

**Alaska Nitrogen Products, LLC
Kenai Plant
Plant 4 Purge and Vent Gas Recovery System
System 77
Process Hazards Analysis Revalidation**

Final Report

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Project No.: K00S48R1

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1.0 ABOUT THIS STUDY

The Process Hazards Analysis, K77S0048 conducted between July 17, 1996 to August 8, 1996 was revalidated at Unocal's (Alaska Nitrogen Products, LLC) Kenai Plant on April 18th, 19th, 2000. The original PHA, as well as the revalidation, focused on the Plant 4 Purge Gas Recovery, System 77.

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 (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 the Plant 4 Purge and Vent Gas Recovery System 77 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 Unocal's (Alaska Nitrogen Products, LLC) representatives on April 18th, 19th, 20th, & 21st, 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 open recommendations from the baseline PHA, see Attachment 4;
2. General discussion regarding incidents occurring in the process since the baseline PHA; see Attachment 8;
3. A review of those documented changes since the baseline PHA, see Attachment 5;
4. The completion of the Change Evaluation Checklist, see Attachment 6;
5. The completion of the Human Factors Issues Checklist, see Attachment 7;
6. A review of the Revalidation Guideword List, see Attachment 8;
7. Consideration of those scenarios with potential off-site consequences, see Attachment 9; and
8. The completion; of the Wrap-up Discussion Checklist, see Attachment 11;
9. A review and discussion of Additional Areas, Reverse Flow, and Check Valves "What-If" Worksheets, see Attachment 12.

"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 Attachment 9.

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 10 shows the criteria for applying risk rankings to various scenarios.

Other Issues

Facility Siting – Unocal's (Alaska Nitrogen Products, LLC) Kenai Plant has recently 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 April 18th, 19th, 2000 at Unocal's (Alaska Nitrogen Products, LLC) in Kenai, Alaska.

The study team consisted of the following people

Name	Title	Years Experience
Bill Switzer	Chemical Engineer	31
Mike N Sibley	Plant 4 Operator	11
Dave C Haring	Mechanical Engineer	21
Rick E Warren	Emergency Preparedness and Response Coordinator	26
Mike L Boulette	Inspection Supervisor	5
Edward J. Aisenbrey	PHA Facilitator/PSM Coordinator	23
Licia Piceno	Project Aide/Scribe	5 ½

Process Description

Activity 17: Purge Recovery System

Objective:	To safely and efficiently operate the Purge Recovery System.
Resources:	Trainer
Ref. Mat'ls:	Standard Operating Procedures (SOPs) Standard Operating Conditions and Limits (SOCLs) Transmitter Location Manual Piping and Instrument Drawings (P&IDs) Control Loop Diagram/Descriptions Control Board Flow Diagram Computer Manuals

1. Locate and discuss instruments and alarms on the panel board. Use P&IDs and loop drawings in the discussion.

Note: Instruments are listed by ascending group number.

4PAH3328	Cold Box CH ₄ Pressure	27-7
4PIC3328	CH ₄ From Cold Box	41-4

Function:

4PAH3328 indicates the status of 4HV1993 trip circuit. 4PIC3328 controls the pressure of the methane exiting the cold box.

Alarms activated by 4PAH3328 and 4PIC3328:

4PAH3328 activates a discrete alarm. 4PIC3328 activates the operator-programmable high low pressure alarm, 4PAHL3328, on the DCS.

Associated alarms:

None

Discussion:

4PIC3328 is used to control the pressure of the methane exiting the cold box. To maintain sufficient flow through 4FV1287A during regeneration of the adsorbers, 4PIC3328 is adjusted to control the differential pressure across the adsorbers as measured between 4PIC3328 and 4PIC3360. Typically, a differential pressure of 20 psig is maintained between 4PIC3328 and 4PIC3360 to keep 4FIC1287, regeneration gas flow, in control. 4PAH3328 will send a signal to

trip 4LV1856 and 4HV1291 closed if the pressure exceeds the setpoint of 135 psig on 4PAH3328.

4FAL1287 Low Flow Adsorber Regeneration 27-8

Function:

Indicates a low flow of regeneration gas to the adsorbers

Alarms activated by 4FAL1287:

4FAL1287 activates a discrete alarm on the DCS.

Associated alarms:

None

Discussion:

If the flow of regeneration gas falls below the setpoint, 650 GPM, on 4FAL1287, the sequence step control is overridden. The regeneration step control timer will not restart until the regeneration gas flow exceeds the low flow setpoint on 4FAL1287.

4FIC1298 Vent Gas to 4D214 28-1

Function:

Controls flow of vent gas to 4D214, vent gas absorption column

Alarms activated by 4FIC1298:

4FIC1298 activates the operator-programmable low flow alarm 4FAL1298 on the DCS

Associated alarms:

None

Discussion:

4FIC1298 controls the flow rate of the combined vent gas feed from Plants 1 and 4 to 4D214. 4FV1298, a three-way valve, is a feed-forward diverting valve that maintains the flow setpoint by controlling flow through a bypass loop around 4D214. As the vent gas flow approaches the setpoint of 4FIC1298, 4FV1298 opens the bypass port, and diverts a portion of the vent gas around 4D214. This gas stream, containing ammonia, combines with the ammonia free gas to the vent gas header. This increased load could cause the bypass to open excessively, sending vent gas containing ammonia to the reformer burners, thereby increasing NO_x emissions from the reformer.

4TI3525	Vent Gas to 4D214	28-2
	<p>Function: Indicates temperature of vent gas to 4D214, vent absorption column</p> <p>Alarms activated by 4TI3525: 4TI3525 activates the operator-programmable high temperature alarm 4TAH3525 on the DCS.</p> <p>Associated alarms: None</p> <p>Discussion: 4TI3525 indicates the temperature of the combined streams of vent gas from both Plants 1 and 4. An increase in temperature generally indicates an increase in ammonia in the vent gas to 4D214. Excessive vent gas temperature to 4D214 can reduce the efficiency of absorption in 4D214. To maximize efficiency, temperature at 4TI3525 is normally operated about -18°F.</p>	
4FIC1283	Lean Solution to 4D214	28-3
	<p>Function: Controls the flow of lean solution to 4D214</p> <p>Alarms activated by 4FIC1283: 4FIC1283 activates the operator-programmable low and high flow alarms 4FALH1283, on the DCS.</p> <p>Associated alarms: None</p> <p>Discussion: Controls the flow rate of lean solution to 4D214, vent gas absorption column. Lean solution is delivered to 4FV1283 from the combined flows from 4FV1285, excess lean solution flow to 4D213, high pressure absorption column, and from the tube side of 4F1202, rich solution preheater. Lean solution flow is normally operated between 5 to 6.8 GPM when at full rates.</p>	
4TI3526	Lean Solution to 4D214	28-4
	<p>Function: Indicates lean solution temperature to 4D214, vent gas absorption column.</p> <p>Alarms activated by 4TI3526: None</p>	

Associated alarms:

None

Discussion:

4TI3526 indicates the temperature of the lean solution to 4D214, vent gas absorption column. Temperature of the lean solution is maintained to efficiently absorb the majority of ammonia from the vent gas. Normally, to maximize efficiency, temperature at 4TI3526 is about 70° to 80°F.

4LIC1851	Vent Gas Absorber	28-5
4LAH1851	4D214 High Level	29-6
4LI1849	Vent Gas Absorber	29-5

Function:

Indicates and controls the level in 4D214, vent gas absorption column.

Alarms activated by 4LIC1851, 4LAH1851 and 4LI1849:

4LIC1851 activates both operator-programmable high and low level alarms 4LAHL1851 on the DCS. 4LAH1851 activates a discrete high level alarm on the DCS. 4LI1849 activates both operator-programmable high and low level alarms 4LAHL1849 on the DCS.

