CONDEA VISTA

To: Distribution

From: Kelly Wood
Date: 7-2-1997

Interoffice Communication

Subject: **Utilities, Hazop and Operability Study**

The Hazard and Operability (HAZOP) Study Team met at the Aberdeen Plant June 9th through June 12th to conduct a HAZOP analysis for the Utilities Area. As a result of the HAZOP study, (2) two hazards were identified during the preliminary hazard review, (6) six hazards were identified during the human factors review, (9) nine hazards were identified during the facility siting review, and (3) three hazards were identified during the P & ID/operating procedure review. No hazards were identified during the past incidents review.

Three hazards were identified having a risk ranking of 4. No hazards were identified having a risk ranking of 3 or more. Among the recommendations is a separate siting study for the Propane Tank Farm.

Kelly Wood
HAZOP Team Leader, Capex Engineer

Dist: SJV, JBH, Hazop Review Team

Process Safety Management

Condea Vista Company, Aberdeen Plant

Utilities Area, Hazard and Operability Study

Initial PHA

Start Date: June 09, 1997
End Date: June 12, 1997
Issue Date: June 23, 1997

Issued By: Utilities Hazop Team

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CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

TABLE OF CONTENTS

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

TABLE OF CONTENTS

APPENDICES

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

I. Purpose

The Utilities area Hazop was conducted for the following purposes:

- Provide Management and Operations personnel with the knowledge of where potential hazards exist.
- Provide safe operation documentation for the system.
- Provide a quantitative assessment of the risks involved with the operation of the system.
- Provide documentation that risk management is taking place at the Aberdeen Plant.
- Provide training on Hazop methodology and techniques for Vista personal.
- Make recommendations which the team feels should reduce the risks identified.
- Comply with the Process Hazard Analysis requirements , paragraph (e), of the OSHA Process Safety Management of Highly Hazardous Chemicals regulation, 29 CFR 1910.119.

Performing a Hazop study is generally an assurance that if procedural and/or engineering modifications are implemented to mitigate risk, the area will then operate under some lower risk. It is not, however, a guarantee that hazardous events or operating problems will not be encountered.

II. Rationale

Hazop was chosen to fulfill OSHA's 29 CFR 1910.119 PHA requirement because of the size and complexity of the Aberdeen Plant's Utilities area, as well as the volume of chlorine and propane stored at the Aberdeen Plant.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

III. Scope

The Utilities Area Hazop for the Aberdeen Plant covers the following specific systems:

- Propane Tank Farm, delivery system, and main supply header to the plant.
- Instrument air production and main supply header to the plant.
- Emergency cooling water supply system.
- Cooling Towers 2,4,5, & 6 chlorination systems.
- Water Plant chlorination system.

The following P&ID's and Operating Procedures were examined during the Hazop study..

P&ID Number	Issue Date	Operating Procedure Number	Issue Date
BP-090100	01/24/96	UT-PR-001	12/13/94
BP-090101	11/21/96	UT-PR-002	12/13/94
BP-090102	02/25/94	UT-PR-003	12/13/94
UT-090102	02/25/94	UT-PR-006	12/13/94
UT-090109	08/12/94	VINYL-OM-E008	03/28/95
UT-090111	02/25/94	VINYL-NM-E008	03/28/95
UT-090112	02/17/95	UT-AS-001	08/02/95
UT-090113	02/17/95	UT-AS-009	08/02/95
UT-090114	02/17/95	UT-WP-002	05/31/94
UT-090117	08/23/94	UT-WP-003	05/31/94
WP-090106	01/25/96	UT-WP-017	05/31/94
		UT-WP-018	05/31/94
		UT-CT-001	05/12/97
		UT-CT-002	05/12/97
		UT-CT-003	05/12/97

The Hazop study focused on the following potential hazards:

Personal Injury/Death Resulting From	Equipment/Property Damage Resulting From	Production Loss Resulting From	Environmental/Community Impact Resulting From
Fire	Fire	Equipment Damage	Spills
Explosion	Explosion	Power Failure	Vapor Releases
Toxic Exposure	Corrosion	Maintenance	Emissions
Chemical Contact	Misoperation	Turnarounds	Fire
Thermal Burns	Overpressure	Equipment Failure	Explosion
Asphyxiation	Overheating	Instrument Failure	
Impact Injury	Freezing	Misoperation	

- Human Factors
- Past Incidents
- Facility Siting

IV. Team Members and Qualifications

Selection of the Hazop team is consistent with OSHA requirements and the requirements outlined in the Condea Vista Company, Corporate Safety & Health Standard, PSM-004, " Process Hazard Analysis", section 4.7.2, May 19, 1997.

Name	Title	Expertise	Qualifications
Kelly Wood	Facilitator	Engineering & Operations	Kelly has five years experience in the Aberdeen Plant and has performed two previous Hazop studies. Kelly has had formal Hazop team leader training (see Appendix H).
Jimmy Brewer	Utility "A" Technician	Operations	Jimmy has worked in the Aberdeen Plant for 27 years. Jimmy's first 22 years were spent as a yard operator, and the last 5 years were spent as a utilities operator.
Charlie Peden	Instrument Technician	Instrumentation/ Maintenance	Charlie has worked in the Aberdeen Plant for 26 years. The first 13 in general maintenance and the last 13 as an instrument technician.
Jerald Uptain	Safety Supervisor	Safety & Industrial Hygiene	Jerald has worked in the Aberdeen Plant for 26 years. Jerald has been Safety Supervisor for 24 years.
Milton Threadgill	Maintenance Helper	Maintenance	Milton has worked at the Aberdeen Plant for 27 years. Milton has 26 years experience as a Yard Operator and 1 year experience as a maintenance helper.
Janice Minga	Management Systems Coordinator	PSM Compliance	Janice has worked at the Aberdeen Plant for 25 years and has been involved with the plant's PSM compliance effort for the past 2 years.
Sam Brown	I&E Supervisor	Instrumentation/ Maintenance	Sam has worked at the Aberdeen Plant in maintenance/instrumentation for 25 years.
O.C. Pace	Vinyl Shift Supervisor	Operations	O.C. has worked at the Aberdeen Plant for 28 years all in the Vinyl unit. O.C. has progressed from the trainee level to Vinyl shift supervisor.

V. Team Orientation

A. Methodology

The methodology used to perform the Hazop study is outlined in the Condea Vista Company, Corporate Safety & Health Standard, PSM-004, " Process Hazard Analysis", section 5, May 19, 1997.

B. Risk Ranking Tables

Risk Ranking of identified process hazards was completed per the instructions and information provided in the Condea Vista Company, Corporate Safety & Health Standard, PSM-004, " Process Hazard Analysis", Appendix D, May 19, 1997.

C. Hazop Execution Plan

- Gather required pre-work material (Appendix D).
- Select appropriate team members
- Post memo to all employees stating that a Hazop study will be done. Memo includes what area or process the Hazop will focus on, team members, meeting place, and meeting times.
- Hold Team Orientation Meeting. The orientation meeting is used to set the tone for the Hazop. It includes a review of the following:
    - Purpose and Scope of the Hazop
    - Rationale for choosing Hazop for the PHA
    - Hazop Execution Plan
    - Methodology
    - Process Description
    - Pre-work material
    - Site Specific Hazards of the Process
    - Previous Incidents
    - Human Factors
    - Facility Siting
- Perform line by line analysis of process nodes. Includes P&ID's and operating procedures.
    - Identify Hazards of the Process
    - Rank Hazards By How Much Risk They Exhibit
    - Recommend Actions to Mitigate Risks
- Compile all team findings during Hazop into a report.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

D. Human Factors Checklist

Equipment	+	-	Observed Practice
Labeling	equipment clearly labeled	mislabeled or not labeled	
Access	immediately at hand	hard to reach or access	
Operability	power assisted operation	difficult to operate/change	
Layout	well-planned, logical arrangement	confusing/inconsistent arrangement	
Uniqueness	only component of its kind in area	several components look similar	

Controls	+	-	Observed Practice
Labeling	controls clearly labeled; uniform coding	mislabeled or not labeled	
Mode	fully automatic; well-tuned	manual operation; many manual steps	
Involvement	operator continually involved	operator detached from process	
Displays	clear, simple, representational	unclear, complex, non-representational	
Displays	immediate, unambiguous	none or potentially misleading	

Deviations	+	-	Observed Practice
Alarms	first-out; safety critical alarms	many simultaneous or false alarms	
Coverage	dual operator coverage at all times	operator not always present	
Time	no time pressure for response	inadequate time for response	
Preparedness	periodic simulation exercises	no drills or simulation of scenarios	
Last-Resort	shutdown not discourage; fast access	shutdown discouraged or unsafe	

Transient	+	-	Observed Practice
Procedures	complete, accurate, current, verified	incomplete/too general/out of date	
Identifying	ID, location of devices/actions given	ambiguous device/action identification	
Format	graphical identification aids	confusing/inconsistent; difficult to read	
Aids	checklist or supervisory check	task sequence done by memory	

"+" = FACTORS BEYOND STANDARD PRACTICE; MAY REDUCE HUMAN ERROR OR INADEQUATE RESPONSE LIKELIHOOD.

"-" = FACTORS THAT MAY TEND TO INCREASE THE LIKELIHOOD OF HUMAN ERROR OR INADEQUATE RESPONSE.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

Scheduling	+	-	Observed Practice
Overtime		extreme enough to affect performance	
Consistency	permanent shift assignments	inconsistent shift rotations/schedules	
# of Tasks	tasks, work force, and skills matched	tasked required exceed time available	
Task Frequency	routine tasks	very infrequent; no expertise base	
Intensity	regular tasks at normal pace	differing tasks in rapid succession	

Communicate	+	-	Observed Practice
Shift Changes	status communicated verbally, plus turnover sheet used	inadequate communication of plant status between shifts	
Field/Control	constant communication with field operator	no communication with field operator	
Supervision	frequent supervisory communication	little or no supervisory checks	
Emergency	rapid, unambiguous plant alarm system	no distinction between area/type	

Environment	+	-	Observed Practice
Noise Level	office environment noise level	area where hearing protection required	
Climate	indoors, climate controlled	temperature/humidity/ precipitation/wind extremes	
Visibility	visibility enhancement of some kind	visibility limitation of some kind	
Lighting		inadequate lighting for task	

"+" = FACTORS BEYOND STANDARD PRACTICE: MAY REDUCE HUMAN ERROR OR INADEQUATE RESPONSE LIKELIHOOD.

"-" = FACTORS THAT MAY TEND TO INCREASE THE LIKELIHOOD OF HUMAN ERROR OR INADEQUATE RESPONSE.

E. Facility Siting Checklist

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		1. Location of on-site populations relative to the unit.
X		2. Location of off-site populations relative to the unit. Location of environmentally sensitive areas.
X		3. Location of critical and safety systems.
X		4. Dominant Wind Direction.
X		5. Climate and water extremes; earthquake; flooding; hurricanes; tornadoes; windstorms.
X		6. Site topography
X		7. External hazards and threats (fire, explosion, toxic release from nearby process or facilities; aircraft, subsidence, sabotage).
X		8. On-site traffic flow patterns and clearances.
X		9. Security and reliability of all critical feeds, utilities, and safety systems.
X		10. Evacuation routes, emergency exits, safe rally spots.
X		11. Passive mitigation systems such as dikes, berms, (control spills and fires) and blast walls (protect against explosions).
X		12. Crane lifts over operating equipment and piping.
X		13. Barricades between traffic and equipment and piping.
X		14. Adequate lighting for normal operation, routine maintenance, power failure procedures, evacuation.
X		15. Communication systems.
X		16. House keeping - walkways, aisles, operating areas, evacuation routes.
X		17. Location of railroads to process equipment (derailment, access).
X		18. Open ditches, sumps, low points (collect toxic and flammable vapors).
X		19. Entry into confined spaces during emergencies- Trapped Gases, Hazards, Permit.
		Buildings
X		20. Location of occupied building near process units. (Please note that the Dow Chemical Fire and Explosion Index will be used as a screening tool to determine if the building is located sufficiently remote from the process. If the building is not located sufficiently remote from the process, the team should suggest that a more detailed study be conducted.)

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		Control Rooms
X		21. Minimum occupancy; only essential functions during emergencies.
X		22. Control Room Construction.
X		23. Fresh air intake locations/isolation; Temporary safe havens; Access during an emergency.
X		24. Control room location relative to unit, columns, and pipe bridges.
X		25. Supply of breathing air in control room. Sufficient for emergency shutdown.
X		26. Instrument labels up-to-date.
		Process Facilities
X		27. Area electrical classification.
X		28. Accessibility for mechanical integrity inspection and testing.
X		29. Protection of piping and vessels from vehicles and forklifts.
X		30. Protection of small bore lines, fittings, from external impact, personnel.
X		31. Routing of process piping, critical controls cable trays, critical utilities.
X		32. Vent, drain, and relief valve discharge locations.
X		33. Remote shutoff valves for feed lines to the unit, accessible, functional in emergency.
		Loading, unloading, and storage facilities
X		34. Incompatible materials segregated; storage, dikes, sumps, drains, and waste.
X		35. Siting, labeling of unloading spots for incompatible materials.
X		36. Spacing consideration for flammable, combustible, and unstable liquid storage (note use the checklist - "Hazardous Analysis Review for Spacing Considerations for flammable, combustible, and Unstable Liquid Storage")
X		39. Storage of flammable solids such as wood, paper, rags.
		Fire Protection
X		40. Access for fire fighting and other emergency services - trains, vehicle parking, construction.
X		41. Ignition sources, continuous, intermittent, uncontrolled, hot surfaces.
X		42. Access to hydrants, monitors, and deluge valves.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
X		43. Grading drains flammables away from storage.
X		44. Equipment spaced to minimize potential fire explosion damage.
X		45. Coverage of fire monitors/sprinkler systems.
X		46. Fire proofing of structures.
		Accident Mitigation
X		47. Detection of leaks and ruptures.
X		48. Emergency shutdown switch locations.
X		49. Accessibility of isolation valves, size.
X		50. Potential for fire/explosion in units affecting other equipment.
X		51. Critical control, mitigation, communication after initial explosion or release.
		Personnel Protection
X		52. Passageways, pedestrian traffic patterns vs. hazardous locations.
X		53. SCBA/respirators locations; accessibility on all shifts.
X		54. Sufficient escape routes from operating areas, shops, labs, offices.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

HAZARDOUS ANALYSIS REVIEW FOR SPACING APPLICATIONS FOR FLAMMABLE, COMBUSTIBLE AND UNSTABLE LIQUID STORAGE

Instructions: This checklist represents item #36 on the CONDEA Vista Company Facility Siting Checklist. The hazard review team will review each item and mark to indicate a review was completed. Comments and findings are shown in a separate report. No scenario rankings are given to these findings.

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
X		1. Tanks accessible for fire fighting purposes.
X		2. Minimum distance between tank and property line or building as defined in paragraph 2-3 of NFPA 30, attached.
X		3. Outside base tank dike at ground level at least ten (10) feet from property line.
X		4. Minimum distance between any two storage tanks one third (1/3) of adjacent tank diameters, but at least three (3) feet. If unstable, flammable, or combustible liquids are stored, distance shall be minimum of one half (1/2) the sum of the diameters.
X		5. Inside base of tank dike at ground level at least five (5) feet from storage tank.
X		6. Minimum distance between liquefied petroleum gas (LPG) container and storage tank twenty (20) feet. If storage tank operates above 2.5 psig, or is equipped with emergency venting that will permit pressures to exceed 2.5 psig, then Item 4. above applies.
X		7. Storage tanks not permitted inside buildings.
X		8. When a storage tank is located in an area subject to flooding, the following shall be observed.
		a. The provisions of Item 8. shall apply only if the maximum flood stage exceeds the elevation of the dike wall.
		b. Provisions to prevent tank, either full or empty, from floating during rise in water level to established maximum flood stage.
		c. Independent water supply facilities available for loading partially empty tanks with water. If filling with water is impractical or hazardous due to tank contents, tank shall be protected by other means against movement or collapse.
		d. Top of vertical tank extends above maximum flood stage by at least thirty (30) percent of its allowable storage capacity.
		e. In addition to Items a., b., c., and d. above, if tank is located such that seventy (70) to one hundred (100) percent of its allowable liquid storage capacity will be submerged at the established maximum flood stage, then the following also applies.

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		i. Is tank raised, or height increased, until it extends above the level obtainable at maximum flood stage a distance equivalent to at least thirty (30) percent if its allowable liquid storage capacity. Submerged part of tank shall not exceed two and one-half (2 1/2) times its diameter.
		ii. As an alternate to Item i. above, adequate noncombustible structural guides, designed to permit tank to float vertically without loss of product may be provided.
		f. Horizontal tanks located such that more than seventy (70) percent of storage capacity will be submerged at the established flood stage attached to foundation of concrete, or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood waters to the established flood stage.
		g. For tanks in Item f. above, are tank vents or other openings that are not liquid tight extended above the level obtainable by flood waters at maximum flood stage water level.
		h. Spherical or spheroid tanks protected by applicable methods specified for either vertical or horizontal tanks as described above.

Definitions:

Combustible Liquid. A liquid having a flash point at or above 100EF (37.8EC).

Flammable Liquid. A liquid having a flash point below 100EF (37.8EC) and having a vapor pressure not exceeding 40 psia at 100EF (37.8EC).

Unstable Liquid. A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure or temperature.

Reference Materials:

NFPA (National Fire Protective Association) 30, Flammable and Combustible Liquids Code

OSHA 1910.106

CONDEA VISTA COMPANY, ABERDEEN PLANT
UTILITIES AREA HAZOP

F. Team Orientation Meeting Review Checklist

Reviewed Yes	Reviewed No	Review Topic
X		1. Purpose of Hazop
X		2. Rationale for choosing Hazop for the PHA
X		3. Scope of Hazop
X		4. Hazop Execution Plan
X		5. Methodology
X		6. Process Description
X		7. Pre-work material
X		8. Site Specific Hazards of the Process
X		9. Previous Incidents
X		10. Human Factors
X		11. Facility Siting

	1 - 6/5/97	2 - 6/10/97	3 - 6/11/97	4 - 6/12/97
BREWER, JIMMY				
BROWN, SAM				
JERALD, UPTAIN				
MILTON, THREADGILL				
MINGA, JANICE			-	-
PACE, O.C.	-	-	-	
PEDEN, CHARLIE		-	-	-
WOOD, KELLY				

VI. Description of Covered Processes

A. Propane System

Process description for propane system is detailed in the Condea Vista Company, Utilities Operations Manual, Procedure # UT-PR-001, "Propane System General Information", "Discussion" section, December 13, 1994. See Appendix B.

