Agrium

Kenai Nitrogen Operations

Plants 1 & 4 Reforming Shift Conversion, CO_2 Removal, and Methanation Systems: 01/10/11/12/13/14/15/16/59/60/61/62/63/64/65/66

Process Hazards Analysis Revalidation

Final Report

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Project No.: K00S29R1

TABLE OF CONTENTS

1.0 ABOUT THIS STUDY

The Process Hazards Analysis, K00S0029 conducted between January 5, 1996 to March 12, 1996 was revalidated at Agrium's Kenai Nitrogen Operations on November 7, 2000 through to November 17, 2000. The original PHA, as well as the revalidation, focused on Plants 1 and 4 Reforming Shift Conversion, CO_2 Removal, and Methanation Systems: Plant 1—01/10/11/12/13/
14/15/16, and Plant 4—59/60/61/62/63/64/65/66.

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:

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

Methodologies

Baseline PHA

The original, or baseline, PHA was conducted primarily using the HAZOP deviation guideword technique and the "What-If" technique.

HAZOP Deviation Guideword Technique

The guidewords, in conjunction with key process parameters, prompt the Process Hazards Analysis team to brainstorm possible causes and potential consequences of deviations from expected operation. For example, the deviation of "NO FLOW" would prompt the leader to ask the team, "What could cause no flow in this section or line segment?" The "Possible Cause/Potential Consequence" scenarios were documented in the report worksheets along with "Existing Systems and Safeguards," that either reduce the likelihood of the cause occurring or reduce the potential consequences. For scenarios involving significant risk, "Recommendations," which the team believed, may further reduce the risk or improve the operability of the facility were also documented.

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.

What-If Technique

The "What-If" technique involves asking questions that require the team to analyze deviations from the procedure. An example is, "What-If"…the drying step were left out of the procedure?" The team then develops consequences of this action (or inaction) and documents the safeguards in a manner similar to HAZOP. The "What-If" scenario is then ranked for risk, and recommendations are made if appropriate, similar to the HAZOP technique.

Revalidation

The PHA procedure used to revalidate Plants 1 & 4 Reforming Shift Conversion, CO_2 Removal, and Methanation was the Guideword/Checklist PHA Revalidation Method. 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)

Collection of Information

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

1. Baseline PHA, including worksheets, Action Item list, P&IDs reviewed, and status of recommendations.
2. Documented changes to the design or operation of the process since the baseline PHA (including MOCs).
3. Documented incident reports from this unit.
4. Latest revision of Piping and Instrument Diagrams (P&IDs) that describe the process.
5. Other Process Safety Information, such as PRV design basis and data and Standard Operating Conditions and Limits (SOCLs).

Information Review

The collected information; was reviewed by the Revalidation Team Leader and Agrium Kenai Nitrogen Operations representatives on October 9, 2000 through to November 7, 2000. The purpose of the Information Review is to screen the baseline PHA 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 and any project PHAs affecting this unit.
3. Review all incidents occurring in the system since the baseline PHA, and develop a list of those pertinent to the revalidation process.
4. Develop a list of all changes that have occurred to the design or operation of the process since the baseline PHA, see Attachment 5. This is done by comparing the latest P&IDs with the P&IDs reviewed during the baseline PHA, and by reviewing those changes to the design or operation of the process that have been analyzed by the MOC 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, and reviewed the completion of the Initial PHA Content Checklist and the Baseline PHA Screening Checklist. The group was then lead through the revalidation procedure, which included:

1. General discussion regarding the status of open recommendations from the baseline PHA, see Attachment 4;
2. Work through the Change Evaluation Checklist to identify undocumented changes, see Attachment 5;
3. Work through the Operations Change Evaluation and Wrap-up Checklist Issues, see Attachment 6;
4. Work through the Maintenance Change Evaluation and Wrap-up Checklist Issues, see Attachment 7;
5. Work through the Engineering Change Evaluation and Wrap-up Checklist Issues, see Attachment 8;
6. Work through the Inspection Change Evaluation and Wrap-up Checklist Issues, see

Attachment 9;
7. Work through the Emergency Response Change Evaluation and Wrap-up Checklist Issues, see Attachment 10;
8. Work through the Safety Group Change Evaluation and Wrap-up Checklist Issues, see Attachment 11;
9. Work through the General Change and Wrap-up Checklist Issues, see Attachment 12;
10. Review Human Factors Issues/Checklist, see Attachment 13;
11. Discuss Previous Incident Reports, see Attachment 14;
12. Evaluate Potential Off-Site Consequences, see Attachment 15;
13. Discuss Additional Areas "What-If" Worksheets, see Attachment 16;
14. Review Revalidation Guideword Checklist, see Attachment 17;
15. Review Risk Ranking Matrix, see Attachment 18.