Associated alarms:

None

Discussion:

4LIC1851 controls the level in 4D214 by controlling the flow from 4G287A/B, rich solution pumps, which take suction from the bottoms of 4D214. 4LAH851 will auto-start the standby pump if the hand switch in the field is in the auto mode. 4LI1849 is a duplicate level indication and alarm on 4D214. Do not allow the level in 4D214 to become excessively high, as it will carry water and ammonia over to the reformer burners. To reduce the level in 4D214, a reduction of lean solution flow, 4FIC1283, to 4D214 and starting the standby rich solution pump may be necessary. The level is normally operated to control at about 50%.

4TI3528	Scrubbed Gas Exit 4D214	29-1
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Function:

4TI3528 indicates temperature of gas exiting 4D214, vent gas absorption column.

Alarms activated by 4TI3528:

4TI3528 activates the operator-programmable low temperature alarm 4TAL3528 on the DCS.

Associated alarms:

None

Discussion:

4TI3528 indicates temperature of ammonia free vent gas exiting 4F1213, in-line vane separator, located downstream of 4D214. This gas joins the stream from 4FV1298 bypass to the vent gas header downstream of 4TI3528. To maximize efficiency, temperature at 4TI3528 is normally about 85°F.

4TI3527

Rich Solution Exit 4D214

29-2

Function:

Indicates the temperature of the rich solution exiting 4D214, vent gas absorption column.

Alarms activated by 4TI3527:

None

Associated alarms:

None

Discussion:

4TI3527 indicates the temperature of the rich solution exiting 4D214. An increase in temperature generally indicates an increase in ammonia in the rich solution. Excessive temperature of the rich solution can reduce the efficiency of absorption.

4RL287A

4G287A Rich Solution Pump Run Light

29-3

4RL287B

4G287B Rich Solution Pump Run Light

29-4

Function:

Indicates operating status of the rich solution pumps.

Alarms activated by 4RL287A/B:

The discrete indication/alarm informs the board of the operating status of the pump with on or off indication/alarm.

Associated alarms:

4LAH1851, 4D214 high level

Discussion:

This display will inform the Board Operator of the operating status of these pumps. One is typically on, in the hand mode, while the other is off, in the auto mode. If a high level start is initiated by 4LAH1851, the standby pump will auto start if the hand switch, 4HS2016A/B, in the field is in the auto mode.

4TI3565	#4 Vent Gas Header	29-7
	Function: Indicates temperature of the vent gas to the vent gas header	
	Alarms activated by 4TI3565: None	
	Associated alarms: None	
	Discussion: This instrument takes its signal from the total flow of vent gas exiting both 4D214, vent gas absorption column, and 4FV1298 bypass. This instrument indicates the temperature of the vent gas flow to the reformer burners or to the KAV. To maximize efficiency, temperature at 4TI3565 should operate at about -18°F.	
4LI1847	Lean Solution Tank 4F1204	30-1
	Function: Indicates level in 4F1204, lean solution accumulator	
	Alarms activated by 4LI1847: 4LI1847 activates the operator-programmable high and low level alarms 4LAHL1847 on the DCS.	
	Associated alarms: None	
	Discussion: 4LI1847 indicates the level in 4F1204. Level is controlled by 4LIC1847 on the APACS, which adds vacuum condensate to 4FI204. The level is normally operated at about 50%.	
4LIC1843	4E1204 Reboiler	30-2
	Function: Controls the level in 4E1204, regeneration column reboiler.	
	Alarms activated by 4LIC1843: 4LIC1843 activates the operator-programmable high and low level alarms 4LAHL1843 on the DCS	
	Associated alarms: None	
	Discussion: 4LIC1843 controls the level of lean solution in 4E1204. Lean	

solution exits the bottom of 4E1204 and is sent to 4E1202, rich solution preheater. From 4E1202, flow of lean solution is delivered to 4D214, vent gas absorption column, and to 4F1204, lean solution accumulator. 4LV1843 admits a stream of lean solution from 4E1202 to 4F1204.

4TIC3509	Vapor Exit Reboiler	30-3
4TI3510	Vapor Exit Reboiler	31-2

Function:

Controls and indicates the temperature of vapor exit of 4E1204, regenerating column reboiler.

Alarms activated by 4TIC3509 and 4TI3510:

4TIC3509 and 4TI3510 activate the operator-programmable high and low temperature alarms 4TAHL3509 and 4TAHL3510 on the DCS.

Associated alarms:

None

Discussion:

4TIC3509 controls the temperature of vapor exiting 4E1204 by controlling the 550 psig steam flow. The heated vapor is delivered to 4D215, ammonia regeneration column, where ammonia is removed from the rich solution. Maintaining operating temperature is important since the majority of the ammonia is removed from the rich solution in 4D215. 4TI3510, a duplicate indication, displays temperature of the vapor exiting 4E1204. If the 550 psig steam flow, 4FI1279, to the reboiler begins swinging, put 4TIC3509 in manual until the temperature on 4TI3509 and 4TI3510 stabilizes. To maximize efficiency, temperature at 4TI3509 and 4TI3510 is normally about 390°F.

4FI1279	Steam to Reboiler	30-4
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Function:

Indicates 550 psig steam flow to 4E1204, regeneration column reboiler.

Alarms activated by 4FI1279:

4FI1279 activates the operator-programmable high and low flow alarms 4FAHL1279 on the DCS.

Associated alarms:

None

Discussion:

Indicates flow of 550 psig steam to 4E1204. This flow can be

monitored when 4TV3509 changes to maintain the temperature of the vapor exiting the reboiler.

4TI3507	4D215 Vapor to 4E242	30-5
4TI3508	4D215 Vapor to 4E242	30-6

Function:

Indicates temperature of ammonia vapor to 4E242

Alarms activated by 4TI3507 and 4TI3508:

4TI3507 activates the operator-programmable high and low temperature alarms 4TAHL3507 on the DCS. 4TI3508 activates the operator-programmable high and low temperature alarms 4TAHL3508 on the DCS.

Associated alarms:

None

Discussion:

These duplicate indicators measure the temperature of the ammonia exiting the overheads of 4D215, ammonia regenerating column. The temperature of the ammonia gas is controlled with ammonia reflux flow, 4FIC1278, to minimize water content in the ammonia stream to 4E242A/B, ammonia refrigeration condensers. The normal operating temperature is about 111°F to 118°F, depending on pressure on the system.

4PIC3311	4D215 Vapor to 4E242	30-7
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Function:

Controls pressure in 4D215, high pressure ammonia absorption column

Alarms activated by 4LI3311:

4PIC3311 activates the operator-programmable high and low level alarms 4PAHL3311 on the DCS.

Associated alarms:

None

Discussion:

4PIC3311 controls the overhead pressure in 4D215. The normal operating temperature is about 230°F to 245°.

4FI1280	4D215 Vapor to 4E242	30-8
	Function: Indicates the flow of ammonia gas from 4D215 high pressure ammonia absorption column	
	Alarms activated by 4L1842: None	
	Associated alarms: None	
	Discussion: 4FI1280 indicates the flow of ammonia gas from 4D215, to 4E242A/B, ammonia refrigeration condensers. Design flow is rated at 2300 lb/hr.	
4LI1845	4D215 Ammonia Regenerator	31-1
	Function: Indicates the level in 4D215, ammonia regeneration column.	
	Alarms activated by 4L1845: 4LI1845 activates the operator-programmable high and low level alarms 4LAHL1845 on the DCS.	
	Associated alarms: None	
	Discussion: Typically, 4D215 is operated with an indicated level of 0%. However, the field operator may observe a level in the sight glass.	
4TI3514	Rich Solution to 4D215	31-3
	Function: Indicates the temperature of the rich solution flow to 4D215, ammonia regeneration column	
	Alarms activated by 4L1847: None	
	Associated alarms: None	
	Discussion: 4TI3514 indicates the temperature of the rich solution exiting 4E1202, rich solution preheater, prior to entering 4D215.	