B. Instrument Air System

Instrument air is compressed by compressors, CP-708 and CP-909, at a rate of 525 ICFM and a pressure of 100 psig. The compressors have internal aftercoolers that reduce the temperature of the discharged air which exits at around 200 °F. The hot air then flows through aftercoolers, EX-033 and EX-032, where its temperature is further reduced to about 80 °F. Water that has condensed is separated from the air in the air/water separator on the discharge of EX-032. The air then flows through surge tank, DM-332. Air exiting DM-332 then flows to the Deltek instrument air dryer.

Upon entering the Deltek, DR-028, the air is first filtered and then further cooled. Cooling is done first by passing the air on the shell side of an air/air heat exchanger and then by passing the air across refrigeration coils. A small knockout pot again removes any condensed water. The air then enters one of two desiccant beds where the dew point is reduced to -40 °F or less. Air exiting the desiccant bed passes through the tube side of the air/air heat exchanger mentioned above. The instrument air is then filtered again and distributed throughout the plant for use in the control of air operated valves and other control systems.

C. Emergency Cooling Water System

Process description for the Emergency Cooling Water System is detailed in the Condea Vista Company, Vinyl Operations Manual, procedures # Vinyl-OM-E008 & Vinyl-NM-E008, "Operation of Deluge Water to Emergency Cooling Water System", "Discussion" section, March 28, 1995. See Appendix B.

D. Cooling Tower Chlorination System

Process description for the Cooling Tower Chlorination System is detailed in the Condea Vista Company, Utilities Operations Manual, procedure #'s UT-CT-001 & UT-CT-002, "Operation of Chlorination System for CT-002, CT-004, and CT-006", "Operation of Chlorination System for CT-005","Discussion" section, May 12, 1997. See Appendix B.

E. Water Plant Chlorination System

Process description for the Water Plant Chlorination System is detailed in the Condea Vista Company, Utilities Operations Manual, procedure # UT-WP-002, "Chlorine Feeder System Operation", "Discussion" section, May 31, 1994. See Appendix B.

VII. List of Hazards Identified

A. Preliminary Hazards Review

- Steam piping to, in, and around vaporizers is badly corroded. Piping is potentially a burn hazard and could cause steam system downtime in the event of a piping failure.

- Equipment, instrument, and line labeling is insufficient in many areas under scope of Hazop. Special attention should be made to items referenced in operating procedures.

B. Past Incidents Review

- No hazards were identified during the past incidents review. No documented incidents, near misses, or injuries have occurred in the utilities area.

C. Human Factors Review

- Steam piping around vaporizers is very congested making accessibility difficult.

- The Water Plant alarm panel has several alarms that have no purpose. Since beginning operation, many alarms were installed and subsequently deemed unimportant and disconnected. However, their spot on the alarm panel remains thus requiring extra attention to pick out important alarms.

- Utilities operator detached from other operations personal. If the operator were to become injured and could not use his radio, it could be an extended amount of time before he was missed.

- Air compressor alarms, in many instances, do not give operators sufficient time to advert a shutdown.

- Presently operators are required to work many overtime hours.

- Plant alarm cannot be heard in all utility work areas. Specifically at the waste water ponds.

D. Facility Siting Review

- Buildings on adjacent personal property are close to propane storage tanks, however are not within Dow Fire & Explosion radius.

- Occasional low flying crop dusters fly over the plant.

D. Facility Siting Review..cont

- Access road by Boilerhouse is too close to buildings and is also close to chlorine containers that set by the coke trays.
- PA system can not be heard in all areas.
- Radios are unusable in some areas of the plant.
- One of the contractor sheds and the maintenance storage barn are inside the Dow Fire & Explosion radius. See Appendix G. for calculations and plot plan.
- Boilerhouse control room may be unsafe if an explosion, earthquake, tornado, ect., occurs.
- If while in operation, the propane tanks or piping upstream of the emergency shut off valve were to develop a leak, both storage tanks would be in danger of spilling their contents.
- Chlorine containers are stored inside a building.

Node: 34. Operation of Deluge Water to Emergency Cooling Water System.	
Type: Procedural Step	Drawings: (OP) VINYL-NM-E008, 3/28/95, (OP) VINYL-OM-E008, 3/28/95
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards	Recommendations
34.1 Other than specified action							
	1. Communication failure between operators 2. Confusion in emergency situation 3. Inadequate lighting 4. Insufficient training	1. VCM release 2. VCM release - E 3. Fire/Explosion - E 4. Fire/Explosion	3 3 1 1	C C D D	4 4 4 4	1. Specific guidance in procedures 2. Training & qualification of personnel	3. Evaluate need to better label equipment, instrumentation, and process lines in all utilities areas.

Node: 40. Emergency response to a chlorine leak of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawing: (OP) UT-CT-003, 5/12/97
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards	Recommendations
40.1 Other than specified action							
	1. Inadequate personal training 2. Emergency response material not available 3. Lack of operator communication 4. Confusion in emergency situation	1. Personal exposure 2. Personal exposure - E 3. Personal evacuation 4. Personal evacuation - E 5. Interuption of plant operations	3 3 3 3 3	C C C C C	4 4 4 4 4	1. Emergency response plan in place 2. Specific guidance in procedures 3. Training & qualification of personnel	1. Evaluate need for developing program to annually inventory chlorine leak response equipment. 2. Evaluate need for annual chlorine A & B kit usage training.

Node: 43. Emergency response to a chlorine leak of Water Plant Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-WP-017, 5/31/94, (OP) UT-WP-018, 5/31/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards	Recommendations
43.1 Other than specified action							
	1. Inadequate personal training 2. Emergency response material not available 3. Lack of operator communication 4. Confusion in emergency situation	1. Personal exposure 2. Personal exposure - E 3. Personal evacuation 4. Personal evacuation - E 5. Interuption of plant operations	3 3 3 3 3	C C C C C	4 4 4 4 4	1. Emergency response plan in place 2. Specific guidance in procedures 3. Training & qualification of personnel	1. Evaluate need for developing program to annually inventory chlorine leak response equipment. 2. Evaluate need for annual chlorine A & B kit usage training.

VIII. List of Recommendations

A. Recommendations From Preliminary Hazard Review

- No recommendations were made as a result of the preliminary hazard review.

B. Recommendations From Past Incidents Review

- No recommendations were made as a result of the past incidents review.

C. Recommendations From Human Factors Review

- Evaluate repiping the steam piping to the vaporizers to facilitate accessibility.
- Audit all equipment, instrumentation, and processes lines for necessary labeling.
- Evaluate the need to automate chlorine feed to cooling towers and water plant.
- Audit water plant alarm panel for unnecessary/unused alarms.
- Evaluate need for dual coverage at the water plant.
- Evaluate the need for additional alarms for the plant instrument air compressors, CP-708, CP-909.
- Evaluate lighting for downstairs of the boilerhouse, propane tank farm, and walkway from deaerator deck to boiler control room.

D. Recommendations From Facility Siting Review

- Evaluate appropriateness of number and location of Scott Air Packs in all utilities areas.
- Investigate ways to control vehicle and pedestrian access to road beside boilerhouse.
- Evaluate need to barricade outside chlorine container storage locations.
- A more detailed siting study is necessary on buildings inside the Dow Fire and Explosion Radius. See Appendix G.
- Evaluate suitability of control room construction during explosion, earthquake, tornadoes, ect.
- Evaluate need for emergency shutoff valve on the discharge of each propane storage tank, PV-029 and PV-030.

D. Recommendations From Facility Siting Review..cont.

- Investigate appropriateness of having chlorine containers inside building. See facility siting checklist, section V,E.

- Evaluate accessibility from plant to propane tank farm through trains, vehicle and pedestrian traffic, construction and construction traffic.

Recommendations	RX	Related Drawings
1. Evaluate need for developing program to annually inventory chlorine leak response equipment. (See: 40.1, 43.1)	4	(OP) UT-CT-003, 5/12/97, (OP) UT-WP-017, 5/31/94, (OP) UT-WP-018, 5/31/94
2. Evaluate need for annual chlorine A & B kit usage training. (See: 40.1, 43.1)	4	(OP) UT-CT-003, 5/12/97, (OP) UT-WP-017, 5/31/94, (OP) UT-WP-018, 5/31/94
3. Evaluate need to better label equipment, instrumentation, and process lines in all utilities areas. (See: 12.1, 34.1)	4	(OP) UT-PR-002, 12/13/94, (OP) VINYL-NM-E008, 3/28/95, (OP) VINYL-OM-E008, 3/28/95
4. Evaluate need for emergency isolation valves on discharge of each propane storage tank. (See: 3.2)	5	BP-090100-PID-D, 1/24/96
5. Evaluate need to replace old corroded steam supply lines to propane vaporizers. (See: 5.2)	5	BP-090101-PID-D, 11/21/96
6. Evaluate unloading procedures and safeguards to prevent unloading into propane surge/storage tank equalization line. (See: 11.3)	5	BP-090100-PID-D, 1/24/96, BP-090102-PID-D, 2/25/94
7. Evaluate sizing basis and calculations for propane pump relief valves. Valves appear to be undersized for certain conditions. (See: 2.1)	5	BP-090100-PID-D, 1/24/96
8. Evaluate the need for a low oil pressure warning alarm or some alarm that may give operators time to advert a instrument air compressor shutdown. (See: 17.2)	5	UT-090109-PID-D, 8/12/94
9. Evaluate relief valve sizing basis for DM-332. Valve is undersized for assumed basis. (See: 21.2)	5	UT-090109-PID-D, 8/12/94
10. Add valve CV2705 to line # 1.1.5 of operating procedure UT-PR-002. (See: 12.1)	5	(OP) UT-PR-002, 12/13/94
11. Update P&ID UT-090117 for revisions to cooling tower chlorination system. (See: 35.1)	5	UT-090117-PID-D, 8/23/94

IX. Items Needing Further Review

- No items were identified that need further review for lack of data, information, knowledge, ect.

APPENDIX A

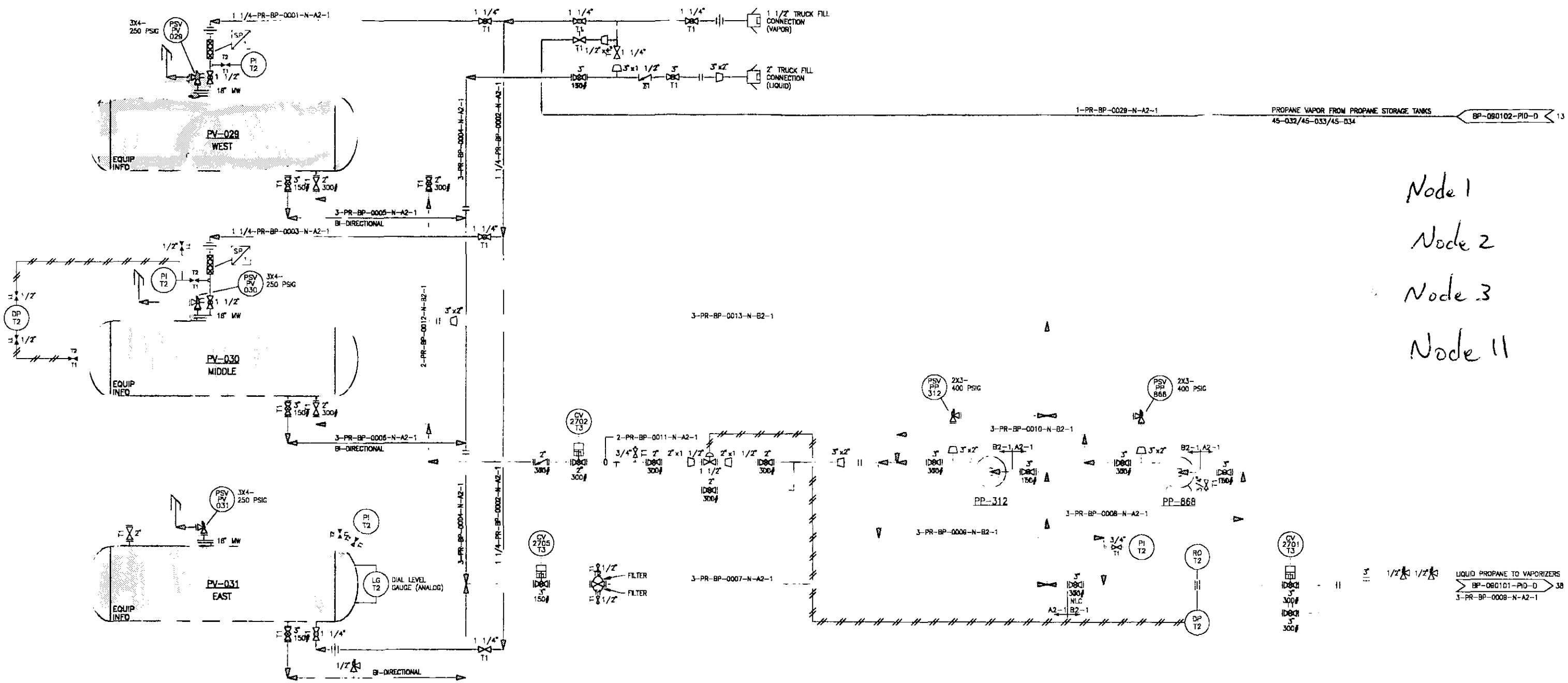
PV 029 PV 030 PV 3
PROPANE STORAGE TANK STORAGE TANK PROPANE STORAGE TANK

Node 1

Node 2

Node 3

Node 11



LEGEND

— 1 1/2" SS FLEX HOSE

PP-312/ [illegible]

SU	DATE	DESCRIPTION	BY	CKD	APD
1	1/24/96	UP-DATE LINE SIZE	RER	DRW	JBH
0	2/25/94	ISSUED TO CLIENT	PAI		MGD

APPD: DATE:	SCALE NONE	LOCATION CODE	AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PROPANE SYSTEM
SHEET 1 OF 3

NO. BP-090100-PID-D | ISSUE 1

FILE NO. ?
DESK NO. ?

ABD00036358

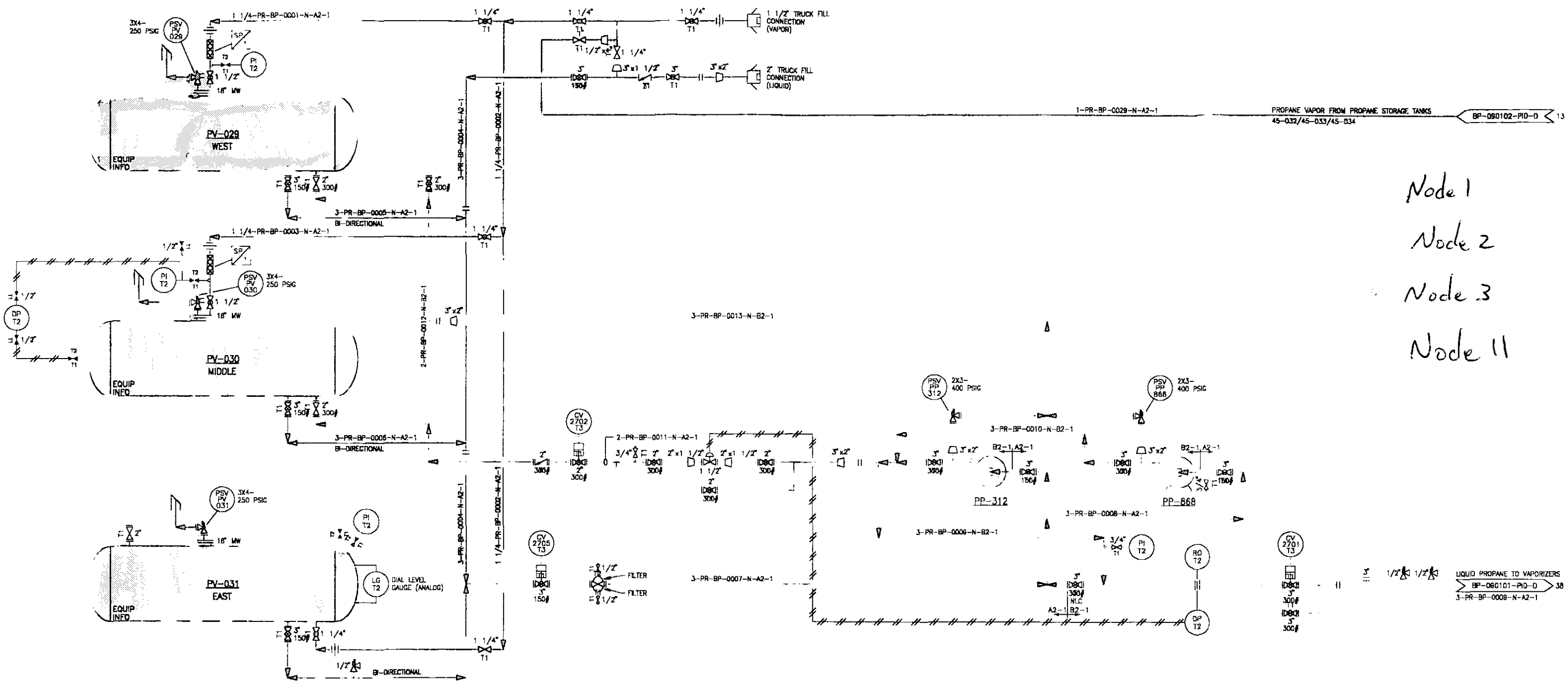
PV 029 PV 030 PV 3
PROPANE STORAGE TANK STORAGE TANK PROPANE STORAGE TANK

Node 1

Node 2

Node 3

Node 11



LEGEND

— 1 1/2" SS FLEX HOSE

PP-312/ [illegible]

SU	DATE	DESCRIPTION	BY	CKD	APD
1	1/24/96	UP-DATE LINE SIZE	RER	DRW	JBH
0	2/25/94	ISSUED TO CLIENT	PAI		MGD

APPD: DATE:	SCALE NONE	LOCATION CODE	AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PROPANE SYSTEM
SHEET 1 OF 3

NO. BP-090100-PID-D | ISSUE 1

FILE NO. ?
DESK NO. ?

