Agrium

Kenai Nitrogen Operations

Ammonia Refrigeration & Compression Systems 20/70 & 23/73
Process Hazards Analysis Revalidation

Final Report

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SECTION 1.0 – ABOUT THIS STUDY

The Process Hazards Analysis, K00S0010, conducted over a two-month period concluding in December of 1993, was revalidated in July of 1998, and revalidated for a second time during the week of February 17-19, 2003. The original PHA, as well as both revalidations, focused on the Kenai Plant's Systems 20/70 and 23/73, which includes the Ammonia Refrigeration & Compression System.

EPA RMP 40 CFR Part 68 Section 112 (7) and OSHA Rule 1910.119, "Process Safety Management of Highly Hazardous Chemicals" requires that the initial Process Hazard Analysis (PHA) for a covered process be updated and revalidated by a knowledgeable team **at least every five years**. The objective of PHA revalidation is to assure that the PHA is consistent with the current process. The PHA is revalidated by evaluating and addressing the following questions:

1. Have significant new hazards been created or introduced into the process?
2. Has the possible occurrence of a catastrophic release in the process unit become significantly more likely?
3. Have consequences of previously identified toxic or flammable material releases become more severe?
4. Have consequences that could go "off-site" been identified?
5. Have previously identified safeguards become compromised or challenged?

METHODOLOGY

Baseline PHA

The Initial Process Hazards Analysis (PHA) was conducted primarily using the "HAZOPS" (Hazard and Operability Study) technique. In a HAZOP, the team uses a creative, systematic approach to identify hazard and operability problems resulting from deviations from the design intent of the process that could lead to undesirable consequences. An experienced team leader systematically guides the team through the plant design using a fixed set of words (called "Guide words"). These guidewords are applied at specific points or "study nodes" in the plant design and are combined with specific process parameters to identify potential deviations from the plant's intended operation. For example, the guideword "No" combined with the process parameter "flow" results in the deviation "No Flow." The specific steps of the HAZOP methodology used in the baseline PHA were:

- Choose study node
- Apply a deviation (parameter + guideword)
- Brainstorm causes of the deviation
- For each cause, identify ultimate global consequences
- Identify existing safeguards
- Qualitatively assess the risk of the scenario
- If warranted, make recommendation(s) to reduce risk and/or improve the operability of the facility

This process is repeated for each deviation and node until the entire process has been analyzed.

Revalidation

There are several processes by which the initial system study may be revalidated. The PHA procedure used to revalidate Systems 20/23 & 23/73 Ammonia Refrigeration & Compression was the node-by-node review of the original PHA. This methodology was organized into the following tasks, and are described below:

1. Collection of Information
2. Information Review
3. Revalidation Study Sessions (with PHA Team)

The revalidation conducted in 1998 used the Guideword/Checklist method. See File K00S10R1 for worksheets.

Collection of Information

The following information was collected prior to the Revalidation Study Sessions:

1. Baseline PHA and previous revalidation, including worksheets, Action Item list, P&ID's reviewed, and status of recommendations.
2. Documented changes to the design or operation of the process since the last revalidation (including MOC's).
3. Documented incident reports from this unit.
4. Latest revision of Piping and Instrument Diagrams (P&ID's) that describe the process.
5. Other Process Safety Information, such as PRV design basis and data and Standard Operating Conditions and Limits (SOCL's).
6. HAZOPS performed on Systems 20/70 & 23/73 since the 1998 Revalidation.

Information Review

The Revalidation Team Leader/PSM Assistant reviewed the collected information prior to the study dates. The purpose of the Information Review is to screen the baseline PHA and latest revalidation for content and quality, and to identify concerns and issues that need to be reviewed by the Revalidation Team during the study sessions. This resulted in the generation of an agenda, or work plan, for the sessions. The Information Review included the following tasks required to identify items for discussion with the team:

1. Review the baseline PHA and complete the Initial PHA Content Checklist, see Attachment 2, and the Baseline PHA Screening Checklist, see Attachment 3. Evaluate the baseline PHA to ensure that off-site consequences were adequately discussed and addressed.
2. Review and verify the documented status of recommendations from the baseline PHA, other revalidations, and any project PHA affecting this unit.
3. Review all incidents occurring in the system since the last revalidation, and develop a list of those pertinent to the revalidation process.
4. Develop a list of all undocumented changes that have occurred to the design or operation of the process since the last revalidation. This is done by comparing the latest P&IDs with the P&IDs reviewed during the previous revalidation, and by reviewing those changes to the design or operation of the process with the ones that have been analyzed by the MOC process. No undocumented changes were revealed during the review process.
5. Develop an agenda, or work plan for the study sessions, see Attachment 1.