4RL286A	4G286A Reflux Pump Run Light	31-4
4RL286B	4G286B Reflux Pump Run Light	31-5

Function:

Indicates operating status of the ammonia reflux pumps.

Alarms activated by 4RL286A/B:

The discrete indication/alarm informs the board of the operating status of the pump with on or off indication/alarm.

Associated alarms:

4PSL3412, low pressure ammonia reflux

Discussion:

This display will inform the Board Operator of the operating status of these pumps. One is typically on, in the hand mode, while the other is off, in the auto mode. If a low pressure start is initiated by 4PSL3412, the standby pump will auto-start if the hand switch, 4HS910A/B, in the field is in the auto mode.

4PI3412	4G286 Ammonia Reflux	31-6
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Function:

Indicates the pressure of the ammonia reflux pumps, 4G286A/B

Alarms activated by 4PI3412:

4PI3412 activates the operator-programmable low pressure alarm 4PAL3412 on the DCS.

Associated alarms:

4RL286A/B, discrete alarms, ammonia reflux pump auto start
4PSL3412, reflux ammonia low pressure alarm

Discussion:

The pressure indication is used to monitor the discharge pressure of the reflux pumps. The Board Operator needs to maintain reflux flow to 4D215, ammonia regeneration column, to entrain any water and cool the ammonia in the overheads product. If the alarm, 4PAL3412, is activated, the Board Operator should verify the standby pump has auto started.

4FIC1278	Reflux Ammonia to 4D215	31-7
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Function:

Controls the flow of ammonia reflux to 4D215, ammonia regeneration column

Alarms activated by 4FIC1278:

4FIC1278 activates the operator-programmable low flow alarm 4FAL1278 on the DCS.

Associated alarms:

None

Discussion:

The flow of ammonia reflux is maintained to entrain water in the overheads product of 4D215. A low flow of reflux will allow an increase water in the overheads product which will eventually end up in the ammonia storage tanks. Adjust 4FIC1278 to keep the overheads temperature of 4D215 on specification. Design operating temperature on 4TI3507 and 4TI3508 is 111°F to 114°F.

4TI3512	Lean Solution Exit 4D215	31-1
4TI3513	Lean Solution Exit 4D215	32-2

Function:

Indicates the temperature of the lean solution exiting 4D215, ammonia

Alarms activated by 4TI3512 and 4TI3513:

4TI3512 and 4TI3513 activates the operator-programmable low alarm 4TAL3512 and 4TAL3513 on the DCS.

Associated alarms:

None

Discussion:

These duplicate indicators measure the temperature of the lean solution exiting the bottoms of 4D215. Temperature of the lean solution is maintained to liberate ammonia from the rich solution in 4D215. Normal operating temperature should be about 377°F.

4TI3516	Rich Solution to 4E1201	32-3
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Function:

Indicates the temperature of the of rich solution to 4E1202, rich solution preheater.

Alarms activated by 4TI3516:

None

Associated alarms:

None

Discussion:

This indicates the temperature of the combined streams of rich

solution from both 4D214, vent gas absorption column, and from 4D213, high pressure absorption column, prior to entering 4E1202.

4TI3515 Lean Solution Exit 4E1202 32-4

Function:

Indicates the temperature of lean solution exiting 4E1202, rich solution

Alarms activated by 4TI3515:

4TI3515 activates the operator-programmable high and low temperature alarms 4TAHL3515 on the DCS.

Associated alarms:

None

Discussion:

This indicates the temperature of lean solution exiting 4E1202. Immediately downstream of 4TI3515, the lean solution can be directed to 4D214, vent gas absorption column, and to 4F1204, lean solution accumulator. The normal operating temperature is about 90°F to 97°F.

4RL285A 4G285A Lean Solution Pump Run Light 32-5
4RL285B 4G285B Lean Solution Pump Run Light 32-6

Function:

Indicates operating status of the lean solution pumps.

Alarms activated by 4RL286A/B:

The discrete indication/alarm informs the board of the operating status of the pump with on or off indication/alarm.

Associated alarms:

4FAHL1285 lean solution to 4D213 high low flow alarm
4FALL1285 lean solution to 4D213 low low flow alarm/trip circuit
4FSL1285, lean solution to 4D213 low flow alarm

Discussion:

This display will inform the Board Operator of the operating status of these pumps. One is typically on, in the hand mode, while the other is off, in the auto mode. If a low pressure start is initiated by 4FSL1285, the standby pump will auto start if the hand switch, 4HS2015A/B, in the field is in the auto mode.

4FIC1285	Lean Solution to 4D213	34-1
4FAL1285	Lean Solution Low Flow	27-1
4FAB1285	4FSL1285 Bypass	27-6

Function:

4FIC1285 controls flow of lean solution to 4D213, high pressure ammonia absorption column. 4FAL1285 indicates status of 4HV1993 trip circuit. 4FAB1285 bypasses 4FAL1285 trip.

Alarms activated by 4FIC1285, 4FAL1285 and 4FAB1285:

4FIC1285 activates the operator-programmable high and low flow alarms 4FAHL1285 and activates the discrete alarm 4FALL1285 on the DCS. 4FAB1285 activates the discrete alarm, 4FAB1285, if put in the bypass mode, on the DCS.

Associated alarms:

4FSL1285 activates the discrete alarms for 4RL287A or 4RL287B.

Discussion:

Flow of lean solution to 4D213 is controlled with 4FIC1285. This is accomplished using 4FV1285, which regulates the flow of lean solution bypassing 4D213. Any flow bypassing 4D213 joins the lean solution stream to 4D214, vent gas absorption column. The lean solution absorbs ammonia from the purge gas in 4D213. If the lean solution flow drops below the setpoint of 4PSL1285, 2 GPM, a signal is sent to auto start the standby lean solution pump, 4G285A/B. If the lean solution flow continues to drop below the setpoint of 4FALL1285, 1 GPM, a signal is sent to 4HV1993 trip circuit, tripping 4HV1993 closed. If 4FAL1285 is activated, the discrete alarm signals and the display on the DCS indicates the status of 4HV1993 trip circuits. During startup, 4FAB1285 is operated in the bypass mode to prevent tripping 4HV1993 while establishing purge gas flow through the purge recovery unit. 4FAB1285 should always remain in the normal mode except during startup. If 4FAB1285 is switched “off,” the low flow trip will be bypassed. 4FIC1285 is normally operated at about 5 GPM but can be adjusted to control the ppm ammonia exit 4D213 gas stream. The primary control parameter is to maintain the ammonia concentration on 4AI1973 less than 200 ppm.

4LIC1854	High Pressure Ammonia Absorption Column 4D213 Bottom	34-2
4LI1852	High Pressure Ammonia Absorption Column 4D213 Bottom	35-8

Function:

Controls and indicates the level in 4D213, high pressure ammonia absorption column

Alarms activated by 4LIC1854 and 4LI1852:

4LIC1854 and 4LI1852 activate the operator-programmable high and low level alarms 4LAHL1854 and 4LAHL1852 on the DCS.

Associated alarms:

None

Discussion:

4LIC1854 controls the level of rich solution in 4D213. The flow of rich solution exits 4D213 and joins the rich solution exiting 4D214, vent gas absorption column. 4LI1852 provides a secondary level indication in 4D213 which operates at about 1900 psig. The level is normally operated at about 50%.

4TIC3531	Feed Gas Interstage	34-3
4TIC3430	Lean Solution to 4D213	34-4

Function:

Controls the temperature of lean solution to 4D213, high pressure ammonia absorption column, but will also control the temperature of the purge gas between the second and third exchanger of 4E1201, feed gas preheater.