ABD00036358

812/EX-8[illegible]
VAPORIZERS

Node 4
Node 5
Node 6

STEAM SUPPLY
17 > BP-090103-PID-D
3-SL-BP-0068-H-A2-3

LIQUID PROPANE
FROM PV-028/030/031
38 > BP-090100-PID-D

3-PR-BP-0009-N-B2-1

3-SL-BP-0070-H-A2-3

3-PR-BP-0018-N-B2-1 > TO PROPANE AIR/MIX CABINET BP-090102-PID-D 6

3-PR-BP-0019-N-B2-1 > TO PROPANE AIR/MIX CABINET BP-090102-PID-D 22

3-PR-BP-0020-N-B2-1 > TO PROPANE AIR/MIX CABINET BP-090102-PID-D 39

EX-811 VAPORIZER EAST

EX-812 VAPORIZER MIDDLE

EX-813 VAPORIZER WEST

LC T2 VACUUM/ BREATHER

PI T2

PSV T2 1X1-

2-PR-BP-0014-N-B2-1

2-PR-BP-0015-N-B2-1

2-PR-BP-0016-N-B2-1

2-PR-BP-0071-N-B2-1

3-SL-BP-0072-H-A2-3

1-CL-BP-0009-H-A2-3

1-CL-BP-0008-H-A2-3

1-CL-BP-0011-H-A2-3

1-CL-BP-0010-H-A2-3

1-CL-BP-0013-H-A2-3

1-CL-BP-0012-H-A2-3

1/2-CL-BP-0015-H-A2-3

1 1/2-CL-BP-0014-H-A2-3

3-PR-BP-0009-N-B2-1

3-SL-BP-0070-H-A2-3

3-PR-BP-0017-N-B2-1

ISU	DATE	DESCRIPTION	BY	CKD	APD
2	11/21/96	UP-DATE LINE NUMBERS	RER	RER	
1	1/24/96	UP-DATE LINE SIZE	RER	DRW	JBH
0	2/25/94	ISSUED TO CLIENT	PAI		MDG

APPD: MDG DATE: 2/25/94 | SCALE NONE | LOCATION CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PROPANE SYSTEM
SHEET 2 OF 3

FILE NO. 7
DSK NO. 7

NO BP-090101-PID-D | SHEET 2

ABD00036359

PROPANE VAPOR/AIR MIX CABINET No. 1 (EAST)

PROPANE VAPOR/AIR MIX CABINET No. 2 (EAST MIDDLE)

PROPANE VAPOR/AIR MIX CABINET No. 3 (WEST MIDDLE)

PROPANE VAPOR/AIR MIX CABINET No. 4 (WEST)

FROM VAPORIZER BP-090101-PID-D

TO BP-090100-PID-D

AIR FILTER

PV-032 EAST — PROPANE STORAGE TANK

PV-033 MIDDLE — PROPANE STORAGE TANK

PV-034 WEST — PROPANE STORAGE TANK

EQUIP INFO

PSV PV-033 3X4-15 PSIG

PSV PV-034 3X4-15 PSIG

ATMOS

TO PLANT GAS SUPPLY SYSTEM UT-090102-PID-D

Node 7
Node 8
Node 9
Node 10
Node 11

ISU	DATE	DESCRIPTION	BY	CKD	APD
0	2/25/14	ISSUED TO CLIENT	PAI		MDG

APPD: DATE:

SCALE NONE

LOCATION CODE

AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PROPANE SYSTEM
SHEET 3 OF 3

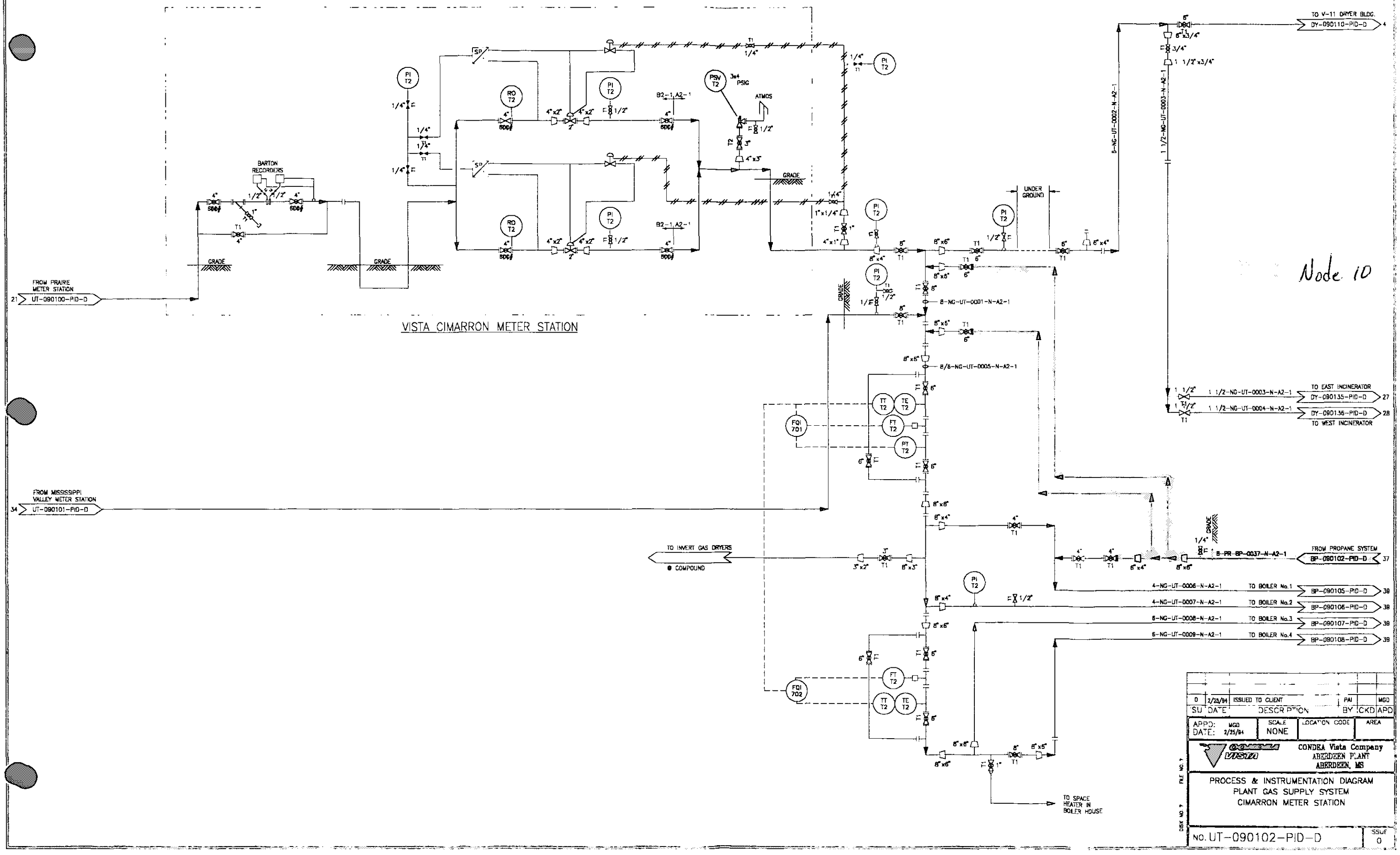
FILE NO. ?

DESK NO. ?

NO. BP-090102-PID-D

ISSUE 0

ABD00036360



ABD00036361

CP 708
INSTRUMENT AIR
COMPRESSOR PACKAGE

CP 709
INSTRUMENT AIR
COMPRESSOR PACKAGE

DM 332

DR 028
DELTEK DRYER

DR 026
INLET FILTER

DR 28
OUTLET

TK 301
SURGE TANK

FROM FL-141
8 DY-090108-PID-D
4-AU-UT-0013-N-M2-1

CWR
42 UT-090114-PID-D
2-WH-UT-0074-N-A2-3

CWS
4 UT-090115-PID-D
2-WC-UT-0060-N-A2-3

Ex-033
Ex-032
AFTERCOOLER
AFTERCOOLER

2 3-PSIG
PSV CP 708
RO T2
CP-708 COMPRESSOR PACKAGE

CWR
20 UT-090115-PID-D
1-WH-UT-0069-N-A2-3

CWS
3 UT-090115-PID-D
1-WC-UT-007B-N-A2-3

6-AU-UT-0011-N-M2-1
6-AU-UT-0012-N-M2-1

4-AU-UT-0014-N-M2-1
ATMOS
PSV DM 332
1 2-PSIG
EQUIP INFO
4-AU-UT-0015-N-M2-1
4-AU-UT-0016-N-M2-1

DR-028
DELTEK INLET FILTER
DELTEK DRYER PACKAGE

6 UT-090115-PID-D CWS
20 UT-090115-PID-D CWR
2-WH-UT-0071-N-A2-3
1-WC-UT-0081-N-A2-3

1 1 1/2-PSIG
PSV CP 709
CP-709 COMPRESSOR PACKAGE
TE T2
1-WH-UT-0070-N-A2-3
CWR
UT-090115-PID-D 22
CWS
1-WC-UT-0082-N-A2-3
UT-090115-PID-D 5

39 UT-090108-PID-D
4-AI-UT-0023-N-M2-1

4-AI-UT-0017-N-M2-1
DR-029
DELTEK OUTLET FILTERS

4-AI-UT-0018-N-M2-1
3-AI-UT-0025-N-M2-1

2-AI-UT-0020-N-M2-1 TO S.A. MODULE
2-AI-UT-0021-N-M2-1 INSTR. AIR HEADER TO NEW MODULE REACTOR AREA
2-AI-UT-0018-N-M2-1
2-AI-UT-0022-N-M2-1 TO NEW MODULE RECOVERY BLDG.
AL B2P085
PG T2
PSV TK 301
2-AI-UT-0019-N-M2-1
2-AI-UT-0027-N-M2-1
TK-301
MW
EQUIP INFO
UT-090111-PID-D 24
3-AI-UT-0024-N-M2-1
UT-090117-PID-D 15
TO BOILER HOUSE IA
IR B2P090
PT T2

Node 17
Node 18
Node 19
Node 20
Node 21
Node 22
Node 23
Node 24

ISS	DATE	DESCRIPTION	BY	CKD	APD
2	8/12/94	REVISED FOR MOCA UT-008-93	RER	GWW	JBH
1	6/3/94	DRAWING UP-DATED	RER	LHS	JBH
0	2/25/94	ISSUED TO CLIENT	PAI		MGD

APPD: MGD DATE: 2/25/94 | SCALE NONE | LOCATION CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PLANT UTILITY AIR SYSTEM
SHEET 3 OF 5

NO UT-090109-PID-D | ISSUE 2

FILE NO. ?
DESK NO. ?

ABD00036362

Node 25

Node 20

TO DC-008 DY-090110-PID-D 9
TO DC-007 DY-090109-PID-D 9
TO DC-006 DY-090108-PID-D 9
TO DC-005 DY-090107-PID-D 9
TO DC-004 DY-090106-PID-D 9
1 1/2-AU-UT-0121-N-M2-4
1 1/2-AU-UT-0120-N-M2-4
1 1/2-AU-UT-0119-N-M2-4
1 1/2-AU-UT-0118-N-M2-4
1 1/2-AU-UT-0117-N-M2-4
2"x1 1/2"
2-AU-UT-0116-N-M2-4
TO SMALL BLEND TANKS
TO SWITCHING VALVES IN LARGE BLEND TANK AREA
3/4-AU-UT-0123-N-M2-4
TO HDR. @ PP-147/148 PP-835/836 PP-848/849
2-AU-UT-0124-N-M2-4
1-AU-UT-0122-N-M2-4
TO LARGE BLEND TANK VALVES
ACTIVATOR IA
UT-090108-PID-D 15
3-AU-UT-0093-N-M2-4
2-AU-UT-0102-N-M2-4
3-AU-UT-0103-N-M2-4
1 1/2-AU-UT-0115-N-M2-4
TO FLUID BED DRYER
TO V-11 DRYER BLDG. CONTROL ROOM
TO CHILLER BLDG.
TO CONTROL ROOM
TO COOLING TOWER 5A IA
2-AU-UT-0028-N-M2-1
TO PP-468/480
OLD CHEM WASH AREA
TO EX-114
OM RECOVERY
3/4"x1" UNION
2-AU-UT-0104-N-M2-4
2-AU-UT-0125-N-M2-4
TO OLD MODULE CALCIUM STEARATE AREA
TO TANK FARM
1-AU-UT-0127-N-M2-4
1-AU-UT-0126-N-M2-4
TO FW DELUGE
TO OLD MODULE EMISSION RECOVERY BLDG.
PSV UT 0111 1 1- PSIG
2-AU-UT-0111-N-M2-4
PSV DM 300 1 1 1/2- PSIG
PI T2
DM-300
EQUIP INFO
TO OLD MODULE REACTORS
2-AU-UT-0114-N-M2-4
2-AU-UT-0113-N-M2-4
TO POLYMIC UNIT
2-AU-UT-0112-N-M2-4
TO CENTRATE FILTERS FL-110/120
TO OLD MODULE LOW MOL. SLURRY AREA
UT-090108-PID-D 24
3-AU-UT-0025-N-M2-1
UT-090108-PID-D 27
4-AU-UT-0092-N-M2-4
3-AU-UT-0100-N-M2-4
4-AU-UT-0101-N-M2-4
3-AU-UT-0105-N-M2-4
UT-080107-PID-D 52
TO CV-080 DY-090108-PID-D 54
DY-090110-PID-D 54
TO CV-080A
TO 500 SILOS DY-090127-PID-D 32
2-AU-DY-0057-N-M2-4
P-1
LAB
TO V-10 DUST COLLECTION DY-090117-PID-D 5
TO DRYERS 6, 7, 8 UTILITY AIR
TO SMALL BLEND TANKS SWITCHING VALVES
TO DRYERS 4, 5 UTILITY AIR
TO COMPOUND AREA
TO BOILER HOUSE
3-AU-UT-0108-N-M2-4
3-AU-UT-0110-N-M2-4
V-10 BLDG. STORAGE
V-10 DRYER BLDG.
PSV DM 055 2J3-SS-C 100 PSIG
DM-055
EQUIP INFO
6-AU-UT-0109-N-M2-4
3-AU-UT-0107-N-M2-4
TO COMPOUND AREA
DRYER 8 INS. AIR
DRYER 4 INS. AIR
TO CV-080B/CV-070 DY-090109-PID-D 54
TO CV-040B/CV-050 DY-090107-PID-D
TO CV-040A DY-090106-PID-D 54

DM-055
AIR SURGE DRUM
48" x 108"

DM-300
AIR SURGE DRUM

NO.	DATE	DESCRIPTION	BY	CKD	APD
0	2/25/94	ISSUED TO CLIENT	PAI	MGD	

APRD: MGD DATE: 2/25/94 | SCALE: NONE | LOCATION CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PLANT UTILITY AIR SYSTEM
SHEET 5 OF 5

NO. UT-090111-PID-D | ISSUE 0

FILE NO. 7
DISK NO. 7

ABD0003636363

CT-004
WEST COOLING TOWER

CWR FROM RX-700 17 OM-090107-PID-D
12-WH-OM-0009-N-M2-4
CWR FROM RX-600 17 OM-090106-PID-D
8-WH-OM-0007-N-M2-4
CWR FROM RX-500 17 OM-090105-PID-D
8-WH-OM-0005-N-M2-4
CWR FROM RX-400 17 OM-090104-PID-D
8-WH-OM-0003-N-M2-4
12-WH-UT-0044-N-M2-4
CWR FROM RX-300 17 OM-090103-PID-D
8-WH-OM-0001-N-M2-4
12 UT-090117-PID-D
14-WH-UT-0045-N-M2-4
16-WH-UT-0046-N-A2-3
14-WH-UT-0048-N-A2-3
3-WH-UT-0047-N-A2-3 → UT-090113-PID-D 8
3/4-XX-UT-0003-E-A2-1 → UT-090116-PID-D 8
3-WC-DY-0043-N-A2-3 → CWS TO INCINERATOR WATER SYSTEM DY-090134-PID-D 10
18-WH-UT-0046-N-A2-3 → UT-090114-PID-D 12
8-WH-UT-0073-N-M2-4
12-WC-UT-0047-N-A2-3
8-WC-UT-0048-N-A2-3
14-WC-UT-0049-N-A2-3
8-WP-UT-0334-N-M2-4
PIC PCV TS TI FI PI TE TT TCV PC
81T092 81T097 81H086 81H087 81H075 81H076 81H073 81H074 81L088 81L089
AH AL LSH LSL HOA HS A/O
50004B 50004A CT-004
PP-243 PP-281 PP-955
SP
CWS TO RX-700 OM-090107-PID-D 25 — 12-WC-OM-0009-N-A2-3
CWS TO RX-500 OM-090105-PID-D 25 — 8-WC-OM-0005-N-M2-4
CWS TO RX-600 OM-090106-PID-D 25 — 8-WC-OM-0007-N-A2-3
CWS TO RX-400 OM-090104-PID-D 25 — 8-WC-OM-0003-N-A2-3
CWS TO RX-300 OM-090103-PID-D 25 — 8-WC-OM-0001-N-A2-3
TO TK-313 OM-080123-PID-D 33 — 2-WC-OM-0024-N-A2-3
15-WC-UT-0045-N-A2-3
FROM CT-002 UT-090114-PID-D 40
FROM PLANT PROCESS WATER LOOP WP-090106-PID-D 42 — 4-WP-WP-0319-N-M2-4
UT-090117-PID-D 5
UT-090117-PID-D 6
UT-090117-PID-D 7
42 SA-090113-PID-D — 2-WP-SA-0185-H-M2-4

Node 31

PP-243 COOLING WATER PUMP
PP-281 COOLING WATER PUMP
PP-955 COOLING WATER PUMP

ISU	DATE	DESCRIPTION	BY	CKD	APD
2	8/12/94	REVISED FOR MOCA UT-006-93	RER	GWW	JBH
1	6/3/94	DRAWING UP-DATED	RER	LHS	JBH
3	2/17/95	REVISED FOR MOCA DCS-006-94	RER	GWW	JBH

APPD: MGD DATE: 2/25/94 | SCALE NONE | LOCATION CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PLANT COOLING WATER SYSTEM
SHEET 1 OF 4

FILE NO. ?
DSK NO. ?