"What-If" - The team utilized the "What-If" technique to identify potential hazards and areas of concern when it was determined that those hazards or concerns were not adequately addressed by the baseline PHA, such as potential off-site consequences. The "What-If" technique was also utilized to evaluate potential hazards caused by new or modified equipment as the review team deemed appropriate. OSHA recognizes the "What-If" as an acceptable method of evaluating process hazards. Those scenarios evaluated using the "What-If" technique can be found in Attachments 15 and 16.

The "What-If" technique involves asking questions that require the team to analyze deviations from the design intent. An example is: "What-If...the drying step were left out of the procedure?" The team then develops consequences of this action (or inaction) and documents the safeguards in a manner similar to HAZOP. The "What-If" scenario is then ranked for risk, and recommendations are made if appropriate, similar to the HAZOP technique. Attachment 18 shows the criteria for applying risk rankings to various scenarios.

Other Issues

Facility Siting – Agrium Kenai Nitrogen Operations has completed a plant-wide facility siting study, which adequately addresses those issues; therefore, the Facility/Plant Siting Issues checklist was not utilized.

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 baseline 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 Process Hazards Analysis Revalidation was conducted on November 7, 2000 through to November 17, 2000 at Agrium Kenai Nitrogen Operations in Kenai, Alaska.

The study team consisted of the following people:

Name	Title	Years Experience
Mike M. Thompson	Mechanical Engineer	4
William R. Switzer	Advising Chemical Engineer	32
Raymond Hanson	Chemical Engineer	14
Bill D. Gregg	Plant 1 Operator	10
Tim Johnson	Operation Supervisor Plant 1	7
Tamara L. Bronner	Plant 4 Operator	16
Steve E. Donnelly	Plant 4 Operator	19
Eric Jensen	Instrument Tech.	10
Mike L. Boulette	Inspection Supervisor	8
Dana L. Bassel	Safety Specialist	30
Michele Grzybowski	Environmental	6
Bruce A. Jackman	Maintenance Engineer	7
Edward J. Aisenbrey	PHA Facilitator/PSM Coordinator	23
Licia Piceno	Project Aide/Scribe	6

Process Description

General Information

The manufacturing of ammonia uses basic principles of chemistry with readily available ingredients. Natural gases from the Swanson River gas field along with natural gas from the Steelhead platform in Cook Inlet provide fuel and feedstock. Water is supplied from local wells for steam and ambient air is used as a source of nitrogen. With the aid of catalysts, heat exchangers, and compressors, the natural gas is reformed into hydrogen and combined with nitrogen to yield ammonia, which is then liquefied and stored for transport by ship to West Coast and Pacific Rim markets.

The process can be divided into six distinct areas. Feed gas is prepared and reformed into its components. The gas stream is purified of CO by conversion, purged of CO_2 in the MDEA area, and then trace amounts of CO_2 and CO are removed by methanation before synthesis of ammonia occurs in the converter. Gaseous ammonia is refrigerated and liquefied. The liquid ammonia is pumped to the storage tank.

Gas Preparation and Reforming

In the Gas Preparation and Reforming Section of the ammonia plant, heated natural gas is passed through organic sulfur removal (OSR) vessels. This sulfur free gas stream is again preheated in the upper section of the Primary Reformer. Steam (550 psig), that is produced by the Utility Plant and steam that has stripped ammonia from process condensate is added to the gas stream. The steam and natural gas mixture is further heated before entering the catalyst tubes in the main section of the Primary Reformer. There, the gas burners create process temperatures of about 1305°F. This high temperature, along with catalyst, causes the methane (CH_4) to react with steam (H_2O) and rearrange (reform) into new gases, namely hydrogen (H_2), carbon monoxide (CO) and carbon dioxide (CO_2).