Alarms activated by 4TIC3531 and 4TIC3430:

4TIC3531 and 4TIC3430 activate the operator-programmable low temperature alarms 4TAL3531 and 4TAL3540 on the DCS. 4TIC3531 and 4TIC3430 also activate the discrete alarms/indications on the status of the override control condition.

Associated alarms:

None

Discussion:

Normally, 4TIC3540 controls the temperature of the lean solution to 4D213 by bypassing part of the lean solution flow around 4E1201 with 4TV3540. Lean solution of 2% ammonia freezes at 27.5°F. Freezing is most likely to occur first on the tube walls at the exit from 4E1201. For this reason, the purge gas temperature between the co-current and counter-current sections of 4E1201 is controlled using

discrete alarm signals and the display on the DCS indicate the status of 4HV1993 trip circuits.

4PIC3327	4D213 to CH₄ Header	34-7
4PAH3327	1200 Psig Trip	27-3

Function:

4PIC3327 vents excess purge gas to the fuel gas header. 4PAH3327 indicates status of the 1200 psig trip.

Alarms activated by 4PIC3325 and 4PAH3325:

4PIC3327 activates the operator-programmable high and low pressure alarms 4PAHL3327 and 4PAH3327 on the DCS. 4PAH3327 activates the discrete alarm/indication on the DCS.

Associated alarms:

None

Discussion:

If excessive pressure is encountered on the purge gas entering the adsorbers, 4F1205A/B, 4PIC3327 opens 4PV3327, venting excess pressure to the fuel gas header. This vent is designed to only pass 30% of the design of purge gas flow. If the pressure exceeds the setpoint of 4PSH3327, 1200 psig, a signal is sent to 4HV1993 trip circuit, tripping 4HV1993 closed. If 4PAH3327 is activated, the discrete alarm signals and the display on the DCS indicates the status of 4HV1993 trip circuits.

4PIC3360	Recovered CH₄ to Vent	34-8
4PIC3360	Recovered CH₄ to Vent	41-5
4PIC3360	Recovered CH₄ to Vent	48-8

Function:

Vents excess recovered CH₄ to the KAV

Alarms activated by 4PIC3360:

4PIC3360 activates the operator-programmable high and low pressure alarms 4PAHL3360 on the DCS.

Associated alarms:

None

Discussion:

4PIC3360 vents excess recovered methane to the KAV. This valve should remain closed during normal operation conditions.

4HC1993	4HV1993 Reset	27-5
	Function: Opens 4HV1993 when trips are satisfied.	
	Alarms activated by 4HC1993: 4HC1993 activates the discrete alarms 4HC1993 OPEN/CLOSED on the DCS.	
	Associated alarms: None	
	Discussion: 4HC1993 controls the position of 4HV1993, purge gas flow to the PRU, Purge Recovery Unit. If any of the trips to 4HV1993 are activated, 4HV1993 will remain closed until all of the trips are cleared.	
4FIC1292	#1 Purge Gas to PRU	35-1
	Function: Controls flow of purge gas from Plant 1 to the PRU.	
	Alarms activated by 4FIC1292: 4FIC1292 activates the operator-programmable high and low flow alarms, 4FAHL1292, on the DCS.	
	Associated alarms: None	
	Discussion: The flow of purge gas is changed to control the "inerts" in Plant 1's SynLoop gas stream. Typically, the control of 4FIC1292 is under the direction of the Plant 1 Board Operator. The flow rate on 4FIC1292 will affect the pressure on our SynLoop. If it is necessary to change the flow, notify the Plant 1 Board Operator. This instrument is normally operated in the manual mode.	
4FIC1293	#4 Purge to PRU	35-2
	Function: Controls flow of purge gas from Plant 4 to the PRU	
	Alarms activated by 4FIC1293: 4FIC1293 activates the operator-programmable high and low flow alarms, 4FAHL1293, on the DCS.	
	Associated alarms: None	

Discussion:

The flow of purge gas is changed to control the "inerts" in Plant 4's SynLoop gas stream. The flow rate on 4FIC1293 will affect the pressure on the SynLoop. This instrument is normally operated in the manual mode. In the auto mode, 4FIC1293 takes an external setpoint from 4PICV1427, SynLoop pressure controller, to maintain pressure in the SynLoop.

4TI3539

Feed Gas Exit 4D213

35-5

Function:

Indicates the temperature of the feed gas exiting 4D213, high pressure ammonia absorber

Alarms activated by 4TI3539:

None

Associated alarms:

None

Discussion:

4TI3539 indicates the temperature of the relatively ammonia-free feed gas entering the adsorbers, 4F1205A/B. Typically, the temperature should be about 40°F, but should be operated less than 45°F.

4AI1973

Feed Gas Exit 4D213

35-6

Function:

4AI1973 analyzes the ammonia content of the feed gas exiting 4D213, high pressure ammonia absorber.

Alarms activated by 4AI1973

4AI1973 activates the operator-programmable high range alarm, 4AIH1973, on the DCS.

Associated alarms:

None

Discussion:

4AI1973 indicates the ammonia PPM exiting the 4D213 gas stream. If the ammonia concentration exceeds design of the overhead gas stream, lean solution flow to 4D213 needs to be increased. An excess in ammonia entering the downstream adsorbers 4F1205A/B will overload the adsorbers, and subsequently the cold box will prematurely fail. Maximum design is set at about 250 PPM. During normal operating conditions, 4AI1973 should be below 200 ppm ammonia content.

4LSH1855 4D213 High Pressure Ammonia Absorber Overhead 35-7

Function:

Indicates a level of liquid in the chimney section of 4D213, high pressure ammonia absorber

Alarms activated by 4LSH1855

4LSH1855 activates a discrete alarm, 4LAH1855, on the DCS.

Associated alarms:

None

Discussion:

4LSH1855 indicates a level of liquid in the chimney section of 4D213. Potential exists for damage to the adsorbent in 4F1205A/B. To prevent damage to the adsorbers, lean solution flow should be reduced and the level in 4D213 should be reduced. It may be necessary to open the bypass on 4LV1854, 4D213 bottoms level controller.

4TI3530 Purge Gas to 4E1203 36-2

Function:

Indicates the temperature of the purge gas to 4E1203, hydrogen product chiller

Alarms activated by 4TI3530:

None

Associated alarms:

None

Discussion:

4TI3530 indicates the temperature of the combined purge gas streams from Plants 1 and 4 to 4E1203.

4TIC3535 Feed Gas Exiting 4E1203 36-2

Function:

Controls the temperature of the feed gas exiting 4E1203, hydrogen product chiller

Alarms activated by 4TIC3535:

None

Associated alarms:

None

Discussion:

4TIC3535 controls the temperature of the feed gas exiting 4E1203 by controlling the flow of feed gas bypassing 4E203. Opening 4TV3535 will increase the outlet temperature of the feed gas. Design operating temperature is 4°F.

4TI3534

Purge Gas Exiting 4E1201

36-3

Function:

Indicates the temperature of the purge gas exiting 4E1201, feed gas preheater.

Alarms activated by 4TI3534:

None

Associated alarms:

None

Discussion:

4TI3534 indicates the temperature of the purge gas exiting 4E1201. Design operating temperature is 30°F.

4TI3533

Purge Gas to 4D213

36-4

Function:

Indicates the temperature of the purge gas to 4D213, high pressure ammonia absorption column

Alarms activated by 4TI3533:

None

Associated alarms:

None

Discussion:

4TI3533 indicates the temperature of the purge gas entering 4D213. Design operating temperature is 11°F.

4TI3517

Lean Solution to 4E1201

36-5

Function:

Indicates the temperature of the lean solution entering 4E1201, feed gas preheater

Alarms activated by 4TI3517:

None

Associated alarms:

None

Associated alarms:

None

Discussion:

4TI3564 indicates the temperature of the purge gas from Plant 1. To change the temperature of the purge gas contact Plant 1 Board Operator.