NO UT-090112-PID-D | ISSUE 3

ABD00036364

CT-006
EAST COOLING TOWER

13 UT-090117-PID-D
UT-090112-PID-D
3-WH-UT-0047-N-A2-3
20-WH-UT-0048-N-A2-3
CWR FROM TK-751
9 NM-090123-PID-D
3-WH-NM-0038-N-A2-3
CWR FROM WE-299/300
12 NM-090126-PID-D
2-WH-NM-0065-N-M2-4
CWR FROM RX-741
17 NM-090103-PID-D
8-WH-NM-0026-N-A2-3
CWR FROM RX-742
17 NM-090104-PID-D
8-WH-NM-0027-N-A2-3
CWR FROM RX-743
17 NM-090105-PID-D
8-WH-NM-0028-N-A2-3
CWR FROM RX-744
17 NM-090106-PID-D
8-WH-NM-0029-N-A2-3
CWR FROM RX-745
17 NM-090107-PID-D
12-WH-NM-0030-N-M2-4
20-WH-UT-0049-N-A2-3
CWR FROM EX-334/336
NM-090111-PID-D
6-WH-NM-0038-N-A2-3
FROM FL-121/137
30 DY-090119-PID-D
4-WP-DY-0240-N-A13-1
31 NM-090108-PID-D
CWR FROM EX-335
6-WH-NM-0035-N-A2-3
CWR FROM EX-337/338
35 NM-090112-PID-D
8-WH-NM-0036-N-A2-3
2 NM-090117-PID-D
3 NM-090117-PID-D
CWR
UT-090115-PID-D 9
3-WH-UT-0072-N-A2-3
FROM SA MODULE
SA-090109-PID-D 12
8-WH-SA-0038-N-M2-4
8-WC-UT-0065-N-M2-4
16-WH-UT-0050-N-A2-3
20-WC-UT-0050-N-A2-3
S 82H072
HOA
S 82H073
S 82H071
S 82H086
HS A/C
HS A/O
TE I 82T097
LSH AH 82L086
LSL AL 82L086
PIC
PCV
PI
TI
FI
PS
50006B
50006A
PP-906
PP-907
PP-908
CT-006
2-WH-UT-0051-N-A2-3
UT-090114-PID-D 4
TO SA MODULE
4-WC-SA-0037-N-M2-4
SA-090109-PID-D 6
3-WC-UT-0053-N-A2-3
UT-090115-PID-D 7
3-WC-NM-0038-N-A2-3
NM-090123-PID-D 8
CWS TO TK-751
CWS TO WE 299/300
2-WC-NM-0078-H-A2-3
NM-090123-PID-D 10
I 82T088
TT
20-WC-UT-0050-N-A2-3
6-WC-UT-0052-N-A2-3
CWS TO EX-335
6-WC-NM-0034-N-M2-4
NM-090109-PID-D 17
CWS TO EX-334/336
6-WC-NM-0038-N-A2-3
NM-090111-PID-D 24
CWS TO RX-741
8-WC-NM-0025-N-A2-3
NM-090103-PID-D 25
CWS TO RX-742
8-WC-NM-0026-N-M2-4
NM-090104-PID-D 25
CWS TO RX-743
8-WC-NM-0027-N-M2-4
NM-090105-PID-D 25
10-WC-UT-0051-N-A2-3
CWS TO RX-744
8-WC-NM-0028-N-M2-4
NM-090106-PID-D 25
CWS TO RX-745
12-WC-NM-0029-N-M2-4
NM-090107-PID-D 25
3-WC-DY-0044-E-M2-4
DY-090134-PID-D 30
CWS TO INCINERATOR WATER SYSTEM
UT-090117-PID-D 1
3/4-XX-UT-0004-E-A2-1
UT-090116-PID-D 35
8-WC-NM-0035-E-M2-4
CWS TO EX-337/338
NM-090112-PID-D 37
FROM PLANT WATER LOOP
8-WP-WP-0318-S-M2-4
WP-090108-PID-D 44
UT-090117-PID-D 4

Node 32

PP-906/PP-907/PP-908
COOLING WATER PUMPS

ISU	DATE	DESCRIPTION	BY	CKD	APD
2	8/12/94	REVISED FOR MOCA UT-006-93	RER	GWW	JBH
1	4/25/94	DRAWING CORRECTIONS	RER		MGD
3	2/17/95	REVISED FOR MOCA DCS-006-94	RER	GWW	JBH

APPD: MGD
DATE: 2/25/94
SCALE: NONE
LOCATION CODE:
AREA:

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PLANT COOLING WATER SYSTEM
SHEET 2 OF 4

NO. UT-090113-PID-D
ISSUE 3

FILE NO.
DISK NO.

ABD00036365

CT-002
NORTH COOLING TOWER

4 UT-090113-PID-D — 2-WH-UT-0051-N-A2-3

10 UT-090115-PID-D — CWS TO AFTERCOOLERS — 2-WC-UT-0083-N-A2-3

12 UT-090107-PID-D — CWS TO CP-836 — 6-WC-UT-0058-N-M2-4

4-WC-UT-0060-N-A2-3

12 UT-090112-PID-D — 16-WH-UT-0046-N-M2-4

13 OM-090103-PID-D — CWR FROM TK-313 — 2-WH-OM-0075-N-A2-3

14 OM-090114-PID-D — CWR FROM EX-002/004/311 — 3-WH-OM-0022-N-A2-3

15 OM-090125-PID-D — CWR FROM EX-323 — 2" — 2"x3/4" — 3/4-WH-OM-0024-H-M2-4

8-WC-UT-0055-N-A2-3

16 OM-090111-PID-D — CWR FROM EX-008/009 — 6-WH-OM-0020-N-A2-3

17 OM-090113-PID-D — CWR FROM EX-351 — 4-WH-OM-0021-N-A2-3

18 OM-090114-PID-D — CWS TO EX-002/004/311 — 3-WC-OM-0021-N-A2-3

19 OM-090113-PID-D — CWS TO EX-351 — 4-WC-OM-0020-N-A2-3

20 OM-090108-PID-D — CWR FROM EX-340 — 6-WH-OM-0011-N-A2-3

21 OM-090115-PID-D — CWR FROM EX-376 — 4-WH-OM-0023-N-A2-3

22 OM-090115-PID-D — CWS TO EX-376 — 4-WC-OM-0022-N-A2-3

24 OM-090110-PID-D — CWS TO EX-005/006 — 4-WC-OM-0012-N-A2-3

25 OM-090111-PID-D — CWS TO EX-008/009 — 6-WC-OM-0018-N-A2-3

8-WH-UT-0052-N-A2-3

28 OM-090110-PID-D — CWR FROM EX-005/006 — 4-WH-OM-0013-N-A2-3

30 OM-090108-PID-D — CWS TO EX-340 — 6-WC-OM-0011-N-A2-3

31 UT-090107-PID-D — CWS TO CP-812 — 4-WC-UT-0060-N-A2-3

35 UT-090115-PID-D — 16-WC-UT-0054-N-A2-3

8 UT-090117-PID-D

10 UT-090117-PID-D

40 UT-090112-PID-D — 16-WC-UT-0045-N-A2-3

41 DY-090113-PID-D — TO EX-218/219 — 2-WC-UT-0058-N-A2-3

9 OM-090117-PID-D

44 OM-090125-PID-D — TO EX-323 — 2-WC-OM-0023-H-M2-4

11 UT-090117-PID-D

52 DY-090110-PID-D — TO V-11 DRYER BLDG. — 2-WC-DY-0061-N-A2-3

12"x6" — 12"x4" — 12-WC-UT-0056-N-M2-4 — 16"x3" — 16-WH-UT-0046-N-M2-4 — 16"x3/4" — A2-3 J16-1 J16-1 A2-3

3/4-XX-UT-0005-E-A2-3 — UT-090116-PID-D 10

12"x10" — 16-WC-UT-0054-N-M2-4 — 10-WC-UT-0057-N-M2-4 — 14-WH-UT-0053-N-A2-3

TIC T2 — FI — PI T2 — PP-252 — PP-253

16"x10" — 16"x10" — 2" PVC

AH B1L091 — LSH T2 — AL B1L080 — LSL T2 — TE T2 — I B1T096 — T1 T2 — HOA T2 — S B1H071 — HOA T2 — S B1H072

50002B

14"x12" — 14"x12"

CT-002

50002A BASIN

14"x10" — B.F. — 14"x10" — 14"x10" — 14"x10"

14-WH-UT-0056-N-A2-3

6-WC-UT-0062-N-M2-4 — 6-WC-UT-0062-N-A2-3 — UT-090115-PID-D 20

PI T2 — TI T2 — PP-258 — PP-257

UT-090117-PID-D 1

3/4-XC-UT-0014-B2-12 — UT-090115-PID-D 30

2-WH-UT-0059-N-A2-3 — FROM EX-218/219 DY-090113-PID-D 33

4-WH-UT-0058-N-A2-3 — FROM CP-912 UT-090107-PID-D 35

6-WH-UT-0057-N-M2-4 — UT-090107-PID-D 36 — FROM CP-836

14"x6" — 14"x4" — 6"x2"

14-WH-UT-0056-N-A2-3 — UT-090115-PID-D 38

16-WC-UT-0054-N-A2-3 — UT-090115-PID-D 40

2-WH-UT-0074-N-A2-3 — CWR UT-090109-PID-D 42

2-WH-DY-0060-N-A2-3 — FROM V-11 DRYER BLDG. DY-090110-PID-D 53

GRADE

Node33

PP-252/PP-253
COOLING WATER PUMPS
223.2' HD
BOWL
5/8" MP DIA
& BOWLS

PP-257/PP-258
COOLING WATER PUMPS
2 STAGE

NO.	DATE	DESCRIPTION	BY	CKD	APD
2	8/12/94	REVISED FOR MOCA UT-006-93	RER	GWW	JBH
1	4/25/94	DRAWING CORRECTIONS	RER		MCD
3	2/17/95	REVISED FOR MOCA DCS-006-84	RER	GWW	JBH

APPD. DATE: MGD 2/25/94 | SCALE: NONE | LOCATION CODE | AREA

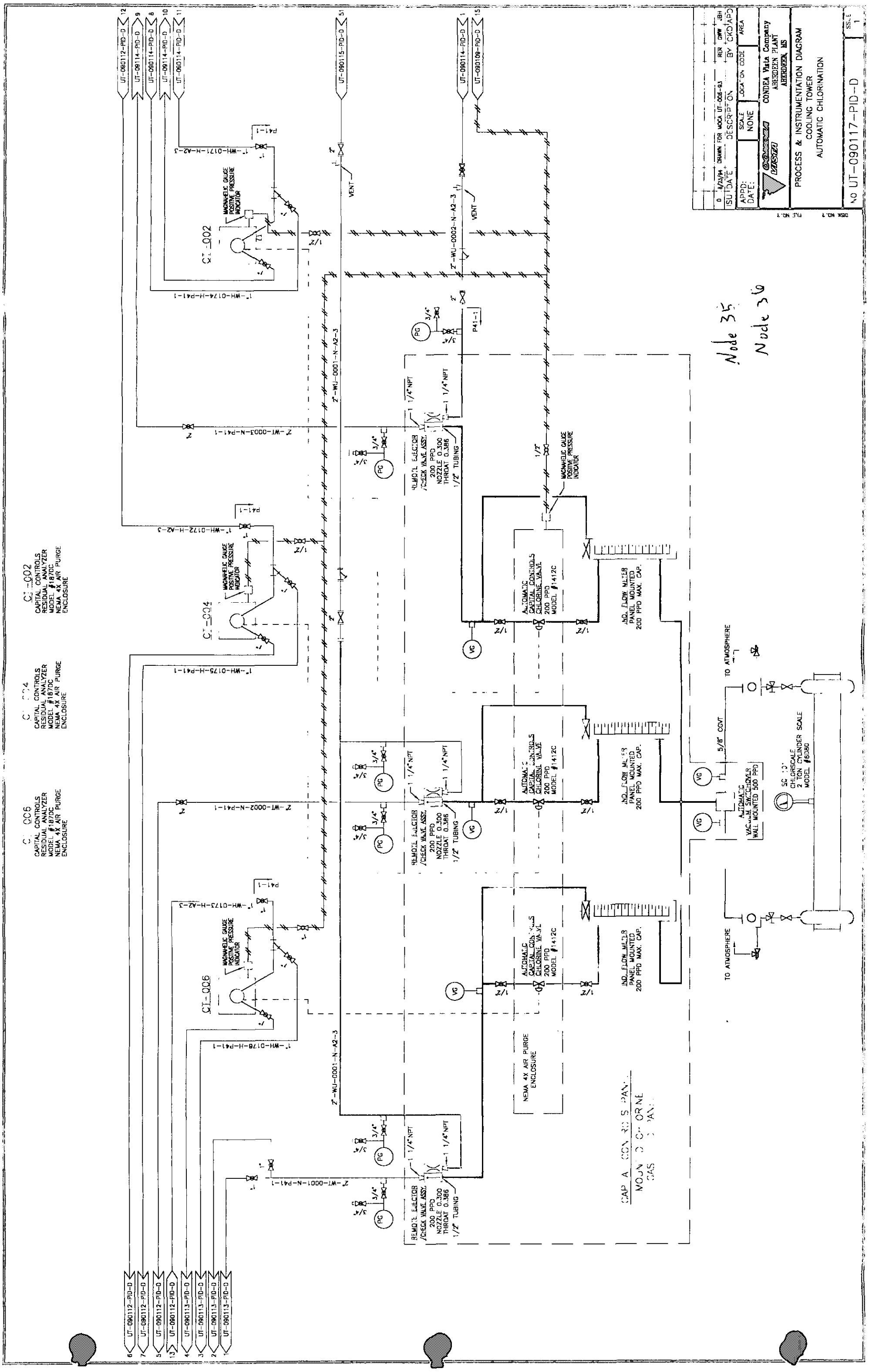
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
PLANT COOLING WATER SYSTEM
SHEET 3 OF 4

NO. UT-090114-PID-D — SHT 3

FILE NO. ? DISK NO. ?

ABD00036366


PROCESS & INSTRUMENTATION DIAGRAM
COOLING TOWER
AUTOMATIC CHLORINATION
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
DRAWING NO. UT-090117-PID-D
SCALE NONE
ISSUE DATE 8/23/94
DRAWN FOR MOCA UT-006-93
DESCRIPTION
BY CK'D/APD
APPD:
DATE:
AREA
LOCATION CODE
SIZE D
SHEET 1
DISK NO. 1
FILE NO. 1
UT-090112-PID-D
UT-090114-PID-D
UT-090115-PID-D
UT-090109-PID-D
UT-090113-PID-D
CT-002
CT-004
CT-006
CAPITAL CONTROLS RESIDUAL ANALYZER MODEL #1870C NEMA 4X AIR PURGE ENCLOSURE
MAGNAHELIC GAUGE POSITIVE PRESSURE INDICATOR
REMOTE EJECTOR /CHECK VALVE ASSY. 200 PPD NOZZLE 0.300 THROAT 0.386
1/2" TUBING
AUTOMATIC CAPITAL CONTROLS CHLORINE VALVE 200 PPD MODEL #1412C
IND. FLOW METER PANEL MOUNTED 200 PPD MAX. CAP.
VENT
TO ATMOSPHERE
5/8" CGVT
AUTOMATIC VACUUM SWITCHOVER WALL MOUNTED 500 PPD
CHLORSCALE 2 TON CYLINDER SCALE MODEL #6080
NEMA 4X AIR PURGE ENCLOSURE
Node 35
Node 36

CV-404
V NOTCH CHLORINATOR

W & I SERIES 75WAS
MAX. FEED: 360#/DAY

POLYMER SKID UNIT

MI-200
POLYMER FEED SYSTEM

W & I MAX - YIELD
MODEL 48-1008
10-100 GPM (DILUTION WATER)
MAX. FEED: 0.05 GPH

7 WP-090105-PID-D
1-WP-WP-0327-N-M2-4
3"x1"
3-WP-WP-0324-N-M2-4
PROCESS WATER
BP-090103-PID-D 7
TO COKE TRAY AERATORS
9 WP-090100-PID-D
1-WP-WP-0328-N-M2-4
TO VP-803/804
11 WP-090102-PID-D
1-WP-WP-0329-N-M2-4
12 WP-090104-PID-D
1-WP-WP-0339-H-M2-4
HOSE STA. ● TK-350
HOSE STA. WEST END OF CLARIFIERS
2-WP-WP-0325-N-M2-4
TO MI-400/401
WP-090105-PID-D 9
1-WP-WP-XXXX-X-041-1
ELECTRIC HOIST & TROLLEY
SPARE
PI 5846
PI 5847
PCV
HCV
FG
PSV
HS HOA HSOV
PI
PVC C.S.
2"X3/4"
702
XA 848
PAHL 848
PSHL 848
VAC
PI 5821
PI 5822
PI 5819
HS 848 HOA
HSOV 848
PI 5839
FG 5823
PCV T2
PCV 5824
PSV 5848
HCV 5825
PSV 5828
CV-404
VENT TO OUTSIDE OF CHLORINE ROOM
ASH 808B
ASH 808A
AIT 808
AE 808
AAH 808
LOCATED OUTSIDE OF CHLORINE ROOM
CHLORINE LEAK DETECTOR CYLINDER AREA MONITOR
RUN HL 847
XA 817 INTERLOCK FAILED
HL 847A
HS 847A OFF ON
HS 847 AUTO MAN
HL 847B RUN
HZIC 847 % STROKE
HSIC 847
HL 8475
PULSE RATE (SPEED)
AG-XXX
POLYMER ADDITION
CALIBRATION FEED TANK
POLYMER FEED PUMP
POLYMER FEED PUMP
POLYMER CLYINDER
POLYMER TRANSFER PUMP
POLYBLEND SYSTEM
1-XX-WP-0002-E-Q41-1
36 WP-090100-PID-D CHLORINE 2-XC-WP-0001-E-Q41-1
37 WP-090101-PID-D POLYMER 1-XX-WP-0002-E-Q41-1
13 WP-090101-PID-D
14 WP-090101-PID-D

POLYMER SKID UNIT

Node 37
Node 36

ISU	DATE	DESCRIPTION	BY	CKD	APD
3	1/25/96	REVISED FOR MOCA #UT-007-95	RER	VEM	JBH
2	1/25/96	REVISED FOR AFE: #G735	RER	GSN	JBH
1	5/2/94	DRAWING UP-DATED	RER	LHS	MGD
0	2/25/94	ISSUED TO CLIENT	PAI		MGD

APPD: MGD DATE: 2/25/94 | SCALE NONE | LOCATION CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

PROCESS & INSTRUMENTATION DIAGRAM
WATER TREATMENT PLANT
ADDITIVE SYSTEM

NO. WP-090106-PID-D | SHEET 3

FILE NO. 7
DSK NO. 7

ABD00036368

APPENDIX B

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

CONTROLLED DOCUMENT - MASTER LIST

Department: Mechanical	Page 1 of 1
Utilities Operations Manual (Propane System)	December 13, 1994

Identification Number	Title	Date
UT-PR-001	Propane System General Information	12/13/94
UT-PR-002	Start-up & Operation of Propane System	12/13/94
UT-PR-003	Propane System Shutdown	12/13/94
UT-PR-004	Propane Truck Unloading	12/13/94
UT-PR-005	Propane Tank Gauging	12/13/94
UT-PR-006	Propane System Emergency Procedures	12/13/94

CONTROLLED DOCUMENT - COPY # 2

FORM - ADMIN - 0002
REV. March 29, 1994

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

CONTROLLED DOCUMENT - DISTRIBUTION LIST

Department: MECHANICAL Date: December 13, 1994

Title: Utilities Operations Manual (Propane)

Holder (Location or Position)	Copy
Maintenance Supervisor - Utilities	M
Utilities Control Room	1
Mechanical Superintendent	2
Maintenance Engineer	3

Note: Copy "M" is the Master Copy of the Controlled Document.