Not all of the natural gas is reformed. A small percentage passes through the Primary Reformer and moves to the Secondary Reformer. Before entering the Secondary Reformer, compressed air is added to the reformed gas. This compressed air immediately ignites the hydrogen to create a very high temperature and additional reforming of natural gas occurs within a catalyst bed. The addition of compressed air also serves to add nitrogen into the reformed gas stream; this nitrogen (N_2) will later react with H_2 to produce ammonia (NH_3). The reformed gas passes through the Waste Heat Boiler where excess heat, or waste heat, is used to produce high-pressure steam. High-pressure steam is also produced in the Primary Reformer.

Note that the reforming reaction is strongly endothermic (requires lots of heat input), hence the large high temperature furnace and the combustion process in the Secondary Reformer.

Shift Conversion

Reformed gas must be purified of carbon monoxide before being converted into ammonia. The purification is accomplished by passing the reformed gas over a catalyst bed that promotes the combination of carbon monoxide and water (in the form of steam) into carbon dioxide and hydrogen. This conversion gives off heat. The additional heat gained, plus the initial heat from the reformed gas, is used to produce high and low pressure steam. Because the primary carbon monoxide conversion is occurring at a relatively high gas temperature, this is usually referred to as the "high temperature shift conversion."

The high temperature shift conversion does not completely remove all of the carbon monoxide. Additional purification occurs in another catalyst bed that promotes the same chemical reaction. This time the combination of carbon monoxide with water as steam occurs at a lower temperature. This is referred to as the "low temperature shift conversion." The carbon monoxide content of the gas stream has been lowered to less than one percent of the total volume. Additional H_2 has been produced and the gas stream is ready for carbon dioxide removal.

During both conversions, excess heat is generated. The Excess or Waste Heat Boilers remove this heat and produce high-pressure and low-pressure steam.

Carbon Dioxide Removal

Carbon dioxide (CO_2) is a by-product of producing synthesis gas for ammonia production. The CO_2 produced in the Reforming Section and Conversion Section of the Ammonia Plant is removed in the CO_2 removal systems. The MDEA systems are named for the fluids used to absorb the CO_2 from the gas streams. Removal of CO_2 occurs in the Absorber under conditions of high pressure and low temperature, in this case 400 psig and 130°F. After the gas stream releases the CO_2, it proceeds to methanation and synthesis.

The CO_2 removal solutions move to accumulators where some of the CO_2 is quickly released along with other inerts. The Accumulators are referred to as "Fat Flashers" because the inerts "flash" out of the rich ("fat") solution.

All CO_2 must be removed in order to recycle the CO_2 removal solutions. CO_2 is removed in the Regenerators, where the warmed CO_2 removal solutions enter and additional heating occurs. Under conditions of low pressure and high temperature (20 psig and 257°F) the CO_2 is released and routed for use in the Urea Plants; some excess CO_2 is vented to atmosphere. Additional heat exchangers cool the CO_2 removal solutions, leaving the Regenerators, and pumps increase the pressure in preparation for another cycle through the Absorber.

Methanation and Synthesis

The synthesis gas must be free of all carbon monoxide and carbon dioxide. This is ensured by passing the synthesis gas stream over a catalyst bed that completes a chemical reaction, opposite that of reforming. The CO and CO_2 combines with hydrogen, which yields methane, water, and heat. This reaction occurs in the Methanator. A small percentage of methane can be tolerated in the synthesis gas but the water must be removed. The amount of heat produced is directly proportional to the amount of CO and CO_2 that is present. This heat is used to bring the Methanator inlet gas up to the reaction temperature in the catalyst bed.

Process Safety Information

Study P&IDs

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

P&ID	DESCRIPTION	LATEST REVISION
R1I-1000	Incoming Gas Distribution Process	Rev. 13
R1I-1010	Gas Reforming Process	Rev. 6
R1I-1020	Ammonia Shift Conversion Process	Rev. 10
R1I-1030	Sulfinol CO_2 Removal Process	Rev. 23
R1I-1110	BFW Service Flow Auxiliary	Rev. 14
R4I-4000	Ammonia Reforming Process	Rev. 16
R4I-4001	PC System & Feed Gas Process	Rev. 15
R4I-4010	CO/CO_2 Conversion Process	Rev. 15
R4I-4020	HP Steam Generation Process	Rev. 7
R4I-4021	LP Steam Generation Process	Rev. 6
R4I-4030	Sulfinol Regeneration Process	Rev. 7
R4I-4040	Sulfinol Absorption Process	Rev. 9

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.