4TI3563

#4 Purge to PRU

37-3

Function:

Indicates the temperature of the purge gas from Plant 4 SynLoop purge separator.

Alarms activated by 4TI3563:

None

Associated alarms:

4TAH1661 indicates a high temperature on the purge gas exiting 4E241, SynLoop purge condenser.

Discussion:

4TI3563 indicates the outlet temperature of 4F235, purge gas separator. Temperature control of the Plant 4 purge gas stream is accomplished with 4TIC1661, temperature controller on 4E241.

4FIC1287

Regeneration Gas to Adsorber

38-1

4FM1287

Regeneration Gas to Adsorber

38-2

Function:

4FIC1287 controls the flow of regeneration gas, and 4FM1287 is the regeneration gas minimum flow alarm/switch.

Alarms activated by 4FIC1287 and 4FM1287:

4FIC1287 activates the operator-programmable high and low flow alarms, 4FAHL1287, on the DCS. 4FM1287 activates a discrete alarm, 4FSL1287, on the DCS.

Associated alarms:

Discrete alarms, 4FAL1287, indicate a low flow of regeneration gas to the adsorber.

Discussion:

4FIC1287 is used to control the flow of regeneration gas to the adsorbers, 4F1205A/B. 4FIC1287 is also used to control the flow of regeneration gas during startup and thaw-out operating conditions. If the flow of regeneration gas drops below the setpoint of 4FM1287, 650 scfm, the sequencer will be put on override and the sequence timers will stop. All valves will remain in the hold position until the

minimum flow requirement is satisfied.

At high regeneration gas flow rates and low fuel gas pressures, the molecular sieve bed undergoing the regeneration may fluidize. This condition must be avoided. If 4FAH1287 is activated, the potential for fluidization exists. Increasing the regeneration heating time and reduced flow rates may be required to complete the regeneration. Design regeneration flows are 950 scfm with recovered methane and 650 scfm with feed gas regeneration. Low flow alarm-programmed setpoints are 650 scfm on normal regeneration and 470 scfm on feed gas regeneration.

4TI3548 Steam to 4E1205 38-3

Function:

Indicates temperature of steam to 4E1205, regeneration gas heater

Alarms activated by 4TI3548:

None

Associated alarms:

None

Discussion:

4TI3548 indicates temperature of 550 psig steam to 4E1205.

4TI3547 Regeneration Gas Exiting 4E1205 38-4

Function:

Indicates the temperature of the regeneration gas exiting 4E1205, regeneration gas heater

Alarms activated by 4TI3547:

4TI3547 activates the operator-programmable high low temperature alarm, 4TAHL3547, on the DCS. 4TI3547 also activates a discrete alarm, 4TAL3547, low temperature alarm, on the DCS.

Associated alarms:

None

Discussion:

4TI3547 indicates the temperature of the regeneration gas exiting 4E1205. This instrument will put the sequencer in override and the regeneration sequence step timer on hold if the temperature of the regeneration gas is not above the setpoint, 440°F, within 14 minutes after the start of the main heating period. The regeneration sequence step timer will not continue until the minimum temperature setpoint is

satisfied. 4TAL3547 trip point is adjusted with loop 4TSH3546, adjusting the SPLL to the desired temperature.

4TI3546	Regeneration Gas Exiting 4F1205A/B	38-5
4TM3546	Regeneration Gas Exiting 4F1205A/B	38-6

Function:

4TI3546 indicates the temperature of regeneration gas exiting 4F1205A/B adsorbers. 4TM3546 is a regeneration gas temperature alarm switch.

Alarms activated by 4TI3546 and 4TM3546:

4TI3546 activates the operator-programmable high low temperature alarms, 4TAHL3546, on the DCS. 4TI3546 also activates a discrete alarm, 4TM3546, high low temperature alarm, on the DCS. 4TM3546 activates an operator-programmable discrete alarm, 4TSL3546, regeneration gas low temperature, on the DCS.

Associated alarms:

None

Discussion:

4TI3546 indicates the temperature of regeneration gas exiting the adsorbers. This instrument measures the temperature during both the heating and cool down steps during adsorber regeneration.

4TM3546 is the minimum temperature setpoint the regeneration gas must attain after the main heating step. At the end of the main heating step, the temperature measured by 4TI3546 must be above the programmed setpoint on 4TM3546—325°F. If the setpoint temperature is not achieved, the sequencer is put into override, which stops the sequence timers and freezes the output. The sequencer will remain in the override condition until the setpoint of 4TM3546 is satisfied.

At the end of the main cooling step, the temperature measured by 4TI3546 must be above the programmed setpoint on 4TSH3546, SPHL of 70°F. If the setpoint temperature is not achieved, the sequencer is put into override, which stops the sequence timers and freezes the output. The sequencer will remain in the override condition until the setpoint of 4TSH3546 is satisfied.

4PI3332	Feed Gas Exiting 4F1205A	38-7
4PI3332	Feed Gas Exiting 4F1205A	39-7

Function:

Indicates the pressure in 4F1205A adsorber

Alarms activated by 4PI3332:

4PI3332 activates the operator-programmable high and low pressure alarm, 4PAHL3332 and 4PSHH3332, a discrete trip alarm on the DCS.

Associated alarms:

None

Discussion:

This instrument indicates the pressure of the adsorber. This instrument can be monitored during the absorber switching to verify if the adsorbers are in the pressurization or depressurization steps. At the end of the equalization steps, the pressure differential across the adsorber is checked. If the differential measured between 4PI3332 and 4PI3333 is greater than 15 ΔP, 4PAL3332 will alarm and the step sequencer will stop. At the end of the depressurization of 4F1205A adsorber, the pressure differential is checked. If the differential measured between 4PI3332 and 4PI3360 is greater than 15 ΔP, 4PAL3332 will alarm and the step sequencer will stop. Excess pressure differential could damage the adsorber internals. The setpoint of 4PAH3332 can be adjusted by setting loop 4PSH3332, SPHL, to the desired differential pressure.

4PI3333	Feed Gas Exiting 4F1205B	38-8
4PI3333	Feed Gas Exiting 4F1205B	39-8

Function:

Indicates the pressure in 4F1205B adsorber

Alarms activated by 4PI3333:

4PI3333 activates the operator-programmable high pressure alarm, 4PAH3333, on the DCS.

Associated alarms:

None

Discussion:

This instrument indicates the pressure of the adsorber. This instrument can be monitored during the absorber switching to verify if the adsorbers are in the pressurization or depressurization steps. At the end of the equalization steps, the pressure differential across the

converter is checked. If the differential measured between 4PI3332 and 4PI3333 is greater than 15 ΔP, 4PAL3333 will alarm and the step sequencer will stop. At the end of the depressurization of 4F1205B absorber, the pressure differential is checked. If the differential measured between 4PI3333 and 4PI3360 is greater than 15 ΔP, 4PAL3333 will alarm and the step sequencer will stop. Excess pressure differential could damage the adsorber internals. The setpoint of 4PAH3333 can be adjusted by setting loop 4PSH3333, SPHL, to the desired differential pressure.

ZAO VAL	ZAO Valve Number	39-1 & 46-1
F1205 OP	Confirm Valve Open	39-2 & 46-2
ADSORBER	Valve Status	39-3 & 46-3
F1205 CL	Confirm Valve Open	39-4 & 46-4
ZAO VAL	ZAO Valve Number	39-5 & 46-5

Function:

Indicates status of valves on the adsorbers

Alarms activated by these instruments:

None

Associated alarms:

None

Discussion:

Indicates if the valves on the adsorber are open or closed

ADS STEP	Adsorber Sequence Step	39-6, 46-3, & 47-6
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Function:

Indicates the sequence step

Alarms activated by ADS STEP:

None

Associated alarms:

None

Discussion:

Indicates the sequence step.