CONTROLLED DOCUMENT - COPY # 2

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
PROPANE SYSTEM GENERAL INFORMATION	UT-PR-001

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. **Purpose-** To provide general information on the use & operation of the propane system.

II. **References-** MSDS For Propane.
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. **Safety and Health Considerations-**

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

IV. Discussion -

The propane vaporization system is designed to provide propane as a fuel when natural gas is not available. This system provides a switch in fuel without altering existing equipment. The Utility Operator handles the fuel changes.

Pure propane does not burn efficiently in systems designed to burn natural gas because the combustion of propane demands more air than the combustion of natural gas. In order to burn the propane in this system, the air demand is lowered to the same as natural gas by mixing the propane with air.

The major pieces of equipment in the propane vaporization system are the transfer pumps, the steam fired vaporizers, and the propane-air mixers.

There are two transfer pumps located at the south end of the center propane storage tank in the propane tank farm. Only one pump is ever used at any one time and the other pump is a spare. If there already is 125 psig in the feedline, there is enough pressure to sustain the vaporizers and the pumps may be bypassed.

The propane feeds into three vertical steam-fired vaporizers which are located north of the propane storage tanks. The steam to each of the vaporizers is left on to provide immediate service in winter months. Each vaporizer's output capacity is 100,000 S.C.F.H.

Vaporized propane is fed to one of the four venturi-type propane air mixers. The mixers are located between the vaporizers and the and the propane ~~storage~~ tanks. Each mixer contains 5 ventri mixer tubes that produce a 55% propane and a 45% air mixture. Each tube is controlled by individual regulators. The capacity of each mixer is 50,000 S.C.F.H.

The propane-air fuel gas is stored in three surge tanks located between the mixers and the propane storage tanks. The tanks are fed by the steam-fired vaporizers and mixers. The propane mixture feeds directly from the surge tanks to the plant fuel lines. The propane fuel gas flow is controlled manually by a valve north of the boiler house.

Liquid propane is fed to each of the steam-fired propane vaporizers at approximately 6,700 pounds per hour.

Steam is continually fed to each vaporizer at approximately 1,500 pounds per hour.

20,000 lb/hr ÷ 82 GPM

The steam pressure is reduced from 150 psig to approximately 25 psig by a regulator. This low pressure steam provides the heat required to vaporize the liquid propane.

The propane is vaporized and mixed with ambient air in the Algas Venturi Mixers. This mixture is approximately 55% and 45% air and has a specific gravity of 1.3 with a heating value of 1425 BTU/SCF. This gas exits the mixtures and flows into two of the mixed gas surge tanks 45-032 and 45-034. The high output pressure alarm will shut off the mixer if high pressure(>8.5 psig) develops in the surge tank.

Each of the three mixers will supply 50,000 SCFH of fuel gas to the plant. This fuel gas exits the surge tanks on demand through an existing 8 inch underground line and flows throughout existing lines to the plant at 8 psig.

V. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Mixers Low Temp.	02-TAL-410	30°F	Incomplete vaporization of propane, Improper air/propane mixing.	Increase steam flow to vaporizers. Check steam trap operation.
Propane Mixers Low Outlet Pressure	02-PAL-411	6.0 psi	Low fuel gas pressure to boilers and dryers.	Decrease boiler/dryer firing rates. Check propane system for proper operation.
Propane Mixers High Output		8.5 psi	Mixer shutdown / overload	Decrease boiler/dryer firing rates. Check mixer operation. Reset mixer.
Propane Mixers Low Inlet Pressure		60 psi	Mixer shutdown.	Check Propane Transfer Pump operation.
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

VI. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160°F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
START-UP & OPERATION OF PROPANE SYSTEM	UT-PR-002

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. **Purpose** - To provide the necessary information to start-up the propane vaporizers, switch the plant to propane and operate the propane system.

II. **References**- MSDS For Propane.
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. **Safety and Health Considerations**-

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

IV. Operating Procedure -

1.0 To Put Propane System Into Stand-by.

1.1 Pressure up lines and vaporizers.

1.1.1 Contact the Vinyl Control Room and Compound and inform the supervisor that you are going to pressure up liquid lines and vaporizers.

1.1.2 Make sure steam is on to each vaporizer and turn the OFF/ON switch to the ON position for each vaporizer (EA-101, 102, 103).

1.1.3 Inlet valves to mixers (101A, 101B, 103A, 103B) and Inlet valves to vaporizers (EA-101, 102, 103) should initially be closed. This is important for stable operations.

1.1.4 With controller in automatic, set pressure controller (PIC-2706) setpoint at 0 PSIG.

& CV2705

1.1.5 Make sure isolation valves (CV2701 & CV2702) are open.

1.1.6 Open the recirculation line valves and then slowly open the liquid valves on both large storage tanks (45-029 & 45-030) and open pump bypass valve.

1.1.7 Check pressure differential on pressure gauges that are on the inlet and outlet to the vaporizes the difference in pressure should not exceed 5 PSIG.

1.1.8 Open propane inlet valve to one vaporizer very slowly. The greater the pressure difference between the inlet and outlet of the vaporizer, the slower the inlet valve to the vaporizer should be opened.

1.1.9 Open propane inlet valves to the rest of the vaporizers.

1.1.10 Set pressure controller (PIC-2706) setpoint at 125 PSIG.

1.2 Pressure up mixers and surge tanks.

1.2.1 Open inlet and outlet valves of each surge tank (45-032, 034).

1.2.2 Open the five mixed gas valves in each mixer (101A, 101B, 103A, 103B).

1.2.3 Open the five vapor valves in each mixer (101A, 101B, 103A, 103B).

1.2.4 Open the mixer inlet valve very slowly trying not to cause drastic pressure changes at the vaporizer outlet.

= =

"NOTE"

If the valve to the mixer inlet is opened too fast, the possibility of getting liquid Propane past the vaporizers exists. The liquid Propane may freeze some of the five solenoid valves of the mixer.

= =

1.2.5 Open the rest of the mixer inlet valves slowly.

1.2.6 The Propane System is now in Stand-by.

2.0 Start-up (Shifting Plant to Propane).

Before shifting plant to propane the natural gas pipeline operator must be informed so that the gas can be shut off at the pipeline after switch over. This information is located with the key to the natural gas pipeline station.

2.1 Mixer Start-up.

2.1.1 Turn the Mixer Control Switch and the breaker at the Power Panel to the ON position for each mixer to be used.

2.1.2 If the voltage loss or overload light comes on, the mixers must be reset to operate.

2.1.3 Make sure flare valve is closed.

2.1.4 For the first mixer to be started the reset button must be depressed until the overload light goes out.

= =

"NOTE"

If the reset button is not released immediately after the overload light goes out, high discharge pressure can result. The unit will cease operation, and an indication of high output will appear on the Annunciator Panel.

= =

2.1.5 Reset the rest of the mixers to be put into operation. The overload light should not light up, therefore it is not necessary to hold down the reset button when resetting second mixer.

2.1.6 Mixers can be reset at the boiler house or in the field.

2.2 Pump Start-up.

Check the pressure controller gauge (PG-101) at the discharge of pumps (72-312, 72-868) if pressure is less than 125 PSIG one pump must be started.

Use the following procedure to start a pump.

2.2.1 Set pressure controller (PIC-2706) setpoint at 0 PSIG.

2.2.2 Select pump to be used and open the inlet and outlet valves. Make sure that inlet and outlet valves on pump not to be used are closed bypass valve.

2.2.3 Set pressure controller (PIC-2706) setpoint at 125 PSIG and start pump.

2.2.4 The pressure should not be permitted to go above 150 PSIG. If the pressure goes above 150 PSIG turn off pumps. The automatic pressure controller will control the pressure.

2.3 Switch-Over

2.3.1 Make sure the mixers are operating and system pressure has stabilized.

2.3.2 Notify the Vinyl Control Room and Compound that you are going to switch the plant to Propane.

2.3.3 Slowly open the propane valve at the fuel gas manifold located at north side of the boilerhouse.

2.3.4 Slowly close the natural gas valve while observing the gas pressure on the gas manifold gauge. Try to keep pressure as constant as possible. Pressure should not fall below 6 psig.

3.0 Normal Operation

3.1 Check operation and record readings on vaporizer run sheet three times a shift (See Appendix, Form PR-3).

3.2 Visually check the system for leaks or any abnormal operation.

3.3 Look for frosting as an indication of abnormal operation.

V. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Mixers Low Temp.	02-TAL-410	30°F	Incomplete vaporization of propane, Improper air/propane mixing.	Increase steam flow to vaporizers. Check steam trap operation.
Propane Mixers Low Outlet Pressure	02-PAL-411	6.0 psi	Low fuel gas pressure to boilers and dryers.	Decrease boiler/dryer firing rates. Check propane system for proper operation.
Propane Mixers High Output		8.5 psi	Mixer shutdown / overload	Decrease boiler/dryer firing rates. Check mixer operation. Reset mixer.
Propane Mixers Low Inlet Pressure		60 psi	Mixer shutdown.	Check Propane Transfer Pump operation.
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

VI. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160^{0}F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
PROPANE SYSTEM SHUTDOWN	UT-PR-003

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. Purpose - To provide the necessary information to shutdown the propane system and switch back to natural gas.

II. References- MSDS For Propane.
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. Safety and Health Considerations-

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

UTILITIES OPERATIONS MANUAL	
PROPANE SYSTEM SHUTDOWN	UT-PR-003

IV. Operating Procedure -

1.0 Propane System Shutdown

Before shutdown of propane system, inform natural gas pipeline operator that we will be switching back to natural gas.

1.1 Switch from propane to natural gas.

1.1.1 Notify the Vinyl Control Room and Compound that you are going to switch the fuel gas from propane back to natural gas.

1.1.2 Slowly open natural gas valve on gas manifold north of boilerhouse.

1.1.3 Slowly close propane valve on gas manifold making sure to keep fuel gas pressure above 6 psig.

1.1.4 Turn off pumps (72-312, 72-868).

1.1.5 Close isolation valves (CV2701 & CV2702) and pump inlet control valve (CV2705).

1.1.6 Turn off mixers (MX-101A, 101B, 103A, 103B).

1.1.7 Close inlet valves to mixers. This is important to prevent freeze up of mixers.

1.1.8 Bleed pressure off surge tanks (45-032, 45-034) through Boiler #1. After Boiler #1 shuts down on low gas pressure, light flare and bleed remaining pressure off surge tanks.

1.1.9 Notify the Vinyl Control Room and Compound that the switch from propane to natural gas has been made.

1.1.10 The system is now in stand-by.

1.2 To take system out of stand-by.

1.2.1 Close inlet valve to vaporizers.

1.2.2 Turn off vaporizers (EA-101, EA-102, EA-103).

1.2.3 Close tank (45-029, 45-030) re-circulation line valves.

1.2.4 Close tank (45-029, 45-030) liquid discharge valves.

V. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Mixers Low Temp.	02-TAL-410	30°F	Incomplete vaporization of propane, Improper air/propane mixing.	Increase steam flow to vaporizers. Check steam trap operation.
Propane Mixers Low Outlet Pressure	02-PAL-411	6.0 psi	Low fuel gas pressure to boilers and dryers.	Decrease boiler/dryer firing rates. Check propane system for proper operation.
Propane Mixers High Output		8.5 psi	Mixer shutdown / overload	Decrease boiler/dryer firing rates. Check mixer operation. Reset mixer.
Propane Mixers Low Inlet Pressure		60 psi	Mixer shutdown.	Check Propane Transfer Pump operation.
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

UTILITIES OPERATIONS MANUAL	
PROPANE SYSTEM SHUTDOWN	UT-PR-003

VI. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160°F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
PROPANE TRUCK UNLOADING	UT-PR-004

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. **Purpose** - To provide the necessary information to off-load propane tank trucks.

II. **References**- MSDS For Propane.
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. **Safety and Health Considerations-**

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

UTILITIES OPERATIONS MANUAL	
PROPANE TRUCK UNLOADING	UT-PR-004

IV. Operating Procedure -

1.0 Propane Tank Truck Off-Loading Procedures.

1.1 Guard will notify utility operator upon propane tank truck arrival.

1.2 Truck proceeds to truck scale (Operator must be familiar with weighing techniques in case a yard operator is not available).

1.3 Fill out scale ticket data.

1.4 Weigh truck, leave ticket in scale house.

1.5 Truck proceeds to unloading site.

1.6 Secure road south of boilerhouse with yellow Caution Tape and inform contractors in the contractor area that **no hot work** is allowed until offloading is complete.

1.7 Gauge tanks prior to unloading truck. Under normal operation, the East tank will not be loaded during this procedure and does not require gauging. Inlet to East tank must be closed prior to unloading.

1.8 Check gauging table to determine volume in tanks. Enter these values along with the date and time on the Propane Tank Differential Volume Record.

1.9 Obtain tank truck capacity. Divide the capacity by two and add to each tank. Check gauging table to ensure that tanks will safely hold entire volume of tank truck. Enter these values onto the Propane Tank Differential Volume Record. (See Appendix, Form PR-1).

1.10 Proceed with unloading.

1.11 Truck driver is to guard truck, hook up hoses, and open valves on truck and unloading station.

1.12 Utility operator must confirm that all connections are made

correctly and required valves are opened.

1.13 Truck driver will start truck pump and proceed to unload truck.

1.14 Truck driver is to remain with truck during entire unloading procedure.

1.15 In the event of a line rupture during off loading, the remote valves (CV2703, CV2704) on the system can be closed from off the loading station hand switch. If possible, the liquid and vapor manual block valves should be closed.

1.16 When tank truck is empty, the truck driver is to close valves on the unloading station and truck.

1.17 Utility operator must confirm that correct valves are closed.

1.18 The truck driver and utility operator will depressure through vent to flare discharge only and disconnect hoses.

1.19 Replace unloading station pipe caps.

1.20 Remove Caution tape from road.

1.21 Truck proceeds to truck scale.

1.22 Weigh out truck and keep weigh ticket.

1.23 Gauge tanks and along with time of completion, enter these values onto the Propane Tank Differential Volume Record.

1.24 Attach Propane Tank Differential Volume Record and weigh ticket to morning report and give to the utility supervisor.

V. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

VI. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160^{0}F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
PROPANE TANK GAUGING	UT-PR-005

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. **Purpose** - To provide the necessary information to check propane storage tank level.

II. **References**- Propane MSDS
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. **Safety and Health Considerations**-

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

IV. Discussion -

Propane is stored in three horizontal bullets located east of the boilerhouse. The middle and west bullets are approximately 10 feet in diameter and 45 feet long. The east bullet is approximately 8 feet in diameter and 42 feet long. The east and west bullets are equipped with 2 dipsticks, one extending to the bottom and the other extending to the middle of the tank. Each dipstick has a small bleed that will vent liquid when the interface is detected. The following procedure is used when taking inventory on the propane bullets.

V. Operating Procedure -

1.0 Middle and West Bullets.

1.1 Loosen the dipstick apparatus that extends to the middle of the bullet and fully extend the dipstick.

1.2 Open the bleeder slightly and gradually lower the dipstick.

1.3 When liquid starts coming from the bleeder, stop lowering the dipstick and close bleeder.

1.4 Measure the distance from the top of the manway to the bottom of the dipstick cap.

1.5 Add the measured reading to 60 inches and record on inventory sheet (See Appendix).

1.6 If no liquid is detected with this dipstick, measure level with dipstick that extends to the bottom of the bullet. Use the same procedure as above, except record the inches measured (do not add 60 to reading).