Revalidation Study Sessions (with PHA Team)

The revalidation study was discussed and prepared by a multi-disciplined team knowledgeable in the process and in the PHA method used. At the beginning of the session, the Team Leader reviewed the PHA revalidation scope and purpose. The group was then lead through the revalidation procedure, which included:

1. General discussion regarding the status of open recommendations from the baseline PHA and previous revalidation, See Attachment 4;
2. Discuss and verify completion of MOC's worked since the 1998 Revalidation;
3. Discuss Previous Incidents with open recommendations, See Attachment 14;
4. Generate a list of Global Improvements affecting this unit.
5. Perform a node-by-node review of the original baseline PHA.

Other Issues

During this second round of system revalidations, an engineering review will be conducted of all relief valves in the systems undergoing revalidation. There are 28 relief valves (PSV's) in System 20; 19 in System 23; 42 in System 70; and 14 in System 73. The set pressure and relieving capacity of these relief valves is being reviewed to ensure that the existing relief valves are properly designed for the current operating conditions. Any relief valve design deficiencies will be documented in the PSV files and engineering recommendations for correction will be issued as PHA recommendations. This engineering review is currently underway with a target completion date of July 2003. Any PHA recommendations that result from this engineering review will be issued in a separate report.

A CCPS Concept book, titled "Revalidating Process Hazard Analyses" written by Walter L. Frank & David K. Whittle, was utilized to help determine the appropriate method for revalidating PHA K00S10R1. Another helpful tool was an AICHE article titled "Six Steps to Effectively Update and Revalidate PHAs", written by Kevin E. Smith & David K Whittle, EQE International, Inc. an ABS Group Company. Both of these references can be found in the PSM Assistant office.

Compliance with OSHA Rule 1910.119 and EPA RMP Rule

This study complies with OSHA rule 1910.119, "Process Safety Management of Highly Hazardous Chemicals" and EPA 40CFR Part 68 Section 112, "Risk Management Program."

In particular, this study complies with paragraph (e, 6) of the OSHA rule that states; "At least every five years after the completion of the initial process hazard analysis. The process hazard analysis shall be updated and revalidated by a team, meeting the requirements in paragraph (e)(4) of this section to assure that the process hazard analysis is consistent with the current process." The study also complies with Subpart D (68.67) of the RMP Rule covering the same requirements as OSHA 1910.119 and potential off-site consequences.

The study was completed within five years of the previous System PHA. A multi-disciplined team, including at least one person with knowledge and experience in the process, discussed and prepared the study in a manner to ensure that the baseline PHA is consistent with the current process.

Process Hazards Analysis Team (e, 4)

The PHA Revalidation was discussed and prepared by a team with expertise in engineering and operations, with at least one employee having specific expertise in the process being evaluated. The study team consisted of the following people:

Name	Title	Years of Experience	Sessions Attended
America Dukowitz	PSM Assistant/PHA Leader	5	3
Chuck Bergonzini	Safety Specialist	20	1
Michelle Grzybowski	Environmental Engineer	7	1
William Switzer	Chemical Engineer	34	3
Forrest Pipkin	Mechanical Engineer	3	3
John Boosinger	Plant 1 "A" Operator	17	3
Mark Stynsberg	Plant 4 "A" Operator	25	3
Larry Engel	Millwright/Mechanic	20	3
Dwayne Goche	Inspector	5	Partial
Russell Peterson	Chemical Engineer/Advisor	25	Partial

Process Description

Systems 20 and 70 consist of the Ammonia Refrigeration Loops for Plant #1 and Plant #4 respectively. Systems 23 and 73 consist of the Ammonia Refrigeration Compressor and the ancillary utility systems necessary for refrigeration compressor operation for Plants #1 and #4 respectively. The 20/23 and 70/73 processes are nearly identical, with only subtle differences in their operation.

At the Agrium Kenai Plant, there are two units producing liquid ammonia for internal use and for external sales. In addition, a slipstream of the ammonia produced in these units is used as a refrigerant for cooling and liquefying other ammonia streams within the process.