ADHT AR	Time Remaining Heat A	40-1
ADCL AR	Time Remaining Cool A	40-2
ADHT BR	Time Remaining Heat B	40-3
ADCL BR	Time Remaining Cool B	40-4

Function:

Indicates the time remaining for the heating or cooling steps

Alarms activated by these instruments:

None

Associated alarms:

None

Discussion:

Indicates the time remaining for the heating or cooling steps

SEQ STOP	Sequence Stop	40-5
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Function:

Indicates the status of the sequencer

Alarms activated by SEQ STOP:

SEQ STOP activates a discrete alarm on the DCS.

Associated alarms:

None

Discussion:

SEQ STOP indicates the status of the sequence timer. If the timer is put into override from an operational error or condition, SEQ STOP will indicate an “OFF” status. If the sequencer is overridden, the operator should locate and correct the problem.

4PIC3350	Cold Box Separator	41-1
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Function:

Controls the pressure of 4F1208, feed gas separator

Alarms activated by 4PIC3350:

None

Associated alarms:

None

Discussion:

4PIC3350 controls the pressure of the recovered hydrogen exiting the feed gas separator. Design pressure is 980 psig.

4LIC1856 Cold Box Separator 41-2

Function:

Controls the liquid level in 4F1208, feed gas separator.

Alarms activated by 4LIC1856:

4LIC1956 activates the operator-programmable high low level alarms, 4LAHL1856, on the DCS.

Associated alarms:

None

Discussion:

4LIC1856 controls the liquid level in 4F1208. This level is normally controlled at about 50%.

4HIC1291 4F1208 Hydrogen to 4F1209 41-3

Function:

Controls the hydrogen injection valve.

Alarms activated by 4HIC1291:

4HIC1291 activates a discrete alarm on the DCS, indicating the valve has been opened.

Associated alarms:

None

Discussion:

4HIC1291 controls the hydrogen injection valve, 4HV1291. If the fuel gas pressure is relatively high or the purge gas is particularly rich in hydrogen (less condensable), the temperature drop across 4LV1856 may be insufficient for the cold box exchangers to work efficiently. The temperature drop may be increased by injecting some hydrogen product into the low pressure liquid (methane) with 4HV1291.

The hydrogen injection valve, 4HV1291, has a secondary purpose, to control the buildup of helium in the synthesis loop. Helium is not removed by condensation, as are other impurities of argon and methane. These gasses are returned along with the recovered hydrogen to the ammonia synthesis loop. These superfluous gasses can cause pressure increases in the synthesis loop, thereby reducing the efficiency of the synthesis loop. Using 4HV1291 will remove the errant gasses by diverting some of the recovered hydrogen to the recovered methane gas stream. Typically, this valve remains closed.

4FIC1294	Recovered Methane to Mains	41-6
4HA1294	4FIC1294 Reformer Trip	41-7

Function:

Controls flow of recovered methane to the main burners.

Alarms activated by 4FIC1294:

4FIC1294 activates the operator-programmable high low flow alarms, 4FAHL1294, on the DCS. 4HA1294 activates a discrete alarm, 4FAH1294, on the DCS.

Associated alarms:

None

Discussion:

4FIC1294 controls flow of recovered methane to the reformer main burners. This flow is pressure and temperature compensated with 4PT3360 and 4TT3566, respectively. This controller should be operated in the manual mode and should be operated to keep 4PIC3360 in control. 4FV1294 can be tripped closed from the board with 4HS1294. 4HA1294 indicates the trip status of 4FV1294.

4PIC3414	Recovered Hydrogen to Vent	41-8
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Function:

Controls the excess recovered hydrogen pressure.

Alarms activated by 4PIC3414:

4PIC3414 activates a discrete alarm, 4PAH3414, pressure alarm high, on the DCS.

Associated alarms:

None

Discussion:

4PIC3414 controls the pressure of the recovered hydrogen by diverting excess to the KAV. 4PIC3414 should normally be operated about 20 psig above the intermediate case suction pressure to keep 4PV3414 closed.

4TI3545	Methane to Mains	42-2
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Function:

Indicates the temperature of the recovered methane destined for the main burners

Alarms activated by 4TI3545:

None

Associated alarms:

None

Discussion:

4TI3545 indicates the temperature of the recovered methane destined for the main burners.

4TI3566 Recovered Methane to Mains 42-3

Function:

Indicates the temperature of recovered methane to the main burners

Alarms activated by 4TI3566:

None

Associated alarms:

None

Discussion:

4TI3566 indicates the temperature of the recovered methane destined for the main burners. 4TI3566 is also used to compensate the temperature for 4FIC1294, recovered methane to the main burners.

4FI1295 Recovered Methane Ahead of Vent 42-4

Function:

Indicates the flow of recovered methane ahead of 4PIC3360, recovered methane to vent

Alarms activated by 4FI1295:

None

Associated alarms:

None

Discussion:

4FI1295 indicates the flow of recovered methane ahead of 4PIC3360, recovered methane to vent. If 4PV3360 is opened, recovered methane will be vented to the KAV. To calculate the flow rate of the vented methane, compare the difference between 4FI1295 and 4FIC1294.

4FIC1296 Hydrogen to #4 Syngas 42-5

Function:

Controls the flow of recovered hydrogen to the SynGas compressor

Alarms activated by 4FIC1296:

4FIC1296 activates the operator-programmable low flow alarm, 4FAL1296, on the DCS.

Associated alarms:

4FAS1296, SynGas trip, activates a discrete alarm on the DCS.

Discussion:

4FIC1296 controls the flow of recovered hydrogen to the SynGas compressor. If the SynGas compressor trips, 4FAS1296 is designed to trip 4FV1296 closed.

4FIC1297 Hydrogen to Methanator Intertie 42-6

Function:

Controls the flow of recovered hydrogen to the methanator intertie

Alarms activated by 4FIC1297:

None

Associated alarms:

None

Discussion:

4FIC1297 controls the flow of recovered hydrogen to the methanator intertie.

4PIC3411 Hydrogen to Methanator Intertie 42-7

Function:

Controls the pressure of recovered hydrogen to the methanator intertie.

Alarms activated by 4PIC3411:

None

Associated alarms:

None

Discussion:

4PIC3411 controls the pressure of recovered hydrogen to the methanator intertie.

4FI1284 Hydrogen Product to 4E1203 42-8

Function:

Indicates the temperature of the recovered hydrogen to 4E1203, hydrogen product chiller

Alarms activated by 4FI1284:

None

Associated alarms:

None

Discussion:

4FI1284 indicates the temperature of the recovered hydrogen to 4E1203, hydrogen product chiller.

4TI3555	Feed to Cold Box	43-1
4THH355	Cold Box Inlet	27-4

Function:

4TI3555 indicates the temperature of the feed gas to the cold box.
4THH3555 indicates status of the cold box inlet temperature trip.

Alarms activated by 4THH3555 and 4TI3555:

4TI3555 activates the operator-programmable high temperature alarms, 4TAH3555 and 4THH3555. 4THH3555 activates a discrete alarm, 4TAHH3555, on the DCS.

Associated alarms:

4TAHH3555 will trip 4HV1993 closed as indicated by 4HC1993.
4TAHH3555 will trip 4FV1287 closed as indicated by 4FAL1287.

Discussion:

4TI3555 indicates the temperature of the feed gas entering the cold box. 4TI3555 also controls a trip of purge gas 4HC1993, closing 4HV1993. If the temperature exceeds the setpoint of 4THH3555, set at 140°F, a signal is sent to 4HV1993 trip circuit, tripping 4HV1993 closed. 4TAHH3555 will trip 4FV1287 closed if the temperature of 4TAHH3555, SPHL, is reached during thaw operations of the cold box. The programmed design setpoint of 4TAHH3555, SPHL, is 120°F.