2.0 RECOMMENDATIONS

Along with appearing in the revalidation study sheets, suggested recommendations identified by the study team are documented below. The recommendations are divided into three categories:

- "Actions" are relatively simple tasks that were assigned to team members, and could be completed before the end of the study.
- "Recommendations" are those tasks that require more evaluation, and possibly engineering or management direction.
- "Operability Recommendations" are those recommendations that have no impact on Safety or Environmental concerns, but would assist plant operability and/or efficiency.

The recommendations are numbered based on the attachment/worksheet in Section 3.0 where the cause/consequence scenario and the recommendation is documented. If there is more than one recommendation per worksheet, they are numbered chronologically. Where there are multiple/similar recommendations across several worksheets (i.e., drawing updates), they will be combined and presented as one, and tracked as a single recommendation. This list is to be used by management to resolve and document resolution of the suggested actions by the Process Hazards Analysis Revalidation team.

RECOMMENDATION: 5-1 Update P&ID R1I-1000 per MOC 800376 to show addition of block valve. (see redline this P&ID) (Reference: Attachment 5, page 5 of this report.)
RECOMMENDATION: 5-2 (EHS) Install lifting lever on 3PSV100 per Brown & Root Safety Valve Audit (MOC 501702) (Reference: Attachment 5, page 5 of this report.)
RECOMMENDATION: 5-3 (EHS) Redesign sample system for all expected conditions. Current system is not sufficient for high temperatures. (Reference: Attachment 5, page 7 of this report.)
RECOMMENDATION: 5-4 (EHS) Addition of Bellevue washers has eliminated fire hazards on 1E102. Install Bellevue washers on 4E202, which experience the same problems. (Reference: Attachment 5, page 13 of this report.)
RECOMMENDATION: 5-5 (EHS) The new gasket design and Bellevue washers on 1E101A/B has eliminated fire hazards on 1E101A/B. Install new gasket design and Bellevue washers on 4E201, which

experience the same problems. (Reference: Attachment 5, page 14 of this report.)
RECOMMENDATION: 5-6 Update P&ID R1I-1110 (MOC 501314) to show the installation of flange for blind location on the drain line (3/4" BD125-905), see redline this P&ID. (Reference: Attachment 5, page 25 of this report.)
RECOMMENDATION: 5-7 (EHS) Engineering to evaluate situation and develop long-term solution to resolve plugging of pressure taps, piping, and sample points with carbamate (MOC 505438). (Reference: Attachment 5, pages 34 & 37 of this report.)
RECOMMENDATION: 5-8 Update P&ID R4I-4020 to reflect SIs (MOC 800526), see redline this P&ID. (Reference: Attachment 5, page 55 of this report.)
RECOMMENDATION: 6-1 (EHS) Move DCS console toward alarm panel. Consider recessing DCS consoles through old control panel. (See Attachment 6—Operation Checklist: Question O-6.) (Reference: Attachment 6, page 1 of this report.)
RECOMMENDATION: 6-2 (EHS) Increase Wharf staffing by four 0perators to reduce overtime load on plant operators and increase available time for sick leave, vacation, training, Wharf, and special project coverage. (See Attachment 6—Operations Checklist: Question O-9.) Additional Reference: Attachment 13, page 9 Human Factors Checklist—Section: Workload and Stress Factors, Question 5. (Reference: Attachment 6, page 2, 3, & 4 of this report.)
RECOMMENDATION: 6-3 (Production) Operations, Tech. Services, and Maintenance to review the needs for DCS support and recommend changes and staffing to support the DCS. (See Attachment 6—Operations Checklist: Question O9.) (Reference: Attachment 6, page 2, 3, & 4 of this report.)
RECOMMENDATION: 6-4 (Production) Operations, Maintenance, and Tech. Services to review the need for additional Tech. Support and Maintenance staffing. (See Attachment 6—Operations Checklist: Question O-9.) (Reference: Attachment 6, page 2, 3, & 4 of this report.)
RECOMMENDATION: 6-5 (EHS)