2.0 East Bullet.

2.1 Loosen level device and open bleeder a small amount.

2.2 Rotate level beginning at 100% until liquid starts coming from bleeder. Then close bleeder.

2.3 Record percentage full on inventory sheet (See Appendix).

UTILITIES OPERATIONS MANUAL	
PROPANE TANK GAUGING	UT-PR-005

WEST AND MIDDLE PROPANE BULLETS					
STRAPPING TABLE					
Depth (Inches)	Capacity (Gallons)	Depth (Inches)	Capacity (Gallons)	Depth (Inches)	Capacity (Gallons)
6	522.6	*48*	11252.8	*86*	23435.0
12	1435.5	*50*	11900.1	*88*	23991.5
14	1864.4	*52*	12547.8	*90*	24569.1
16	2284.5	*54*	13203.7	*92*	25131.8
18	2724.1	*56*	13860.2	*MAX 95.4*	25798.4
20	3187.2	*58*	14385.7	*96*	26177.8
22	3668.0	*60*	15175.5	*98*	26687.8
24	4171.2	*62*	15846.2	*100*	27153.2
26	4692.5	*64*	16477.7	*102*	27624.3
28	5227.0	*66*	17146.9	*104*	28071.7
30	5780.1	*68*	17813.5	*106*	28408.6
32	6392.4	*70*	18437.8	*108*	28863.2
34	6924.0	*72*	19096.7	*110*	29249.6
36	7516.0	*74*	19750.4	*112*	29535.8
38	8118.8	*76*	20359.8	*114*	29826.1
40	8727.7	*78*	21000.3	*116*	29932.6
42	9349.0	*80*	21632.8	*118*	30246.3
44	9978.3	*82*	22219.5	*120*	30351.1
46	10610.6	*84*	22833.2		

EAST PROPANE BULLET					
STRAPPING TABLE					
Depth %	Capacity (Gallons)	Depth %	Capacity (Gallons)	Depth %	Capacity (Gallons)
2	76.9	*36*	5644.6	*70*	13226.2
4	218.8	*38*	6083.9	*72*	13635.8
6	403.2	*40*	6529.2	*MAX 74.2*	14074.8
8	621.4	*42*	6977.7	*76*	14424.6
10	868.0	*44*	7428.7	*78*	14801.2
12	1140.0	*46*	7883.6	*80*	15164.3
14	1434.2	*48*	8339.9	*82*	15513.0
16	1748.4	*50*	8796.7	*84*	15845.1
18	2080.5	*52*	9253.7	*86*	16159.3
20	2429.1	*54*	9709.9	*88*	16453.6
22	2792.4	*56*	10164.8	*90*	16725.4
24	3169.0	*58*	10615.9	*92*	16972.2
26	3557.8	*60*	11064.3	*94*	17190.3
28	3957.7	*62*	11509.6	*96*	17374.6
30	4367.3	*64*	11948.9	*98*	17518.7
32	4786.6	*66*	12381.7	*100*	17593.5
34	5211.9	*68*	12806.9		

UTILITIES OPERATIONS MANUAL	
PROPANE TANK GAUGING	UT-PR-005

VI. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

VII. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160°F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

FOR FINAL REVIEW/APPROVAL

UTILITIES OPERATIONS MANUAL	
PROPANE SYSTEM EMERGENCY PROCEDURES	UT-PR-006

Approved: _____ Date: 12/13/94
Jimmy Autrey - Maintenance Manager

I. **Purpose** - To provide the necessary information to operate or shut down the propane system in emergency situations.

II. **References**- MSDS for Propane
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial Equipment Company.

III. **Safety and Health Considerations-**

General - Liquid propane may cause frostbite if contacted. Vapor has a natural gas odor. Propane is extremely flammable & heavier than air.

A. Properties/Hazards of Chemicals - Reference MSDS.

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Propane	Nomex	Deluge System General Monitors	N/A

C. Control Measures to be Taken if Exposed - Reference MSDS

Inhalation - Remove to fresh air. Guard against self injury. Apply artificial respiration if breathing has stopped.

CONTROLLED DOCUMENT - COPY # 2

IV. Operating Procedure -

1.0 Fire or Vapor Release.

In case of a fire or vapor release in the propane system, the utility operator is to press the emergency propane shutdown switch on the boiler control panel. This switch will shut down the propane pumps (72-312, 72-868) and close isolation valves, CV2701, CV2702, and CV2705. Isolating the storage tanks (45-029, 45-030), pumps (72-312, 72-868) and vaporizers (EA-101, EA-102, EA-103).

Call the Vinyl Control Room to sound emergency alarm and get help to secure unit, then notify the Compound area.

2.0 Power Failure.

2.1 While plant is not on propane.

2.1.1 In the event of a power loss, the Propane Emergency switch is automatically activated. This in turn closes the three automatic control valves (CV-2701, CV-2702, CV-2705) in the system and shuts the propane pumps off.

2.1.2 When power is restored simply re-open the valves (CV-2701, CV-2702, CV-2705) from either the boilerhouse panel or field controller. The field controller is located near the pumps (72-312, 72-868).

2.2 If plant is on propane.

2.2.1 If plant is on propane, follow step 2.1 as stated above.

2.2.2 Reset Mixers.

2.2.3 Re-start pumps following Procedure # UT-PR-002 *Operation & Start-up of Propane System*.

V. Operating Limits -

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Propane Gas High LEL	02-AAH-402	40%	Deluge system trip	Check propane system for leaks.
Propane Deluge System Low Air Pressure	02-PAL-402	20 psi	Deluge system trip	Check instrument air pressure

VI. Safety Systems and Their Functions -

Safety System	Function Performed
Deluge System	Floods area with water if: 1) Excessive heat (160°F) is detected, or 2) High hydrocarbon (approximately 40% hydrocarbon) concentrations are detected, or 3) Loss of air pressure (approximately 25-35 psig)occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

Utilities Operations Manual	
Operation of the Instrument Air Compressors, CP-708 (North) and CP-709 (South).	UT-AS-001

Approved: _____ Date: 8/2/95
Jimmy Autrey-Maintenance Manager

I. Purpose-

The purpose of this procedure is to provide information on the operation of the plant instrument air compressors.

II. References-

Vista Safety and Health Manual
Utility Procedures

III. Safety and Health Considerations-

A. Properties/Hazards of Chemicals-Hot, high pressure air.

Chemical	Personal Protective Equipment	Engineering Controls	Administrative Controls
Hot, High Pressure Air	Hearing Protection and Leather Gloves	Safety Showers and Eye Wash Stations	Safety and Health Procedures

B. Precautions to Prevent Exposure-Refer to Section VI, Operating Limits, this procedure.

C. Control Measures to be Taken if Exposed-
*Cool burns under safety shower or eye wash station.

D. Special or Unique Hazards-Extremely high noise area.

Utilities Operations Manual	
Operation of the Instrument Air Compressors, CP-708 (North) and CP-709 (South).	UT-AS-001

IV. Discussion

Instrument air is very hot after it discharges the compressor. The mechanical friction and the action of compressing air will cause the air temperature, on the discharge header,to exceed 200°F.

Coolers are supplied to lower that temperature before it reaches the Deltech air dryer. The air dryer operation will be covered in another procedure.

V. Operating Procedure

1.0 Start-up Procedure for Instrument Air Compressors, CP-708 and CP-709.

1.1 Check to make sure electrical power is available.

1.1.1 Check that breaker is closed.

a. Breaker is located at the Emergency Generator Substation east of Substation #5 and south of dryer building.

1.2 Open discharge block valve for compressor to be started.

1.2.1 6" discharge valve for #8 (north) compressor.

1.2.2 4" discharge valve for #9 (south) compressor.

1.2.3 Check that the instrument air to plant air interceptor valve is closed.

a. May have to close manual valve until plant air compressors are started during a plant outage.

1.2.4 Check that all vents and drains are closed on the air and cooling water systems.

1.3 Visually check that all trips are in service.

1.3.1 North compressor, CP-708.

a. Low cooling water pressure.
b. High discharge temperature.
c. High vibration shutdown.

1.3.2 South compressor, CP-709.

a. Low cooling water pressure.
b. High discharge temperature.
c. High vibration shutdown.

1.4 Place the LOAD/UNLOAD switch in the UNLOAD position.

1.4.1 Compressor will start easier, with less electrical demand, when started in the unloaded position.

a. The selector switch is used to increase the discharge pressure from the compressor.
b. In the unloaded position, the air is recycled back through the compressor.

1.5 Depress the start button or select start, depending on the switch supplied with the compressor.

1.5.1 Monitor the compressor, listening to unusual noises and vibrations.

a. Check the oil pressure, should be approximately 40 PSIG.
b. Check the innercooler pressure, should be on the plus side and near 30 PSIG.

1.6 Select LOAD with the selector switch.

1.6.1 Instrument air pressure to the plant should begin to rise.

a. Monitor the discharge pressure of the compressor.
b. After a few minutes, under load monitor the compressor, looking for problems.

2.0 Aftercooler Operation.

2.1 Aftercooler is a two pass heat exchanger.

2.1.1 Hot instrument air enters the cooler at approximately 200°F.

2.1.2 Cooling water passes over the internal header, shell side, and cools the air.

2.1.3 Hot cooling water is returned to the cooling water return header.

2.1.4 Air enters the second section of the aftercooler at approximately 83°F.

2.1.5 Cooling water passes over the second section's internal header, cooling it.

2.1.6 Air is then routed to the Deltech air dryer at approximately 80°F.

a. A moisture trap is located on the outlet of the air header on the aftercooler, before the Deltech air dryer.
b. A bypass header is provided to bypass the aftercooler in the event of a leak on the system.

2.1.7 The second stream of cooling water is routed to the cooling water return.

3.0 Monitoring Operation.

3.1 The technician must make several passes around the air compressors through the shift looking for things out of the ordinary.

3.1.1 Listen to the compressor.

a. Listen for unusual noises.
b. Listen for leaks of air.

3.1.2 Look for water leaks.

a. Check the packing on the heads for leakage.

3.1.3 Check the oil level in the compressor.

a. Add oil if it is low.
b. Check for oil leaks. Swap compressors if the leak becomes a hazard or is excessive.
c. Place a catch pan or bucket to catch the oil drips from the leak.

3.1.4 Monitor the temperature and pressure gauges on the entire system.

a. Investigate and report unusual findings.

3.1.5 Check the instrument air to plant air interceptor valve position.

a. It should be closed.

3.1.6 Check the flows and temperatures through the aftercooler.

a. Refer to procedure UT-002, Section 2.0, concerning the operation of the aftercooler.

4.0 Shutdown of the Instrument Air Compressor.

4.1 Swapping compressors for rotation or maintenance.

4.1.1 Start up the standby compressor before shutting down the compressor scheduled to be repaired.

4.1.2 Follow steps in Section 1.0, this procedure, dealing with compressor start-ups.

4.1.3 After the other compressor is on the line and running smooth, shutdown the one scheduled to be repaired.

a. Select UNLOAD on the selector switch for the compressor to be shutdown.
b. Depress the STOP button or select OFF, depending on the type of switch supplied.
c. Prepare the instrument air compressor for maintenance per procedure UT-AS-002, if work is to be performed. Follow existing plant procedures for tag out of energy sources.

4.2 Isolate the cooling water supply if the compressor will be down for an extended period of time.

4.2.1 Will prevent water buildup if a seal is leaking.

a. Crack open a drain on the compressor head.

****

Precautions must be taken due to extremely hot surfaces and high noises.

****

5.0 Safety

5.1 Compressors produce noises that can damage your hearing.

5.1.1 Wear hearing protection at all times in the area.

5.2 Some surfaces can exceed temperatures over 200°F.

5.2.1 Wear leather gloves whenever operating valves or climbing in the piperack.

5.2.2 Be careful where you place your hands or other parts of your body.

5.3 The compressors are driven by belts. Do not stick your hand or tools past the belt guard unless the equipment is isolated and tagged out.

Utilities Operations Manual	
Operation of the Instrument Air Compressors, CP-708 (North) and CP-709 (South).	UT-AS-001

VI Operating Limits

Critical Parameter	Loop Number	Operating Limit	Consequence Of Deviation	Preventive Or Corrective Action
Hot, High Pressure Air	N/A	100 PSIG and <140° F	Produces Hot Surfaces, Potential for Burns	Insulated Lines and Equipment
Hot Oil	N/A	<100° F	Oil Filter Changes Expose Personnel to High Temperature Oil	Wear Protective Equipment. Proper Body Position
High Noise Area	N/A	<85 Decibels in an 8 Hour Period	Hearing Loss	Wear Hearing Protection

VII Safety Systems and Their Functions

Safety Systems	Function Performed
Safety Showers/Eye Baths	Provide Fresh Water in Case of Chemical Exposure or Dirt in Eyes

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

Approved: _____ Date: 8/2/95
Jimmy Autrey-Maintenance Manager

I. Purpose

The purpose of this procedure is to provide information on the operation and isolation of the Deltech air dryer, located east of the instrument air compressors.

II. References

Vista Safety and Health Manual
- *Energy Lock Out Procedure
- *Confined Space Entry Procedure
- *Safe Work Permit Procedure

Utility Procedures

III. Safety and Health Considerations

A. Properties/Hazards of Chemicals-Hot, high pressure air and steam.

Chemical	Personal Protective Equipment	Engineering Controls	Administrative Controls
Hot, High Pressure Air	Leather Gloves Hearing Protection	Safety Shower Eye Wash	Safety and Health Procedures
Steam, Condensate, and Hot Refrigerant	Leather Gloves Hearing Protection	Safety Shower Eye Wash	Safety and Health Procedures

B. Precautions to Prevent Exposure-Refer to Section VI, Operating Limits, in this procedure.

C. Control Measures to be Taken if Exposed-
*Cool burns under safety shower or eye wash station.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

D. Special or Unique Hazards-Hot surfaces and chain operated automatic valves.

IV. Discussion

The Deltech air dryer is used to dry the air on the discharge of the north and south instrument air compressors. Instrument air is routed to the plant for use in the control of air operated motor valves and other control systems.

The Deltech air dryer is very similar in operation to the Pall air dryer. The major difference is that the Pall air dryer uses heated desiccant to dry the air, while the Deltech uses cooled desiccant.

The Deltech air dryer consist of two separate vessels that contain a desiccant material used to remove moisture from the incoming air. After a set time has elapsed, four hours, the bed automatically goes into a regeneration cycle to remove the trapped water, from the desiccant, while the other bed automatically goes in service. There is no disruption in flow.

In preparing the equipment for maintenance, every effort must be made to insure that the dryer is safe for maintenance to work on. The plant tag out/lock out procedure must be followed and equipment must be isolated to insure safe work conditions exist.

The plant procedure dealing with a confined space entry must be followed if, during the course of mechanical repairs or inspection, any opening of the dryer is entered. The insertion of a hand to loosen or remove something, for example, is classified as a physical entry.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

V. Operation/Isolation Procedures

1.0 Equipment Used at the Deltech Air Dryer.

1.1 A prefilter is used to filter the incoming air.

1.1.1 Bypass provided to continue in service operation during the changing of the filter element.

1.2 Inlet air/outlet air exchanger.

1.2.1 Incoming hot air is passed on the shell side of a heat exchanger.

1.2.2 Outlet cool air is passing on the tube side of the exchanger.

1.3 Moisture knock out pot is located before the air enters the bottom of the in service bed.

1.3.1 Solenoid opens and closes, removing collected water.

1.4 Inlet air/refrigerant exchanger.

1.4.1 Cool air is cooling further by passing the cool refrigerant tubing.

a. Solenoid opens and closes, removing collected water from the bottom of the exchanger.

1.5 Two desiccant beds, one in service/one in regeneration.

1.5.1 Air enters the bottom of the in service bed and exits at the top.

1.5.2 Air enters the top of the bed in regeneration and exits the bottom, to atmosphere.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

1.6 The refrigeration system is used during the in service and regeneration modes.

1.6.1 The refrigeration system continually runs.

****

Caution must be exercised due to the presence of hot refrigerant lines.

****

1.7 Purge air heater is used during regeneration process.

1.7.1 A small stream of air is taken from the outlet header.

a. Purge air is passed through an air/hot refrigerant gas exchanger.
b. Hot air is pass through a second exchanger, hot air/steam.
c. The hot stream of air enters the top of the bed, during the regeneration cycle, and exits through a vent at the bottom of the bed, to the atmosphere.

1.8 Outlet air header filters.

1.8.1 Two are provided, one in service while the other is on standby.

2.0 In Service Operation.

2.1 Check that electrical power is available.

2.1.1 Breaker is located in the emergency generator substation, north of the plant air compressors.

a. Breaker is located at power panel MCC 10A1-E, breaker 1G.
b. Refer to procedure UT-EL-001, Section 3.0 concerning energizing electrical breakers.

c. A power on light, plus lights to indicate which bed is in service or regenerating, is located on the indicator panel at the dryer.

2.2 Check that the valving is correct to allow air to flow from the surge tank, through the dryer bed, and out to the instrument air header.

2.2.1 Air leaves the surge tank and passes through a prefilter.

2.2.2 Air enters the shell side of an air to air heat exchanger.

a. Hot, compressed air is precooled by the cool outlet air. Hot air enters the shell side of the exchanger.
b. Cool outlet air is warmed on the tube side of the exchanger.

2.2.3. The air flows through a separator pot, removing moisture before it enters the dryer bed.

a. Automatic solenoid removes water from the bottom of the pot.

2.2.4 Air enters another exchanger, cool air/cold refrigerant gas desiccant, and out the bottom of the exchanger.

a. Automatic solenoid removes water from the bottom of the exchanger.

2.2.5 Air enters the bottom of the in service bed and exits at the top of the bed.

a. Cool outlet air enters the air/air exchanger mentioned in section 2.2.2, this procedure.
b. A small stream of outlet air is drawn off for use in the regeneration process.

2.2.6 Air enters one of two outlet air filters.

a. One filter is in service, the other on standby.

2.2.7 Air flows out the Deltech building and through a manual control valve.

a. The manual valve is chained and locked in a preset position, restricting the flow of instrument air to the plant.

