Overpressure Safety Management in Oil and Gas Industry

65th Canadian Chemical Engineering Conference
October 6th, 2015

Presented by Sam Sanati, P.Eng
Review an Overpressure Protection Incident

Reference: Chemical Safety Board Report
Overpressure Protection-PSM Relation
Cause of Overpressure

- External Fire
- Ambient Effect
- Operator Error
- Instrument or Control system Failure
- Utilities or Process upset
- Valve Mechanical Failure or Fatigue
Overpressure Protection in Alberta

Safety Code Act: Pressure Equipment Safety Regulation
38(1) An owner of pressure equipment must ensure it has overpressure protection that is
   (a) a pressure relief valve that meets the requirements of the ASME Code, or
   (b) other means of overpressure protection acceptable to the Administrator.
Provincial Requirement

ABSA 525:
According to the PESR, all pressure equipment must have overpressure protection, and the overpressure protection system must be properly designed and operated.

TSASK:
Pressure vessels shall be provided with a means of overpressure protection. The use of an overpressure protection device (rupture disc, pressure relief valve, pressure safety valve) is the preferred and approved standard to safeguard a pressure vessel.

16 October 2015
Underlying Causes of Relief Valve Failure

HSE UK Assessment shows 33% of relief valve failures were a result of improper operation.
Examples of Faulty Design

Insufficient bolts  Long Moment Arm  Noise

Source: The Safety Relief Valve Handbook (Marc Hellemans)
Process Safety in Overpressure Protection Design

- Process Hazard Analysis
- Safety Critical Element Identification & Performance Standard
- Noise Assessment Study
- Overpressure Risk Assessment
Using Other Means of Overpressure Protection

When an owner is planning to use other means of overpressure protection in lieu of a PRV, the owner must demonstrate to the Administrator that the proposed overpressure protection system provides an equivalent or greater standard of safety than using a PRV.

- Monitoring Program
- Overpressure Protection by System Design (OPPSD)
- Safety Instrumented System (i.e. HIPPSS)
Overpressure Protection by System Design

- The protection of a pressure vessel against overpressure without the use of a pressure relief device.
- The ASME UG-140 states if pressure vessel is self-limiting and the pressure is less or equal to MAWP at coincidence temperature then PRV is not required.
- Overpressure Risk Assessment (ORA) shall be conducted to justify OPPSD.
- When there is justification of OPPSD then it shall be listed in the safety critical element.
# Overpressure Protection Options

<table>
<thead>
<tr>
<th>OPPSD Self-Limiting</th>
<th>Relief Valve</th>
<th>HIPPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer of Protection</td>
<td>Primary LoP</td>
<td>5th LoP</td>
</tr>
<tr>
<td>PFD</td>
<td>$10^{-4}$</td>
<td>$10^{-2}$</td>
</tr>
</tbody>
</table>

**Advantage**
- Preferred for toxic services
- Low maintenance cost
- Conventional Design and Operation
- High Reliability
- Recommended when environmental and safety is highly concerned

**Disadvantage**
- Requires additional safety margin for design pressure
- High Maintenance
- Environmental Concern (toxic)
- Cost
- Complexity
- Frequent testing
Overpressure Risk Assessment
ASME UG-140 Requirement

1- Multi-Disciplinary team review;
2- Risk Assessment for various overpressure scenarios;
3- Manufacture data report to state the system protected by design;
4- Documentation and sign-off
Can We Use HAZOP in Lieu of ORA?

TSASK (Saskatchewan):

A detailed analysis to identify and examine all potential overpressure scenarios must be conducted. A summary of the results from a hazards and operability analysis (HazOp), failure modes, effects and criticality analysis (FMECA), “what-if” analysis or other equivalent methodology is required.
HAZOP

- Process, Control and Operations Engineers attend
- Don't need a P.Eng. Stamp
- Outcome: Recommendations list
- Info: Process & control Data
- Qualitative Study
- Assumed competent operators

ORA

- HAZOP participants + Relief SME attend
- To be stamped by a P.Eng.
- Outcome: SCE list + Recommendations List
- Info: Process, Control and Mechanical Data
- Semi-quantitative study
- Inadvertent scenarios
Overpressure Risk Assessment Notes

- HAZOP might not meet regulation’s objectives if it is not completed by LOPA to ensure *an equivalent or greater standard of safety* is designed.
- If relieving is utilized as the means of protection then using HIPPS will just increase CAPEX and OPEX and complication.
- Inadvertent valve operation (e.g. control valves bypasses to be wide open) shall be taken into consideration.
- Accessibility to fire protection system shall be reviewed in fire cases.
- Fire Zoning layout to be available for ORA. If equipment is not located within the fire zone then no need to review the fire case.
Overpressure Protection Safety Management
Recommendations

1- For operating plants, existing PRVs’ conditions shall be taken into consideration for PHA revalidation. Also, probability of failure for existing PRVs should be considered.

2- Process Safety engineers needs more contribution during design phase to address safety concerns.

3- Conduct comprehensive ORA and revalidate it as part of MoC.

4- Using a common language for overpressure risk assessment among provinces.

16 October 2015
Thank you

If you’d like to find out more visit: www.atkinsglobal.com

© Atkins Limited except where stated otherwise.

16 October 2015