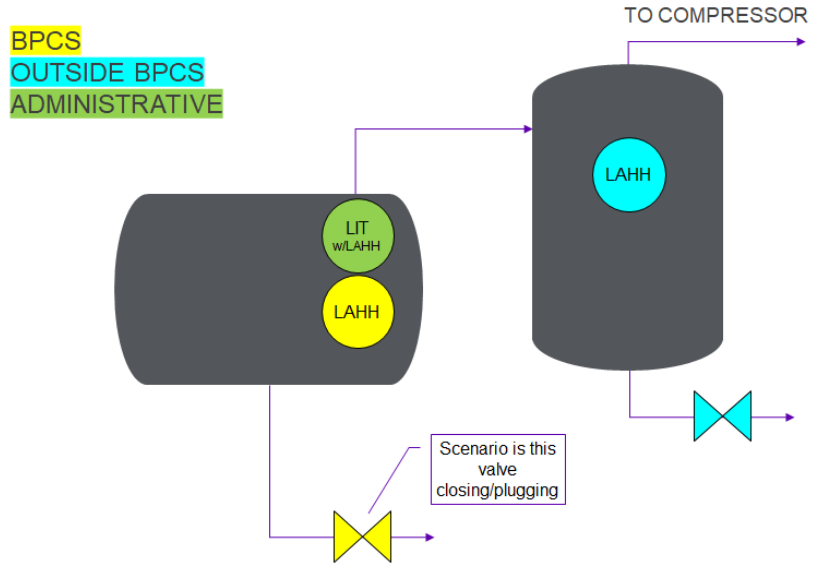
Reciprocating Compressors
Case 1: Instantaneous Bulk Liquid

- ***Cause**:* Slug catcher liquid valve fails to drain, large slug enters facility and overfills vessel
- ***Consequence**:* Catastrophic equipment failure, LOC
- ***Safeguards**:* Level instrumentation, LSHH/LAHH, LIT/LAHH
- ***MidstreamCo**:* Recommended LSHH/LAHH and LIT/LAHH on Slug Catcher and two (2) LSHH's on Suction Scrubber (tied into different PLC's)
- ***Proposed RAGAGEP**:* Redundant level protection on both the Slug Catcher and Suction Scrubber



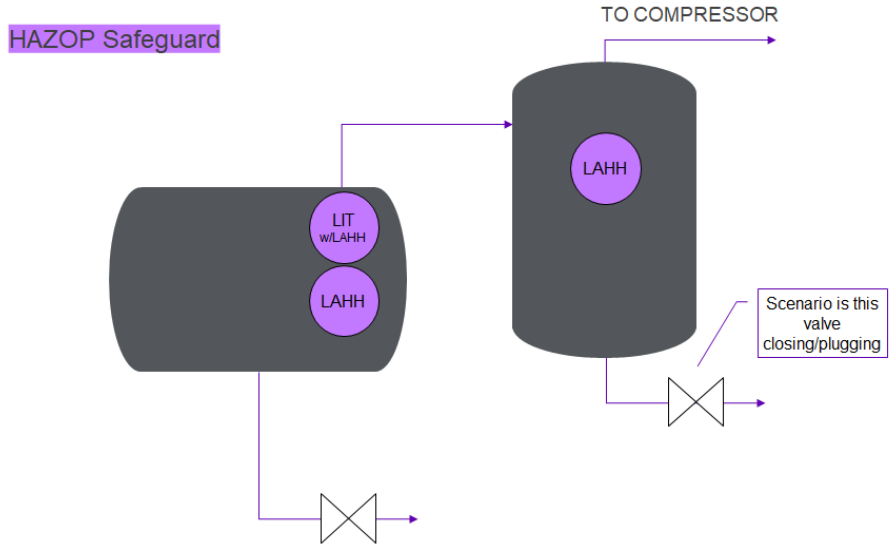
Reciprocating Compressors Case 2: Bulk Liquid Carryover

- ***Cause**:* Chiller liquid valve fails to drain, continuous liquid carryover
- ***Consequence**:* Catastrophic equipment failure, LOC
- ***Safeguards**:* Level instrumentation, LSHH/LAHH, LIT/LAHH
- ***MidstreamCo**:* Recommended LSHH/LAHH and LIT/LAHH on Slug Catcher and one (1) LSHH/LAHH on Suction Scrubber
- ***Proposed RAGAGEP**:* Redundant level protection on the Slug Catcher and single protection on the Suction Scrubber



Reciprocating Compressors Case 3: Entrained Liquid

- ***Cause**:* Suction Scrubber liquid valve fails to drain, potential to see a liquid level over time
- ***Consequence**:* Equipment failure, LOC not expected
- ***Safeguards**:* Level instrumentation, LSHH/LAHH, LIT/LAHH, operator rounds
- ***MidstreamCo**:* Recommended one (1) LSHH/LAHH on Suction Scrubber
- ***Proposed RAGAGEP**:* Level protection on the Suction Scrubber



Drain Systems

- ***Cause**:* Common drain header for high pressure and low/medium pressure drains, valve inadvertently closed on common header
- ***Consequence**:* High pressure drain overpressures low pressure piping/equipment, LOC
- ***Safeguards**:* Locks, carseals, PSHH/PAHH, PIT/PAHH, XV
- ***MidstreamCo**:* Recommended carseal open all manual valves in the common header up to the drain tank
- ***Proposed RAGAGEP**:* Separate drain headers for high pressure versus low pressure

- ***Note that team should also be aware of blowby when looking at drain systems. If blowby causes a release through a PSV of a heavier-than-air vapor, it was recommended to install a LSHH tied to an XV to minimize the blowby release scenario and for a dispersion study to understand the hazards***