2.3 Check the refrigerant flow through the in service bed.

2.3.1 Refrigerant gas is passed through the air/refrigerant exchanger, where the air enters the in service bed.

2.3.2 Cold refrigerant exits the cooler and splits into two directions.

a. One stream goes to a liquid separator, through a filter, then to the refrigeration compressor.
b. The other stream passes an expansion valve and enters the outboard top of the in service dryer bed.
c. A series of check valves, expansion valves, and solenoids control or direct the flow of refrigerant through the system.

2.3.3 Cold refrigerant enters the top of the in service bed and passes through rows of tubing in the desiccant, and exits at the top, inboard side of the bed.

2.3.4 The warm gas, exiting the in service bed, passes through another expansion valve and splits into two directions.

a. One stream passes through a sightglass and back to the condenser.
b. The other stream passes another expansion valve and passes back through the air/refrigerant exchanger.

3.0 Regeneration Cycle.

3.1 A timer determines when the beds will swap, one in service while the other goes into a regeneration cycle.

3.1.1 Solenoids, check valves, and chain operated valves will automatically position for the mode of operation of the bed.

3.2 The refrigeration compressor discharges hot refrigerant through tubing and to the bed in regeneration.

3.2.1 An automatic solenoid opens, allowing hot refrigerant to enter the top, outboard side of the bed in regeneration.

a. Cooled refrigerant gas exits the top inboard side of the bed in regeneration.

****

Caution must be exercised due to the presence of hot refrigerant lines.

****

3.2.2 A series of check valves and solenoids will route the gas to the top of the purge air heater.

a. Heated refrigerant exits the heater and enters the compressor condenser.

3.3 Regeneration purge air is used to remove the accumulated moisture in the desiccant during the heating cycle.

3.3.1 A small stream of outlet air is routed through a purge air heater.

a. Hot refrigerant gas is cooled by the incoming air flow.
b. The incoming air is preheated before entering another heater.

3.3.2 The air stream from the refrigerant/air heater is pass through a steam heater.

a. The air stream is heated to approximately 165° F before it enters the top of the bed in regeneration.

3.3.3 The hot purge air flows through the desiccant that is heated by the hot flow of refrigerant gas through the tubes. See section 3.2, this procedure.

3.3.4 The hot, moist air vents, to the atmosphere, at the bottom the bed in regeneration.

a. Prior to this vent opening, another vent will open to bleed the pressure off the vessel. This vent is equipped with a muffler.

4.0 Isolation and Tag Out/Lock Out of the Deltech Air Dryer.

4.1 If needed, leave the instrument air compressor(s) running and route to the plant air compressor surge tank.

4.1.1 Slowly open the 6" manual block valve at the west side of the plant air compressor surge tank.

a. Attaching a chain, lock, and "Do Not Operate" tag to the open valve is an option. This will warn others not to operate this normally closed valve.

4.1.2 Slowly open the manual bypass valve at the plant air to instrument air interceptor valve. The valve is located just west of the instrument air compressors.

a. Attaching a chain, lock, and "Do Not Operate" tag to the open valve is an option. This will warn others not to operate this normally closed valve.

4.2 Dryer must be bypassed before isolation and tag out/lock out.

4.2.1 The steps in Section 4.1, this procedure, will allow the Deltech air dryer to be bypassed.

4.2.2 Open the breaker for the control power for the Deltech air dryer.

a. Breaker located in the emergency generator substation, north of the plant air compressors.
b. Breaker is at MCC 10A1-E, breaker 1G.
c. Attach a lock and "Do Not Operate" tag to the breaker.

4.2.3 Slowly close the downstream manual block valve, at the knockout pot, at the aftercooler.

a. Attach a chain, lock, and "Do Not Operate" tag to the closed isolation valve.

4.2.4 Close the aftercooler air bypass manual block valve.

a. Attach a chain, lock, and "Do Not Operate" tag to the closed isolation valve.

4.2.5 Close the manual block valves on the discharge of the outlet air filters (two).

a. Attach a chain, lock, and "Do Not Operate" tag to the closed isolation valves.
b. One chain, lock, and tag can isolate both valves.

4.2.6 Open a manual vent on the air side of the dryers and vent the system.

a. Attach a chain, lock, and "Do Not Operate" tag to the opened vent valve.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

5.0 Returning the Deltech Air Dryer Back to Service.

5.1 Check that maintenance has completed their work.

5.1.1 All replaced materials must be removed from the area.

a. Housekeeping must be completed.
b. Hoses, trash, and drums removed from the area or stored in proper location.

5.2 Remove the chains, locks, and tags from the valves.

5.2.1 Account for each lock and tag placed.

5.3 Restore electrical power back to system.

5.3.1 Leave the ON/OFF switch at the control panel in the OFF position.

a. If system was down for more than 4 hours, leave the ON/OFF switch OFF while the refrigeration compressor and system normalize.
b. If the system was down for less than 4 hours, turn power on and begin returning system back to normal operation.

5.4 Close the vent at the dryer used to bleed pressure from the system.

****

Check for water on the air side of the system.
Drain any accumulated water.

****

5.5 Slowly open the downstream block valve on the aftercooler.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

5.5.1 Check for moisture that may have accumulated in the pot during the outage.

a. If air is dry proceed, if not drain the water and determine if there is a tube leak on the aftercooler.

5.6 Slowly open the inlet air filter block valve.

5.6.1 Bleed any accumulated moisture from the line.

5.7 Slowly open the dryer outlet air filter (just one) block valve.

5.7.1 One in service, one closed and on standby.

5.8 Close the 6" block valve at the plant air surge tank.

5.9 Close the bypass block valve around the plant air to instrument air interceptor valve.

6.0 Safety at the Dryers.

****

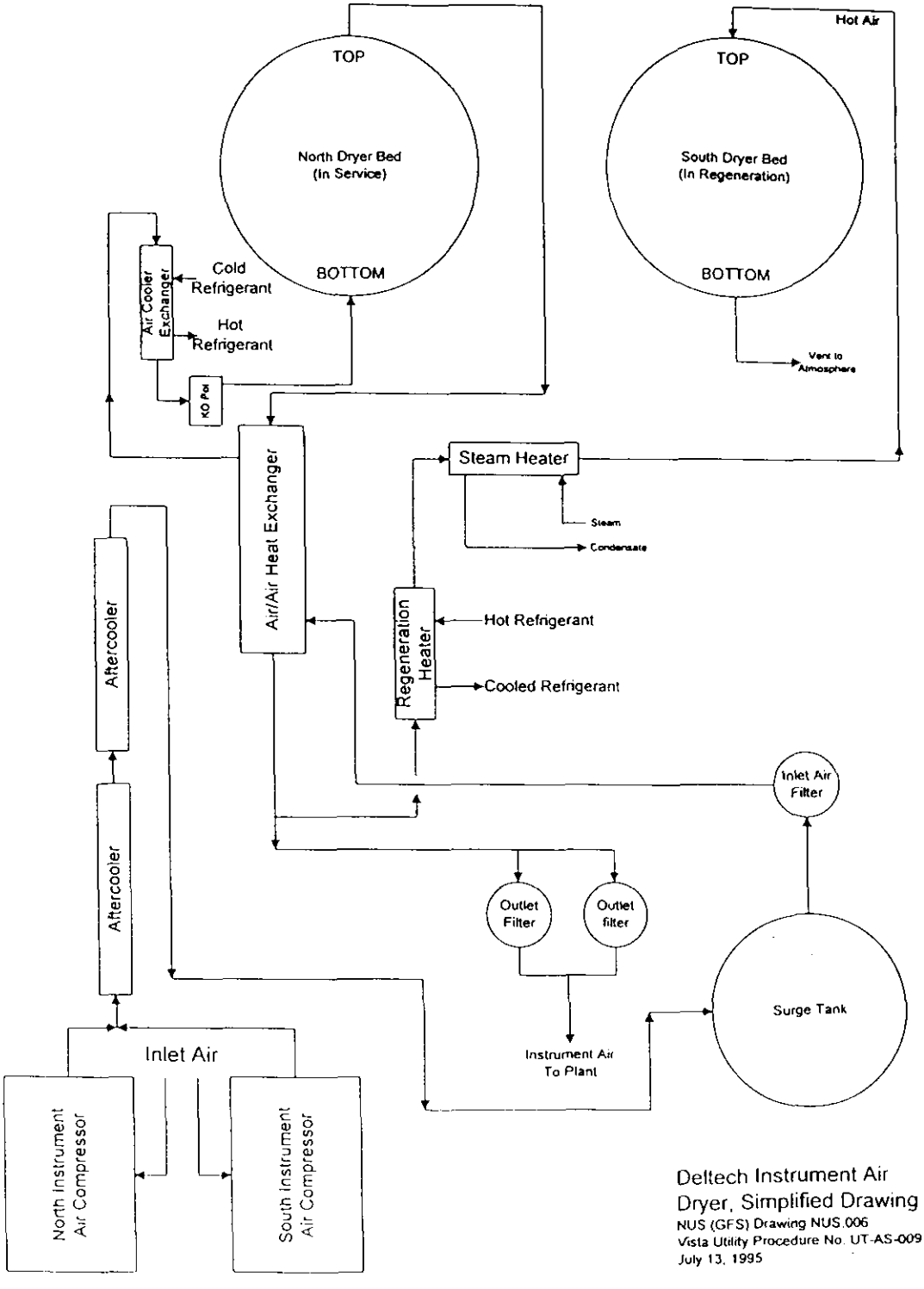
Hearing protection is mandentory around the dryer area.
High temperatures exist on lines at various times.
Valves operate automatically, caution must be exercised when placing hands around valves

****

6.1 The compressors, at the dryers, produce noises that can damage your hearing.

6.1.1 Wear hearing protection at all times in the area.

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009



Deltech Instrument Air Dryer, Simplified Drawing
NUS (GFS) Drawing NUS.006
Vista Utility Procedure No. UT-AS-009
July 13, 1995

Utilities Operations Manual	
Operation and Isolation of the Deltech Air Dryer at the Instrument Air Compressors. Preparation Of Equipment For Maintenance (POEFM).	UT-AS-009

6.2 Some surfaces have very high temperatures.

6.2.1 Wear leather gloves whenever operating valves.

6.2.2 Be careful where you place your hands or other parts of your body.

6.3 The Deltech air dry uses a system of bicycle chain and sprockets to position valves.

6.3.1 Be extremely careful where you stick you hands, valves will operate automatically.

VI. Operating Limits

Critical Parameter	Loop Number	Operating Limit	Consequence Of Deviation	Preventive Or Corrective Action
High Noise Levels	N/A	<80 Decibels	Hearing Loss	Wear Hearing Protection
High Surface Temperatures	N/A	>400° F	Severe Burns	Wear Protective Leather Gloves

VII Safety Systems and Their Functions

Safety Systems	Function Performed
Safety Showers/Eye Baths	Provide Fresh Water in Case of Chemical Exposure

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

APPROVED BY: _____ DATE: 6/7/95
VINYL UNIT MANAGER

I. Purpose - The purpose of this procedure is to describe the operation of the deluge water to emergency cooling water system.

II. References -

N/A

III. Safety and Health Considerations -

General - The deluge water to emergency cooling water system supplies cooling water to the reactors during power failures. Without this water the reactor temperature and pressure could not be controlled causing over pressure of reactors with possible relief valve discharge and VCM exposure.

A. Properties/Hazards of Chemicals -

N/A

DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-NM-E008

WRITTEN BY: R.W. Newman

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

B. **Precautions to Prevent Exposure -**

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
N/A			

C. Control Measures to be Taken if Exposed -

N/A

D. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories -

N/A

E. Special or Unique Hazards -

N/A

DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-NM-E008

WRITTEN BY: R.W. Newman

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

IV. Discussion - During a power failure or loss of normal cooling water systems for any reason, cooling water will be needed to control the temperature and pressure on reactors in poly mode. This water can be supplied by the deluge water system. There are two emergency cooling water valves. One supplies water to all five (5) reactors, the other isolates cooling water to the recovery system. The recovery system isolation valve must be closed to insure full flow of water to the reactors and to block cooling water to the recovery condenser/heat exchangers.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

V. Operating Procedure -

==========

"NOTE"

The deluge water to cooling water system supplies 1500 - 1800 gpm to each module enough water for full cooling on one reactor in each module. If water is needed to fight an existing fire or needed in the other reactor module, cooling water may have to be closed to the new module to insure adequate water supply elsewhere.

==========

1.0 Deluge Water to Cooling Water System.

1.1 Lead operator opens new module supply valve (82HV086).

1.2 Close recovery system isolation valve (82HV087).

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

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"NOTE"

If lead operator cannot get emergency cooling water valves opened/closed, the field operator will have to be notified to open/close the valves. There are three (3) methods of doing so; 1) bypass versa valve with instrument air, 2) put bottled (compressed) air to versa valve, and 3) bypass versa valve with bottled air.

==========

2.0 If lead operator cannot operate valves, field operator should go to the valve.

2.1 New module supply valve (82HV086) is located south of the cooling towers and east of the cooling tower pump for the new module. The compressed air bottle is located at valve.

2.2 The recovery system isolation valve is located between the dump system and the recovery building in the pipe rack. The compressed air bottle is located on the ground level between the knock out tank recirculation pumps and the old PVA charge pumps on the west side of the recovery building.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

3.0 When at the specified valve, one or all of the following can be tried to open/close the valve.

3.1 Bypass versa valve with instrument air.

3.1.1 Verify instrument air supply valve is open.

3.1.2 Close versa valve discharge valve.

3.1.3 Open bypass valve (The lead operator has no control of the valve).

3.2 Bottled air to versa valve.

3.2.1 Close instrument air supply valve.

3.2.2 Open bottled air supply valve.

3.2.3 Open versa valve discharge valve.

3.2.4 Close bypass valve.

3.2.5 Have lead operator give desired command to the valve.

3.2.6 Open bottle valve.

3.2.7 Regulate pressure to the valve until valve operates.

3.3 Bypass versa valve with bottled air.

3.3.1 Close instrument air supply valve.

3.3.2 Open bottled air supply valve.

3.3.3 Close versa valve discharge valve.

3.3.4 Open bypass valve.

3.3.5 Open bottle valve.

3.3.6 Regulate pressure to the valve until valve operates. (Lead operator has no control over the valve).

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

==========

"NOTE"

During a power failure, the DCS will apply emergency cooling water to the reactors in poly mode. This will take place 60-90 seconds after loss of power has been detected by DCS. The lead operator may have to close cooling water to some or all reactors to ensure enough water gets to a reactor that not will drop in pressure or temperature.

==========

4.0 The lead operator will determines whether or not a reactor needs more cooling water.

4.1 Check each reactor for water flow.

4.2 If reactor that has water flow is in recovery mode, select that reactors recovery page.

4.3 Select recovery cooling block, **"OFF"** and **"ON"** should appear at the bottom of the screen.

4.4 Selected **"OFF"** and verify water flow drops.

4.5 If reactor is in poly mode, it will have water flow. Select reactor poly page.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

4.6 Select emergency cooling water block **"OFF"** and **"ON"** will appear at the bottom of the screen.

4.7 Select **OFF** and verify emergency cooling water is off by Emergency Cooling Block turning from green to red.

4.8 If reactor still has flow, select cooling water control valve target.

4.9 Select manual at the bottom of the screen.

4.10 Select valve position on the bottom of the screen.

4.11 Type in zero (0) to close the valve.

4.12 If another reactor has cooling water flow and it needs to be turned off, follow steps in items 4.2-4.5.5.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

==========

NOTE"

When all reactors are under control, put emergency cooling water on each reactor that has been bumped/killed. To help control the reaction process until power is restored.

==========

5.0 Put emergency cooling water on a bumped/killed reactor.

5.1 Select a bumped/killed reactor's poly page.

5.2 Select the **"Emergency Cooling Water"** block. **"Off"** and **"On"** should appear on the bottom of the screen.

5.3 Select **"On"** and verify by monitoring **"Emergency Cooling Water"**. Block changing from red to green and water flow indicators showing flow.

5.4 Repeat steps in items 5.1 - 5.3 until all bumped/killed reactors have cooling water flow.

5.5 If a reactor pressure starts to rise repeat steps in items 4.6 -4.11 on reactors that do not need cooling water at the present time.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

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"NOTE"

The "Deluge Water to Emergency Cooling Water System" valves are tested weekly.

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DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-NM-E008

WRITTEN BY: R.W. Newman

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

VI. Operating Limits -

Critical Parameter	Loop Number	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action
Air supply to cooling water valves	N/A	Enough air to operate cooling water valves.	Cooling water valves would not open, could not control reactor pressure and temperature	Compressed air bottles as a back up air supply.

DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-NM-E008

WRITTEN BY: R.W. Newman

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module PROCEDURE TYPE: Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

VII. Safety Systems and Their Functions -

Safety System	Function Performed
N/A	

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

APPROVED BY: _____ DATE: 6/7/95
VINYL UNIT MANAGER

I. Purpose - The purpose of this procedure is to describe the operation of the deluge water to emergency cooling water system.

II. References -

N/A

III. Safety and Health Considerations -

General - The deluge water to emergency cooling water system supplies cooling water to the reactor during a power failure. This water is used to control reactor pressure and temperature to prevent reactor over pressure, causing possible relief valve discharge and VCM exposure.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

A. Properties/Hazards of Chemicals

N/A

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
N/A			

C. Control Measures to be Taken if Exposed -

N/A

D. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories -

N/A

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

E. Special or Unique Hazards -

N/A

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

IV. Discussion

During a power failure or loss of normal cooling water systems for any reason, cooling water will be needed to control the temperature and pressure on reactors in poly mode. This water can be supplied by the deluge water system. There are two emergency cooling water supply valves. One supplies water to D500, D600, and D700 but both valves have to be open to supply water to D300 and D400. Each of these valves has a manual bypass valve in case the automatic valves can not be opened.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

V. Operating Procedure -

"NOTE"

The deluge to cooling water system supplies 1500 - 1800 gpm to each module, enough water for full cooling on one reactor in each module. If water is needed to fight an existing fire or is needed in the other reactor module, cooling water may have to be closed to the old module to insure adequate water supply elsewhere.