Liquid ammonia from various sources is introduced into the Flash Towers where the reduction in pressure results in lower liquid temperatures and some ammonia vaporizing back to the gaseous state. The Flash Towers are two vessels, which contain five stages of varying pressure. The gaseous ammonia that flashes off in each stage of the Flash Tower is directed to the Ammonia Refrigeration Compressor. The pressurized ammonia is condensed and sub-cooled and returned to the Flash Tower as a liquid. Liquid ammonia is pulled off the third stage flash drum at approximately 18°F to cool gaseous ammonia from the Ammonia Converters in the Ammonia Cooled Condensers. Liquid ammonia from the first stage, at approximately –27°F, is sent to the Refrigerated Ammonia Product Storage Tanks. A slipsteam of liquid from the first stage of the Flash Tower is used for cooling on the Secondary Interstage Synthesis Gas Coolers, the Purge Condensers, and the Vent Condenser. The ammonia used for cooling returns to the Flash Tower and the cycle is repeated.

The Refrigeration Compressors are driven by a 550 psig condensing steam turbine. Oil systems are provided for lubricating and sealing purposes for the compressors.

This system also includes underground Ammonia Drain Tanks in each plant used for draining liquid ammonia from various locations within the specific plant while preparing equipment for maintenance. Ammonia collected in the tank is typically recycled for use in the facility.

Study P&IDs

The following Process & Instrument Diagrams (P&IDs) were studied during the PHA:

P&ID	DESCRIPTION	REVISION
R1I-1060	Plant #1, Synthesis Gas Compression	29
R1I-1070	Plant #1, Synthesis Gas Loop	19
R1I-1080	Plant #1, Refrigeration	30
R1I-1081	Plant #1, Refrigeration Compressor and Turbine Auxiliary Systems	19
R1I-1082	Plant #1, High & Low Temp Pump Turbines Auxiliary Systems	3
R4I-4070	Plant #4, Ammonia Liquefaction	9
R4I-4080	Plant #4, Refrigeration	13
R4I-4085	Plant #4, Ammonia Vent System	8
R4I-4090	Plant #4, Synthesis Gas Compression	11
R4I-4140	Plant #4, Refrigeration Compressor Auxiliary Oil System	5
R4I-4190	Plant #4, Refrigeration Compressor Steam Condensers	2

Due to the size of the P&IDs used for this study, the actual drawings will not be included in this report. The P&IDs used during the study have been retained by Agrium Kenai Nitrogen Operations, PSM Group, and will be maintained in the PHA Revalidation P&ID file drawer.

Other Available PSI

Operating Procedures, Standard Operating Conditions and Limits (SOCLs), and Material Safety Data Sheets were available for review by the revalidation team as needed. Included in the SOCLs are the consequences of deviating from established safe operating limits. Design criteria and maintenance history for relief devices in this system were available for review as necessary.

SECTION 2.0 - RECOMMENDATIONS

RECOMMENDATION: 1

Tech Services to spec out new valves as needed. Instrument Shop can replace with like/kind valves. This needs to be considered for Plant 1 & 4 level valves. This could apply to all the level valves on the Flash Towers. (LCV1713)

Reference: 1.9.3, 1.11.3

RECOMMENDATION: 2

Change valve trim or increase line size. Tech Services needs to evaluate this valve to determine best course of action. This valve limits production. (LCV1714)

Reference: 2.9.3

RECOMMENDATION: 3

Lines with damaged insulation are most suspect and need to be inspected and repaired. Corrosion monitoring program needs to continue. (Plant 4 cold shot lines)

Reference: 6.6.3, 6.8.3, 7.6.3, 7.8.3

RECOMMENDATION: 4

Remove low-pressure lube oil trip and install a low-pressure alarm to the control board. (4GT224A, 4GT225A)

Reference: 8.3.7, 9.3.4

RECOMMENDATION: 5

Install high temp pump trips activated from the control board. (4TCV1662, 4TIC1662, 4TV1662, 4TY1662A)

Reference: 11.4.2

RECOMMENDATION: 6

Install low temp pump trips on the board. (1G224A&B)

Reference: 24.2.2

SECTION 3.0 – STUDY WORKSHEETS & ATTACHMENTS

The following documents were utilized throughout the PHA Revalidation Process. If you require more information, please ask for file K00S10R2.

Attachment 1 Revalidation Agenda
Attachment 2 Initial PHA Content Checklist
Attachment 3 Baseline PHA Screening Checklist
Attachment 4 Discussion of Open Recommendations from Previous Studies
Attachment 14 Previous Incident Reports
Review of MOC's
Node-by-node Worksheets from PHA Pro
List of Global Improvements since 1993