Address the 70 plus DCS issues that are pending. (See Attachment 6—Operations Checklist: Question O-14.) (Reference: Attachment 6, page 5 of this report.)
RECOMMENDATION: 6-6 (Production) Operations to review all Plant 1 SOCLs and update to work with DCS. (See Attachment 6—Operations Checklist: Question O-16.) (Reference Attachment 6, page 5 of this report.)
RECOMMENDATION: 6-7 (Production) Engineering to design and implement better flow instrumentation for 4E272 to eliminate low flow and freeze-up problem. (See Attachment 6—Operations Checklist: Question O-28.) (Reference Attachment 6, page 7 of this report.)
RECOMMENDATION: 6-8 (EHS) Install continuous moisture analyzers on outlet of each dryer train. Flow meter exit each dryer train and temperature recorder each regeneration flow. (See Attachment 6—Operations Wrap-up Checklist: Question 7.) (Reference Attachment 6, page 10 of this report.)
RECOMMENDATION: 7-1 (Production) Install new block valves on 1G108A/B. Isolation block valves on 1G108A/B leak through when trying to isolate these pumps. (See Attachment 7—Maintenance Checklist: Question M-10.) (Reference: Attachment 7, page 2 of this report.)
RECOMMENDATION: 7-2 (EHS) Review and upgrade sight glass system. 1500# sight glass (bulls-eye) are constantly failing (weekly). (See Attachment 7—Maintenance Checklist: Question M-10.) (Reference: Attachment 7, page 2 of this report.)
RECOMMENDATION: 7-3 (EHS) Determine cause of head leaks and repair as necessary. 1E118 head leaks when process gas temperature gets too cool (ice hazard in wintertime). (See Attachment 7—Maintenance Checklist: Question M-10.) (Reference: Attachment 7, page 2 of this report.)
RECOMMENDATION: 7-4 (Production) Repair or replace valves as necessary. Isolation block valves on 4G202A/B/C do not seal. (See Attachment 7—Maintenance Checklist: Question M-10.) (Reference: Attachment 7, page 3 of this report.)

RECOMMENDATION: 7-5 (Production)

Put 4E214 temperature controls on a quarterly routine to calibrate and repair. 4E214 temperature controls do not work properly. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 3 of this report.)

RECOMMENDATION: 7-6 (EHS)

Design and install a more reliable 1500# sample point. 4E246 1500# sample point plugs up regularly. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 3, of this report.)

RECOMMENDATION: 7-7 (Production)

Design and implement a reliable high level indication and alarm. 4D212 PC Stripper high level alarm does not function correctly due to pluggage with carbamate. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 3 of this report.)

RECOMMENDATION: 7-8 (EHS)

Review and upgrade sight glass system. 1500# sight glasses (bulls-eye) are constantly failing monthly. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 4 of this report.)

RECOMMENDATION: 7-9 (EHS)

Determine cause of head leaks and repair as necessary. 4E218 head leaks when process gas temperature gets too cool (ice hazard in wintertime). (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 4 of this report.)

RECOMMENDATION: 7-10 (Production)

Determine and implement long-term solution. AT922, 923, and 924 have been having reliability problems. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 4 of this report.)

RECOMMENDATION: 7-11 (EHS)

Determine and implement long-term solution. 4D200 differential pressure-sensing lines are unreliable and have resulted in a valve failure. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 4 of this report.)

RECOMMENDATION: 7-12 (EHS)

Determine and implement long-term solution. 4PT311 continuously plugs with carbamate. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 5 of this report.)

RECOMMENDATION: 7-13 (EHS)

Determine and implement long-term solution. 4E205A/B bleed valves continuously plug-off. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 5 of this report.)

RECOMMENDATION: 7-14 (Production)

Determine and implement long-term solution. 4E206 manways leak during startup/shutdown consistently. (See Attachment 7—Maintenance Checklist: Question M-10.)

(Reference: Attachment 7, page 5 of this report.)

RECOMMENDATION: 11-1 (EHS)

Training Committee to review compliance with AP-4B Standard No. 3. (See Attachment 11—Safety Group Wrap-up Checklist: Question 7

(Reference: Attachment 11, page 4 of this report.)