4TI3558	Feed to 4E1206B	43-2
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Function:

Indicates the temperature of the feed gas entering 4F1206B, cold box exchanger

Alarms activated by 4TI3558:

None

Associated alarms:

None

Discussion:

4TI3558 indicates the temperature of the feed gas entering 4F1206B, cold box exchanger.

4TI3560

Feed Gas to 4F1208

43-3

Function:

Indicates the temperature of the feed gas to 4F1208, feed gas separator

Alarms activated by 4TI3560:

4TI3560 activates the operator-programmable high and low temperature alarms, 4TAHL3560, on the DCS.

Associated alarms:

None

Discussion:

4TI3560 indicates the temperature of the feed gas to 4F1208, feed gas separator. The temperature of 4F1208 is controlled to efficiently control the recovery of nitrogen and hydrogen. At low flow rates, a lower temperature of the feed gas is maintained to keep a level in 4F1208. As the temperature of the cold box decreases, the nitrogen recovery decreases and the hydrogen recovery increases. Inversely, as the temperature of the cold box increases, the nitrogen recovery increases and the hydrogen recovery decreases. To increase temperature on 4TI3560, increase the feed gas back pressure on 4PIC3328.

Care should be taken when operating the cold box near or above -260°F. Control of the cold box can become unstable and increased pressure on the SynLoop will be experienced. With the warmer temperatures, some of the methane normally condensed in 4F1208 will not condense. This non-condensed methane will exit the feed gas separator with the recovered hydrogen to the SynLoop. This effect will be noticed as possibly rapidly increasing temperatures on the cold box as well as increased pressure on the SynLoop.

4TI3559

CH₄ Exiting 4F1208

43-4

Function:

Indicates the temperature of the methane exiting 4F1208, feed gas separator

Alarms activated by 4TI3559:

None

Associated alarms:

None

Discussion:

4TI3559 indicates the temperature of the methane exiting 4F1208, feed gas separator. Do not operate below -313°F.

4TI3556

CH₄ Exiting Cold Box

43-5

Function:

Indicates the temperature of the methane exiting the cold box

Alarms activated by 4TI3556:

4TI3556 activates the operator-programmable low temperature alarm, 4TAL3556, on the DCS.

Associated alarms:

None

Discussion:

4TI3556 indicates the temperature of the methane exiting the cold box.

4TI3561

Hydrogen Product Exiting 4F1208

43-6

Function:

Indicates the temperature of the recovered hydrogen exiting 4F1208, feed gas separator

Alarms activated by 4TI3561:

None

Associated alarms:

None

Discussion:

4TI3561 indicates the temperature of the recovered hydrogen exiting 4F1208, feed gas separator. Do not operate below -313°F.

4TI3549

Hydrogen Exiting the Cold Box

Function:

Indicates the temperature of the hydrogen exiting the cold box

Alarms activated by 4TI3549:

None

Associated alarms:

None

Discussion:

4TI3549 indicates the temperature of the hydrogen exiting the cold box.

4TI3529 Hydrogen Exiting 4E1203 43-8

Function:

Indicates the temperature of the hydrogen exiting 4E1203, hydrogen product chiller

Alarms activated by 4TI3559:

None

Associated alarms:

None

Discussion:

4TI3529 indicates the temperature of the hydrogen exiting 4E1203, hydrogen product chiller.

4PDI3337 Feed Gas Filter 44-1

Function:

Indicates the differential pressure on 4F1207, feed gas filter

Alarms activated by 4PDI3337:

4PDAH3337 activates a discrete alarm, high differential pressure feed gas filter, on the DCS.

Associated alarms:

None

Discussion:

4PDI3337 indicates the differential pressure on 4F1207, feed gas filter. If the differential pressure increases excessively on the feed gas filter, molecular sieve dust may possibly enter the cold box. If the high alarm 4PDAH3337 is activated, filter element failure is imminent. The limits for the differential pressure on the feed gas filter for a 10 micron filter are: high warning at 50"ΔP, high alarm and filter element failure at 100"ΔP, and maximum operating pressure high warning at 400"ΔP.

4PI3351 Cold Box Nitrogen Purge 44-2

Function:

Indicates the pressure of the cold box enclosure

Alarms activated by 4TI3551:

4TI3351 activates the operator-programmable high and low alarms, 4PAHL3351, on the DCS.

Associated alarms:

None

Discussion:

4PI3351 indicates the pressure of the cold box enclosure. If the pressure were to decrease excessively, atmospheric air could enter the cold box enclosure. A flammable mixture could exist if any feed gas leaks in the cold box exist. If the nitrogen purge cannot be re-established within a reasonable amount of time, the cold box should be shut down. A high pressure could indicate a feed gas leak inside the cold box enclosure. Maintain nitrogen pressure between 3 and 5 inches of water.

4AI1974F1 Cold Box Inlet 44-3

Function:

Indicates the hydrogen content of the feed gas stream to the cold box

Alarms activated by 4AI1974F1:

None

Associated alarms:

None

Discussion:

4AI1974F1 indicates the hydrogen content of the feed gas stream to the cold box. 4AI1974 displays the other gas components in the feed gas stream.

4TI3558 Hydrogen Exiting 4E1206B 44-4

Function:

Indicates the temperature of the hydrogen exiting 4E1206B, cold box exchanger

Alarms activated by 4TI3558:

None

Associated alarms:

None

Discussion:

4TI3558 indicates the temperature of the hydrogen exiting 4E1206B, cold box exchanger.

- 2. For each of the instruments below, explain the effects to the plant when a large change in the monitored process variable occurs (the number in parentheses indicates the minimum number of effects).**
 - 4FIC1993 (3)
 - 4LIC1854 (3)
 - 4LIC1857 (3)
 - 4FIC1298 (2)
 - 4PIC3328 (3)
 - 4TAHL3560 (3)
- 3. For each of the instruments in item 2, list the other instruments that will confirm the process variable change.**
- 4. Using SOCLs discuss the consequences and corrective actions for exceeding the lower and upper limits of the normal operating range for instruments listed in item 2.**
- 5. Read and discuss SOPs for this system (startup, normal operation, shutdown, and emergency shutdown).**
- 6. Draw a sketch, including transmitter(s), controller(s), valve(s), and alarm(s), of the control loop(s) listed below. (Research should be done in field and control room.)**
 - 4TIC3540
 - 4FIC1287
 - 4PIC3328
 - 4FIC1285
 - 4FIC1293
- 7. Observe/assist the Trainer, using SOPs to perform or simulate the following. Repeat until proficient.**
 - Swap lean solution pumps.
 - Change cold box temperature 5°F and return.
 - Simulate removing feeds from the cold box.
 - Explain the consequences and simulate the correction for a high PPM ammonia exit the high pressure absorber.
 - Explain the consequences and simulate the correction for a high regeneration gas flow through the adsorbers.
 - Simulate the startup of the water system using the SOP.

- Explain the consequences and simulate the correction for a loss of 550 psig steam flow to the reboiler.
- Explain the consequences and simulate the correction for a high level in the vent gas absorber.
- Change the purge gas inlet temperature to 4E1201 using 4TIC3535.
- Simulate changing the water flow rate to the high pressure absorber.
- Simulate startup of the purge skid using the SOP.

I feel the Trainee has successfully completed all sections of this activity.

Trainer

Date

8. Hands-On Demonstration—following SOPs perform or simulate the task(s) selected by the Unit Coordinator from those listed above.

I have successfully completed the material in this activity.

I feel the Trainee has successfully completed all sections of this activity.

Trainee

Date

Trainer

Date

Routing Instructions:

Unit Coordinator: After this page has been signed and dated by both parties, replace it with a copy and route the original to the Day Supervisor.

Day Supervisor: Review and route to the Training Group.