LPG Storage Vessels

- ***Cause**:* High level in vessel; high pressure in vessel; low level in vessel feeding pump
- ***Consequence**:* Liquid overfill to downstream vessel, high pressure and LOC, low level and pump cavitation
- ***Safeguards**:* Individual vessel LSHH/LAHH, LIT/LAHH, PSHH/PAHH, PIT/PAHH, XV's, PSV's
- ***MidstreamCo**:* Recommended that each vessel was equipped with an LIT/LAHH and redundant LSHH/LAHH, a PSV, a PIT/PAHH, an inlet XV, and a liquid outlet XV (liquid outlet XV is required per API 2510)
- ***Proposed RAGAGEP**:* Ensuring each vessel is protected and can be isolated individually from the others

http://tanksandterminal.com/buy-sell-used-propane-lpg-storage-tanks.php

Flare Systems

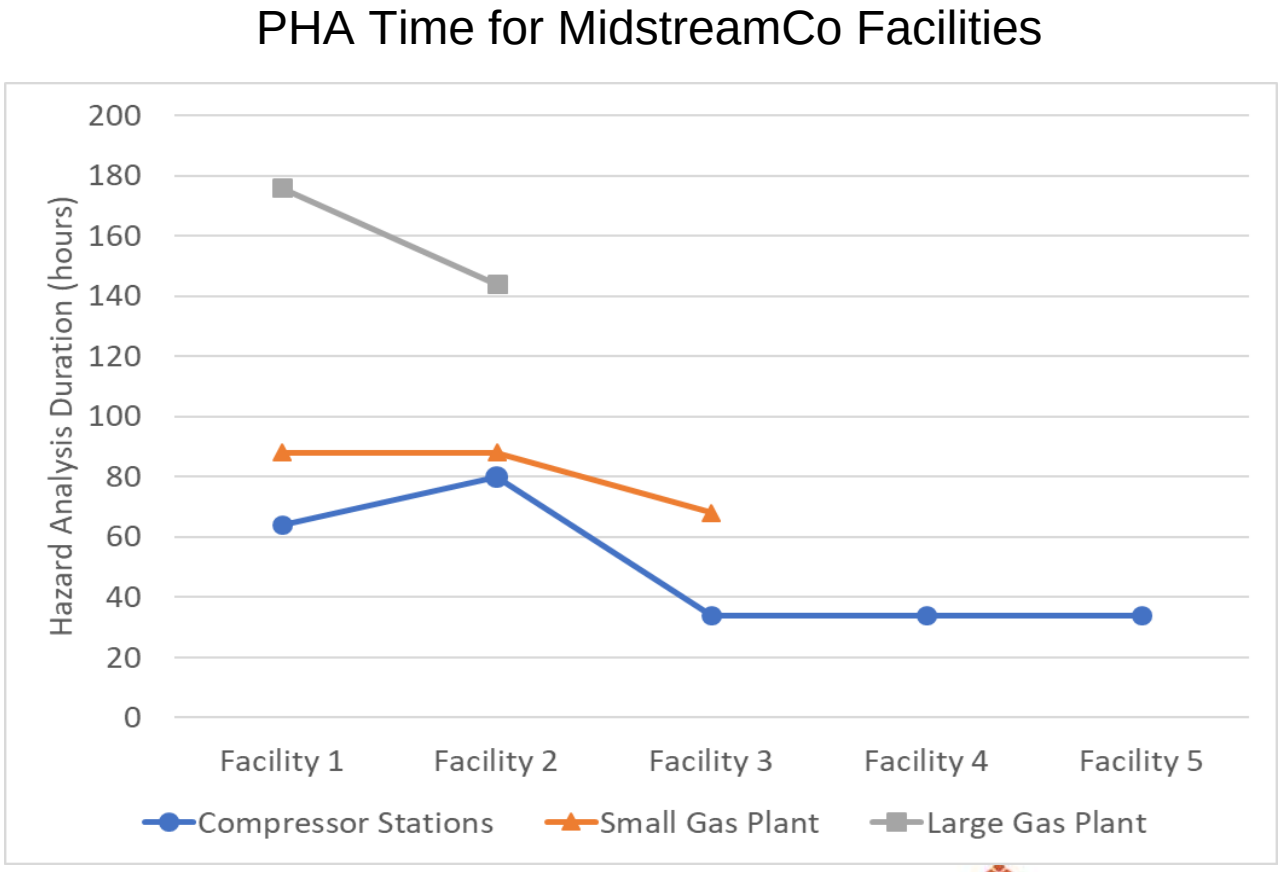
- ***Cause**:* High level in Flare KO Drum
- ***Consequence**:* Liquid overfill to Flare results in “raining fire”
- ***Safeguards**:* LSHH/LAHH, LIT/LAHH, operator rounds
- ***MidstreamCo**:* Recommended that Flare KO Drums were equipped with a LSHH/LAHH that is independent of the KO Drum level control
- ***Proposed RAGAGEP**:* Automated level control on Flare KO Drums and an independent hi hi level protection

Other Opportunities

- Pump dual seal requirements
- Loss of flare purge gas
- Atmospheric tank level and pressure protection
- Truck and rail loading
- Compressor overpressure and loss of suction pressure protection

Improving PHA and Design Efficiency

- Overtime, MidstreamCo saw a reduction in the time taken for the PHA/LOPA Study itself, as well as the post-study review time
- Less time spent during the PHA/LOPA means more time available for day-to-day operations



Using Internal Standards to Develop a Consensus Document

- By use of industry groups such as AIChE and GPSA, ideas could be shared across companies to develop a Midstream Specific Gas Gathering and Processing Design RAGAGEP
- Increased efficiency in the design phase
- Decreased costs
- Increased safety and reliability

Questions? Contact Us!

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