RECOMMENDATION: 12-1 (EHS)

Develop a new startup procedure for new High Temp Shift Catalyst (consult with P&C Group during procedure generation). Plant 4: During startup after 2000 turnaround, High Temp Shift developed a large amount of water that was drained on the ground and was later discovered to have high levels of chromium that employees were exposed to. (See Attachment 12—General Checklist: Question G4.)

(Reference: Attachment 12, page 1 of this report.)

RECOMMENDATION: 12-2 (EHS)

Develop a procedure for handling blowdown water from any vessel containing catalyst including OSRs. Plant 4: During startup after 2000 turnaround, High Temp Shift developed a large amount of water that was drained on the ground and was later discovered to have high levels of chromium that employees were exposed to. (See Attachment 12—General Checklist: Question G4.)

(Reference: Attachment 12, page 1 of this report.)

RECOMMENDATION: 13-1 (EHS)

Fabricate and install permanent platforms for access to these valves. Plant 4: Discharge block valves must be reached from rolling ladder or by climbing out on piping. (See Attachment 12—Human Factors Checklist: Section Field— Question 2.)

(Reference: Attachment 13, page 1 of this report.)

RECOMMENDATION: 13-2 (EHS)

Review alternatives to building scaffold every 15-16 months for access to this valve. Plant 1: Sulfur Guard exit block valve is not accessible. (See Attachment 13—Human

Factors Checklist: Section Field—Question 3.)

(Reference: Attachment 13, page 2 of this report.)

RECOMMENDATION: 13-3 (EHS)

Determine areas in plants where alarms cannot be heard and determine other methods to alert personnel to emergency conditions. Plants 1 & 4: In certain locations, such as in center of Primary Reformer plant alarm system cannot be heard. (See Attachment 13—Human Factors Checklist: Section Field—Question 8.)

(Reference: Attachment 13, page 3 of this report.)

RECOMMENDATION: 13-4 (EHS)

Plant 4: Operations view is to review and remove MycroAdvantage System and APACS. Engineering's view is to improve Plant 4 operator interface. MycroAdvantage System is extremely difficult to use and does not allow multiple personnel to respond. (See Attachment 13—Human Factors Checklist: Section Control Room—Questions 1 & 2.)

(Reference: Attachment 13, page 5 of this report.)

RECOMMENDATION: 13-5 (EHS)

Provide position indicator lights on all MOVs in control Room. (See Attachment 13—Human Factors Checklist: Section Control Room—Question 12.)

(Reference: Attachment 13, page 7 of this report.)

RECOMMENDATION: 13-6 (EHS)

Replace HVAC in Plant 4 to protect electronic equipment. (See Attachment 13—Human Factors Checklist: Section Control Room—Question 16.)

(Reference: Attachment 13, page 8 of this report.)

RECOMMENDATION: 13-7 (EHS)

Increase Wharf staffing by four 0perators to reduce overtime load on plant operators and increase available time for sick leave, vacation, training, Wharf, and special project coverage. (See Attachment 13, page 11 Human Factors Checklist— Section: Workload and Stress Factors—Question 5.)

Additional reference: Attachment 6, page 2, 3, 4, and

(Reference: Attachment 13, page 11 of this report.)

RECOMMENDATION: 16-1 (EHS)

Evaluate the need for these valves and if not needed blind line at check valve to eliminate release source. (See Attachment 16—Additional Areas: Question 6-I (4" manual vent is inadvertently open (4" V137-904) P&ID R1I-1020.)

(Reference: Attachment 16, page 9 of this report.)

RECOMMENDATION: 16-2 (EHS)

Reroute 12" V103-1534 to 6F766 Continuous Boiler Blowdown Drum. (See Attachment

16—Additional Areas: Question 1-K (1F102 carry-over Startup Mode) P&ID R1I-1110.)

(Reference: Attachment 16, page 18 of this report.)

RECOMMENDATION: 16-3 (EHS)

Evaluate environmental concerns and develop and implement recommendations. (See Attachment 16—Additional Areas: Question 2-K (1E622 high-pressure drop) P&ID R1I-1110.)

(Reference: Attachment 16, page 19 of this report.)

RECOMMENDATION: 16-4 (EHS)

Evaluate and redesign continuous blowdown sample point to eliminate plugging. (See Attachment 16—Additional Areas: Question 7-K (1E156 plugs up for any reason) P&ID R1I-110.)