General Information

Process Safety Information

Study P&ID

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

P&ID	DESCRIPTION	LATEST REVISION
R4I-4200, Rev. 8	Purge & Vent Gas Recovery Process	2/28/2000

Due to the size of the P&ID used for this study, the actual drawing will not be included in this report. The P&ID used during the study have been retained by Alaska Nitrogen Products, LLC, 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

Complete drawing update (P&ID R4I-4200) to show 4PSV6021 and orbit valves prior to publishing for turnaround.

Team discussed redundant PSV and inlet/outlet block valves for PSV1978 Hydrogen Chiller and verified in field as PSV6021 and four orbit valves. (MOC 501554, KP-2495)

(Reference: Attachment 5, page 1, of this report.)

RECOMMENDATION: 5-2

MOC should not have been Craft Specific and P&ID R4I-4200, was not, but should have been updated (P&ID R4I-4200). RCM Engineer to handle.

Team discussed MOC 800159, install gaging head assembly on 4F1244A/B and found that the MOC should not have been Craft Specific and that the P&ID had not been updated.

(Reference: Attachment 5, page 3, of this report.)

RECOMMENDATION: 5-3

Upgrade equipment tag and P&ID R4I-4200 to ZSC1995.

Team discussed the questionable numbering for ZSC2001! Team also, reviewed original P&ID (R4Y-1015) for correctness in numbering and found that the equipment tag numbering should be ZSC1995.

(Reference: Attachment 5, page 4, of this report.)

RECOMMENDATION: 5-4

Update P&ID R4I-4200 to indicate FY1294M.

Team discussed the questionable numbering for FY12941 an additional number had been added at the end of the number. Team reviewed original P&ID (R4Y-1015) for correctness in numbering and found that FY12941 should be FY1294M.

(Reference: Attachment 5, page 4 of this report.)

RECOMMENDATION: 5-5

Update P&ID R4I-4200 to indicated PI3359.

Team discussed questionable number for PI3358! Team also, reviewed original P&ID (R4Y-1015) for correctness in numbering and found that PI3358 should be PI3359.

(Reference: Attachment 5, page 4 of this report.)

RECOMMENDATION: 6-1

Upgrade operator training to coincide with current operating practices concerning the APACS system.

Team discussed Attachment 6, Section Operations: Question O-2—and determined that operator training should be upgraded to coincide with current operating practices concerning the APACS System.

(Reference: Attachment 6, page 1 of this report.)

RECOMMENDATION: 6-2

Team recommends Management Review Team set a target date for completion of SOCLs.

Team discussed both Attachments 6 and 7, Questions O-17 and 3, and found that only one (1) SOCL has been currently approved for System 77. (See Recommendation 7-2, Attachment 7, page 7.)

(Reference: Attachment 6, page 2 of this report.)

RECOMMENDATION: 6-3

RCM Engineer to evaluate and determine a solution to the consistent valve-packing problem on the KXV valves.

Team discussed the fact that no incident reports were found for this system although there is a high potential for incidents with hydrogen and methane leaking from these packing. EJAisenbrey to stress importance of near misses and reporting with Operations Superintendents.

(Reference: Attachment 6, page 3 of this report.)

RECOMMENDATION: 6-4

RCM Engineer to evaluate frequencies of, 4G287A/B and 4G286A/B, pump-packing failures and 4G286A/B motor seizure; and develop and implement a plan to correct problem.

Team discussed Question M-2 and found that 4G287A/B, pump packing has a long history of packing failures. The team also found that 4G286A/B packing and motors are unreliable. (See Recommendation 11-3, Attachment 11, page 26.)

(Reference: Attachment 6, page 5 of this reports.)

RECOMMENDATION: 7-1

If DCS project is not done, Engineering to reevaluate alarm priority management.

Team discussed confusion that can occur with multiple alarms on Moore System during upset conditions, but feel the problem will be corrected with the eventual installation of the DCS

<p>System. (Reference: Attachment 7, page 4 of this report.)</p>
<p>RECOMMENDATION: 7-2 Team recommends Management Review Team set a target date for completion of SOCLs. (See Question O-17, Attachment 6.) Team discussed Attachment 7, Human Factors, and Section Procedures: Question 3 and found that only one (1) SOCL had been currently approved for System 77. (See Recommendation 6-2, Attachment 6, page 2.) (Reference: Attachment 7, page 7 of this report.)</p>
<p>RECOMMENDATION: 7-3 Operations management to evaluate the value and cost of hypothetical process upset drills. Team discussed Attachment 7, Human Factors, and Procedures Section: Question 8 and felt that there was a need for hypothetical process upset drills for operators. (Reference: Attachment 7, page 8 of this report.)</p>
<p>RECOMMENDATION:11-1 Emergency Response Coordinator to evaluate wind wall geometry and make recommendations to provide adequate fire-protection for purge skid. Team discussed Attachment 11, Safety/Fire Protection Section: Question 2 and found that wind walls interfere with ability to get firewater on purge skid. (Reference: Attachment 11, page 2 of this report.)</p>
<p>RECOMMENDATION: 11-2 Complete header information on P&ID R4I-4200 before publishing for turnaround. Team discussed Attachment 11, Process Safety Information Section: Question 1 and found that this issue was addressed in a previous PHA Revalidation. (Reference: Attachment 11, page 11 of this report.)</p>
<p>RECOMMENDATION: 11-3 Determine reliability of 4G285A/B and 4G286A/B and develop maintenance program to correct, if reliability is an issue. Team discussed Attachment 11, Maintenance Section: Question 5, EJAisenbrey discussed with MEKellie 4G286A/B pump motor failures and seal failures and 4G285A/B seal failures. (See Recommendation 6-4, Attachment 6, page 5.) (Reference Attachment 11, page 26 of this report)</p>
<p>RECOMMENDATION: 12-1 Investigate source(s) of water in KAV header and eliminate source(s). Team discussed and found that this scenario included FV1287A closed, FV1287B open, and V30 closed. Operations had indicated that a similar scenario has happened. Recommendation addresses similar problem with all PSVs in the Purge Gas Recovery System. (Reference: Attachment 12, page 1 of this report.)</p>
<p>RECOMMENDATION: 12-2 Team discussed at length and determined that a PHA needs to be performed on KP-2397.</p>

Team discussed and found that this was done on KP-2397 and reviewed on MOC 501530. No original MOC was found; however a copy was found in a project file.

(Reference: Attachment 12, page 3 of this report.)

RECOMMENDATION: 12-3

Include check valve on liquid inlet to 4D213 on Critical Check Valve List to insure its reliability.

Team determined that a check valve on liquid inlet to 4D213 should be on the Critical Check Valve List to ensure its reliability.

(Reference: Attachment 12, page 5 of this report.)

RECOMMENDATION: 12-4

Sample for Oxygen and combustibles routinely.

Team discussed cold box enclosure and found that samples for oxygen and combustibles should be done routinely.

(Reference: Attachment 12, page 7 of this report.)

RECOMMENDATION: 12-5

Review the maintenance practice to ensure that oxygen intrusion and environmental release are minimized.

Team discussed KAV header and determined that minimizing the time the KAV is open to ATM would ensure that oxygen intrusion and environmental release are minimized. (See Recommendation 12-6, Attachment 12, page 7.)

(Reference: Attachment 12, page 7 of this report.)

RECOMMENDATION: 12-6

Consider using swing blinds.

Team discussed KAV header and determined that minimizing the time the KAV is open to ATM would ensure that oxygen intrusion and environmental release are minimized. (See Recommendation 12-5, Attachment 12, page 7.)

(Reference: Attachment 12, page 7, 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 Summary Worksheet
Attachment 6	Change Evaluation Checklist
Attachment 7	Human Factors Issues
Attachment 8	Revalidation Guideword Checklist
Attachment 9	"What-If" Worksheets (Off-Site Consequences)
Attachment 10	Risk Ranking Matrix
Attachment 11	Wrap-Up Discussion Checklist
Attachment 12	Additional Areas, Reverse Flow, and Check Valves "What-If" Worksheets