(Reference: Attachment 16, page 20 of this report.)

RECOMMENDATION: 16-5

Update P&ID R1I-1110 to show inlet line to 1F106, 1 ½" BD114-1534. (See Attachment 16-Additional Areas: Question 11-K (1F106 high level), see redline this P&ID.

(Reference: Attachment 16, page 22 of this report.)

RECOMMENDATION: 16-6 (EHS)

Plant 4: Install riser pipe similar to Plant 1. (See Attachment 16—Additional Areas: Question 6-A (1 ½" BD2011-A) P&ID R4I-4000.)

(Reference: Attachment 16, page 25 of this report.)

RECOMMENDATION: 16-7 (EHS)

If recommendation 16-6 is not done, update P&ID R4I-4000 to remove riser from drawing. (See Attachment 16—Additional Areas: Question 6-A (1 ½" BD2011-A).

(Reference: Attachment 16, page 25 of this report.)

RECOMMENDATION: 16-8 (EHS)

Add checking trap drains on 4H267, 10" vent, 6" vent, and 4" vent for liquid build-up to Plant 4 Front-End Operators Equipment Checklist. (See Attachment 16—Additional Areas: Question 6-B (4H267 high level) P&ID R4I-4010.)

(Reference: Attachment 16, page 28 of this report.)

RECOMMENDATION: 16-9 (EHS)

Evaluate and re-design continuous blowdown sample point to eliminate plugging. (See Attachment 16—Additional Areas: Question 3-C (4E256 plugs for any reason) P&ID R4I-4020.)

(Reference: Attachment 16, page 30 of this report.)

RECOMMENDATION: 16-10

Update P&ID R4I-4030 to show signal from LT740 (see redline this P&ID). (See Attachment 16—Additional Areas: Question 3-E (LT740), refer to Attachment 6 this study.)

(Reference: Attachment 16, page 34 of this report.)

RECOMMENDATION: 16-11 (EHS)

Consider lowering settings on PSV354A&B to 75 psig. (See Attachment 16—Additional Areas: Question A (3E620 Shell Side) Section—Check Valve Failure, P&ID R1I-1000.)

(Reference: Attachment 16, page 38 of this report.)

RECOMMENDATION: 16-12 (EHS)

Plant 4: Evaluate the possibility of lowering setpoint on 4PSV8137 to pressure lower than the 550# steam header. (See Attachment 16—Additional Areas: Question A-A (Regeneration 1F101A/B and 4F201A/B) Section—Reverse Flow, P&IDs R1I-1000 & R4I-4000.)

(Reference: Attachment 16, page 40 of this report.)

RECOMMENDATION: 16-13

Update P&ID R1I-1030 to show the installation of check valve (see redline this P&ID). (See Attachment 16—Additional Areas: Question I-I (1E155, 4E255 Tube Side) P&IDs R1I-1030 & R4I-4030.)

(Reference: Attachment 16, page 41 of this report.)

3.0 STUDY WORKSHEETS & ATTACHMENTS

The following attachments were used throughout the PHA Revalidation and may be found on the following pages:

- Attachment 1 Revalidation Agenda
- Attachment 2 Initial PHA Content Checklist
- Attachment 3 Baseline PHA Screening Checklist
- Attachment 4 Discussion of Recommendations from Baseline PHA
- Attachment 5 Change Evaluation Checklist to Identify Undocumented Changes
- Attachment 6 Operations Change Evaluation and Wrap-up Checklist
- Attachment 7 Maintenance Change Evaluation and Wrap-up Checklist
- Attachment 8 Engineering Change Evaluation and Wrap-up Checklist
- Attachment 9 Inspection Change Evaluation and Wrap-up Checklist
- Attachment 10 Emergency Response Change Evaluation and Wrap-up Checklist
- Attachment 11 Safety Group Change Evaluation and Wrap-up Checklist
- Attachment 12 General Change Evaluation and Wrap-up Checklist
- Attachment 13 Human Factors Issues/Checklist
- Attachment 14 Previous Incident Reports Checklist
- Attachment 15 Evaluate Potential Off-Site Consequences Worksheet
- Attachment 16 Additional Areas "What-If" Worksheets
- Attachment 17 Revalidation Guideword Checklist
- Attachment 18 Risk Ranking Matrix