1.0 Deluge water to cooling water system.

1.1 Lead operator will have to open emergency cooling water supply valves.

1.1.1 Old Module - (81HV086).

1.1.2 RX 300/ RX 400 - (81HV087).

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

==========

"NOTE"

If lead operator cannot get emergency cooling water supply valves opened/closed, the field operator will have to be notified to open/close the valves. There are four (4) methods of doing so; 1) open manual bypass valves, 2) bypass versa valve with instrument air, 3) put bottled (compressed) air to versa valve, and 4) bypass versa valve with bottled air.

==========

2.0 **If lead operator cannot operate valves, field operator should go to the valve.**

2.1 Old module valve is located just north of cooling water towers and south of poly vic charge system, south of road.

3.0 **When at the specified valve, one or all of the following can be tried to open the valve.**

3.1 Open manual bypass valve.

3.2 Bypass versa valve with instrument air.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

3.2.1 Verify instrument air supply valve is open.

3.2.2 Close versa valve discharge valve.

3.2.3 Open bottled air supply valve.

3.2.4 Open bypass valve (The lead operator has no control of the valve).

3.3 Bottled air to versa valve.

3.3.1 Close instrument air supply valve.

3.3.2 Open bottled air supply valve.

3.3.3 Open versa valve discharge valve.

3.3.4 Close bypass valve.

3.3.5 Have lead operator give open command to valve.

3.3.6 Open bottle valve.

3.3.7 Regulate pressure to the valve until valve opens.

3.4 Bypass versa valve with bottled air.

3.4.1 Close instrument air supply valve.

3.4.2 Open bottled air supply valve.

3.4.3 Close versa valve discharge valve.

3.4.4 Open versa valve bypass valve.

3.4.5 Open bottle valve.

3.4.6 Regulate pressure to the valve until valve opens (Lead operator has no control over the valve)

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

"NOTE"

During a power failure, the DCS will apply emergency cooling water to the reactors in poly mode. This will take place 60-90 seconds after loss of power has been detected by DCS. The lead operator may have to close cooling water to some or all reactors to insure enough water gets to a reactor that will not control on temperature/pressure.

4.0 The lead operator will determine whether or not a reactor needs more cooling water.

4.1 Check each reactor for water flow.

4.2 If reactor that has water flow is in recovery mode, select that reactors recovery page.

4.3 Select recovery cooling block, "off" and "on" should appear at the bottom of the screen.

4.4 Selected "off" and verify water flow drops.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

4.5 If reactor is in poly mode, it will have water flow. Select reactor poly page.

4.5.1 Select emergency cooling water block "off" and "on" will appear at the bottom of the screen.

4.5.2 Select off and verify emergency cooling water is off by emergency cooling block changing from green to red.

4.6 If reactor still has flow, select cooling water control valve target.

4.6.1 Select manual at the bottom of the screen.

4.6.2 Select valve position on the bottom of the screen.

4.6.3 Type in zero (0) to close the valve.

4.7 If another reactor has cooling water and needs to be turned off, follow steps in items 4.2 - 4.6.3.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

==========

==========

NOTE"

When all reactors are under control, put emergency cooling water on each reactor that has been bumped/killed. To help control the reaction until power is restored.

==========

5.0 Put emergency cooling water on a bumped/killed reactor.

5.1 Select a bumped/killed reactor's poly page.

5.2 Select the "emergency cooling water" block. "Off" and "On" should appear on the bottom of the screen.

5.3 Select "On" and verify by monitoring "emergency cooling water". Block changing from red to green and water flow indicators showing flow.

5.4 Repeat steps in items 5.1 - 5.3 until all bumped/killed reactors have cooling water flow.

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

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"NOTE"

The "deluge water to emergency cooling water system" valves are tested weekly.

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DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-OM-E008

WRITTEN BY: R.W. Newman

FOR FINAL REVIEW/APPROVAL

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: Old Module PROCEDURE TYPE: Emergency

PROCESS AREA: Old Module

PROCEDURE TITLE: Operation of Deluge Water to Emergency Cooling Water System

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VII. Safety Systems and Their Functions -

Safety System	Function Performed
Halon System	Used to extinguish fires in control room.

DATE OF ISSUE: 03/28/95 PROCEDURE NO. Vinyl-OM-E008

WRITTEN BY: R.W. Newman

CONDEA Vista Company - Aberdeen Plant	Page 1 of 7
Utilities Operation Procedures Manual	Revision 0
Operation of Chlorine System for CT-002, CT-004, and CT-006	UT-CT-001

APPROVED BY: _____ **Date:** 5/12/97
Maintenance Manager

I. PURPOSE

The purpose of this procedure is to provide the necessary information and detail the steps necessary to safely operate the cooling tower chlorination system for cooling towers CT-002, CT-004, CT-006.

II. REFERENCES

Harcross Chlorine Leak Response Team; Phone number 601-969-3177.

MSDS - Chlorine

MSDS - Aqua Ammonia

Water Plant Daily Operation Manual, UT-WP-001

Chlorine Leak Response Procedure, UT-CT-003

III. SAFETY AND HEALTH CONSIDERATIONS

General - Do not use hydrocarbon oil, grease, etc. on the chlorine feed system since chlorine will react with these substances.

Chlorine and water form a corrosive solution.

A chlorine "B" kit is available at the water plant and in the chiller building in case of a container leak.

A. Properties/Hazards of Chemicals - Refer to MSDS Chlorine, Aqua Ammonia, Chlorine: greenish/yellow gas; clear amber colored liquid.

Disagreeable and suffocating odor with irritating effect on nose and throat.

III. SAFETY AND HEALTH CONSIDERATIONS - Continued

A. Properties/Hazards of Chemicals - continued

Boiling point: -29.3°F, 2.5 times heavier than air.

Aqua ammonia - 26°F Baume

Colorless liquid, pungent odor, boiling point: 81°F, 1.7 times heavier than air.

B. Precautions to Prevent Exposure:

Chemical	Personal Protective Equipment	Engineering Controls	Administrative Controls
Chlorine Gas: Unknown concentration, no visible vapor cloud, no liquid leakage.	SCBA, Rubber Gloves	Chlorine Detection Alarm	Limited Inventory: No more containers than available trunnions.
Chlorine Gas: Unknown concentration, visible vapor cloud, liquid leak.	Class "A" Suit - Total encapsulating suit SCBA, double gloves, hardhat, rubber boots.	Chlorine Detection Alarm	Limited Inventory: No more containers than available trunnions.
Aqua Ammonia	Rubber Gloves	N/A	Limit Inventory 3 Bottles

C. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories -

Refer to MSDS: Chlorine, Aqua Ammonia

D. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories

No full chlorine for containers will be stored in the plant other than on trunnions.

III. SAFETY AND HEALTH CONSIDERATIONS - Continued

E. Special or Unique Hazards

Flexible tubing between the vacuum regulator and the chlorine eductor may rupture due to fatigue at any time. Leak check entire tube when a new container is placed in service. Replace tubing if leaking. Otherwise, replace as needed.

IV. DISCUSSION

The cooling tower chlorination system is designed to feed chlorine to the cooling towers 2, 4, and 6. The chlorination system and two sets of chlorine container trunnions are located on the south side of Third Street just south of cooling tower #2.

The function of various chlorination system parts is briefly described below:

1. Chlorine Container Valve - Each container has two container valves. When in use, the valves must be aligned vertically. Only the top valve should be connected to the chlorination system. Never use the bottom valve as liquid chlorine may be fed.

2. Chlorination System - The chlorination system is comprised of (1) a vacuum regulator, (2) flow indicating/controlling rotameter, and (3) a chlorine eductor.

   The vacuum regulator has a capacity of 200 lbs./day, and is mounted directly on the chlorine container valve by means of a yoke assembly. Chlorine gas is conveyed under vacuum from the regulator. From the regulator, the transfer tubing splits 3 ways, each to a flow indicating/controlling rotameter. Here the chlorine flow to each cooling tower is set. From the rotameters, chlorine gas flows to a vacuum eductor where it is mixed with water that will flow into one of the three cooling towers.

   The vacuum regulator is equipped with its own rotameter and flow control valve. Since chlorine gas flow is not being controlled at the regulator, this valve shall remain 100% open. Vacuum is controlled by a spring opposed diaphragm which will close tight upon loss of vacuum.

   The vacuum regulator inlet is equipped with a drip leg heater and a gas filter to deflect, trap, and vaporize any liquid chlorine carried from the container.

   Pressure will be prevented from building in the system by means of a spring-loaded, diaphragm-actuated pressure relief valve located on the vacuum regulator.

IV. DISCUSSION - Continued

The vacuum created by the chlorine eductor opens a check valve in the eductor and pulls the chlorine gas into the water stream. The check valve prevents water from backing into the regulator.

A set of scales measures the weight of 1 or 2 chlorine ton containers and their contents.

V. OPERATING PROCEDURE

1.0 Connect Vacuum Regulator to Chlorine Container

1.1 Notify the Vinyl Department that a chlorine container is being put in service.

1.2 At least two people must be present to connect a chlorine container - one to connect and one to stand watch. If a container needs to be connected during off hours, the Vinyl Department must send someone to service as watch.

1.3 Remove the chlorine container valve protective cover and rotate the container until the container valves are aligned vertically.

1.4 Close the water supply valve to each chlorine eductor. There is an eductor for each cooling tower located on the panel west of the chlorine containers.

1.5. Inspect the chlorine tubing from the vacuum regulator to the chlorine eductor for damage.

1.6 Put on a full faceshield equipped with an approved chlorine canister and a pair of rubber gloves. Get some rags and aqua ammonia to check for leaks.

****

WARNING

If a chlorine leak develops during normal handling when Operators are protected only by a full faceshield and chlorine canister, leave immediately and follow Chlorine Leak Response Procedure UT-CT-003.

****

1.7 Confirm that the chlorine container valves are closed.

V. OPERATING PROCEDURE - Continued

1.0 Connect Vacuum Regulator to Chlorine Container - Continued

1.8 Wipe up any moisture on the container valves.

1.9 Loosen the **TOP** container valve cap nut and check for leaks.

1.10 If no leaks, remove cap nut. If a leak is detected, tighten the cap nut and tighten the container valve and packing. Repeat steps 1.8 and 1.9. If the leak can't be stopped, tighten the cap nut and call the chlorine supplier to come get the defective container.

1.11 Using a **new** lead gasket, connect the vacuum regulator to the **Top** container valve.

2.0 Put Chlorine Container in Service

2.1 Ensure drip leg heater on vacuum regulator is "ON".

2.2 Open container valve 1/4 turn, then close. Check for leaks.

2.3 If no leaks, open container valve 1/4 to 1/2 turn. If leaks are present, close container valve and replace lead gasket.

2.4 Open the water supply valve to the chlorine eductors. This should establish chlorine flow from the vacuum regulator to the chlorine eductors. Check for flow to each eductor by inspecting chlorine rotameters located on panel west of containers and on the rotameter located on the vacuum regulator. Check for leaks from the vacuum regulator to the eductors.

2.5 If no flow, close the container valve and check the following:

a) Make sure all water valves are open.
b) Make sure water supply strainers are clean, and
c) Eductor is pulling a vacuum.

2.6 Using chlorine rate control valve located on each chlorine rotameter, set chlorine flow to maintain 0.4 and 0.8 ppm residual chlorine in the cooling towers. Refer to Procedure UT-WP-001 for testing procedure.

V. OPERATING PROCEDURE - Continued

****

WARNING

Never use chlorine rate control valve to shut off gas supply. Damage to valve may occur. Use chlorine container valve to shut off gas supply.

****

3.0 Normal and Emergency Shutdown of Chlorination System

3.1 Close chlorine container valve.

4.0 Shut Down and Disconnection of Vacuum Regulator

4.1 Close the chlorine container valve.

4.2 Continue operation of eductors until rotameters show no flow and a vacuum on chlorine tubing from regulator exists.

4.3 Close the water supply valve to eductors.

4.4 Remove the regulator from the chlorine container.

4.5 Replace the container cap nut and protective cover.

4.6 Turn off the vacuum regulator drip heater.

4.7 Chlorine container may be switched at this time.

VI. OPERATING LIMITS

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Residual Chlorine in Cooling Tower	N/A	0.4 - 0.8 ppm	Under or over feed condition.	Adjust feed control knob on rotameter.
Supply Water Pressure to Eductor	N/A	> 40 psig	Eductor will not pull sufficient vacuum.	Check/clean strainers.

VII. SAFETY SYSTEMS AND THEIR FUNCTIONS

SAFETY SYSTEM	FUNCTION PERFORMED
Chlorine Detector/Alarm	Detect and warn of chlorine leak.

VIII. REVISION HISTORY

Description of the Change	Revision

CONDEA Vista Company - Aberdeen Plant	Page 1 of 7
Utilities Operation Procedures Manual	Revision 0
Operation of Chlorination System for CT-005	UT-CT-002

APPROVED BY: _____ **Date:** 5/12/97
Maintenance Manager

I. PURPOSE

The purpose of this procedure is to provide the necessary information and detail the steps necessary to safely operate the cooling tower chlorination system for cooling tower CT-005.

II. REFERENCES

Harcross Chlorine Leak Response Team; Phone number 601-969-3177.

MSDS - Chlorine

MSDS - Aqua Ammonia

Water Plant Daily Operation Manual, UT-WP-001

Chlorine Leak Response Procedure, UT-CT-003

III. SAFETY AND HEALTH CONSIDERATIONS

General - Do not use hydrocarbon oil, grease, etc. on the chlorine feed system since chlorine will react with these substances.

Chlorine and water form a corrosive solution.

A chlorine "A" kit is available at the emergency supply room behind P-1.

A. Properties/Hazards of Chemicals - Refer to MSDS Chlorine, Aqua Ammonia, Chlorine: greenish/yellow gas; clear amber colored liquid.

Disagreeable and suffocating odor with irritating effect on nose and throat.

Boiling point: -29.3°F, specific gravity 2.5.

III. SAFETY AND HEALTH CONSIDERATIONS - Continued

A. Properties/Hazards of Chemicals - Continued

Aqua ammonia - 26°F Baume

Colorless liquid, pungent odor, boiling point: 81°F, 1.7 times heavier than air.

B. Precautions to Prevent Exposure:

Chemical	Personal Protective Equipment	Engineering Controls	Administrative Controls
Chlorine Gas: Unknown concentration, no visible vapor cloud, no liquid leakage.	SCBA, Rubber Gloves	Chlorine Detection Alarm & Beacon	Limited Inventory. Two 150 lb. containers.
Chlorine Gas: Unknown concentration, visible vapor cloud, liquid leak.	Class "A" Suit - Total encapsulating suit SCBA, double gloves, hardhat, rubber boots.	Chlorine Detection Alarm & Beacon	Limited Inventory: Two 150 lb. containers.
Aqua Ammonia	Rubber Gloves	N/A	Limit Inventory 3 Bottles

C. Control Measures To Be Taken If Exposed:

Refer to MSDS for: Chlorine, Aqua Ammonia

D. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories

Limited storage of 150 lbs. chlorine containers (2). Limited storage at cooling tower 5 (2).

III. SAFETY AND HEALTH CONSIDERATIONS - Continued

E. Special or Unique Hazards

Flexible tubing between the vacuum regulator and the chlorine eductor may rupture due to fatigue at any time.

Leak check entire tube when a new container is placed in service. Replace tubing if leaking. Otherwise, replace as needed.

IV. DISCUSSION

The cooling tower chlorination system is designed to feed chlorine to cooling tower #5. The chlorination system and scale for two 150# chlorine containers are located on the north side of cooling tower #5.

The function of various chlorination system parts is briefly described below:

1. Chlorine Container Valve - Each container has a valve on top of the container. The container must be set on its end with the container valve on top.

2. Chlorination System - The chlorination system is comprised of (1) a vacuum regulator, (2) flow indicating/controlling rotameter, (3) a chlorine eductor, and (4) chlorine container scales.

   Chlorine gas is conveyed under vacuum from the regulator. From the regulator, the transfer tubing carries the chlorine gas through a flow indicating/controlling rotameter. Here the chlorine flow rate is set. From the rotameter, chlorine gas flows to a chlorine vacuum eductor where it is mixed with water that will flow into the cooling tower.

   The vacuum regulator has a capacity of 200 lbs./day and it is mounted directly on the container valve by means of a yoke assembly. The vacuum regulator is equipped with its own rotameter and flow control valve. Since the chlorine gas flow is not being controlled at the regulator, this valve should remain 100% open and the rotameter will be used for flow indication only. Vacuum is controlled by a spring opposed diaphragm which will close tight upon loss of downstream vacuum.

   The vacuum regulator inlet is equipped with a drip leg heater and a gas filter to deflect, trap, and vaporize any liquid chlorine carried from the container.

IV. DISCUSSION - Continued

Pressure will be prevented from building in the system by means of a spring-loaded, diaphragm-actuated pressure relief valve located on the vacuum regulator.

The vacuum created by the chlorine eductor opens a check valve in the eductor and pulls the chlorine gas into the water stream. The check valve prevents water from backing into the regulator.

A set of scales measures the weight of 1 or 2 150 lb. chlorine containers and their contents.

V. OPERATING PROCEDURE

1.0 Connect Vacuum Regulator to Chlorine Container

1.1 Notify the Compound Department that a chlorine container is being put in service.

1.2 At least two people must be present to connect a chlorine container - one to connect and one to stand watch. If a container needs to be connected during off hours, the Compound Department must send someone to service as watch.

1.3 Remove the chlorine container valve protective cover.

1.4 Close the water supply valve to each chlorine eductor.

1.5. Inspect the chlorine tubing from the vacuum regulator to the chlorine eductor for damage.

1.6 Put on a full faceshield equipped with an approved chlorine canister and a pair of rubber gloves. Get some rags and aqua ammonia to check for leaks.

****

WARNING

If a chlorine leak develops during normal handling when Operators are protected only by a full faceshield and chlorine canister, leave immediately and follow Chlorine Leak Response Procedure UT-CT-003.

****

V. OPERATING PROCEDURE - Continued

1.7 Confirm that the chlorine container valves are closed.

1.8 Wipe any moisture on the container valves.

1.9 Loosen, but do not remove, the container valve cap nut and check for leaks.

1.10 If no leaks, remove cap nut. If a leak is detected, tighten the cap nut and tighten the container valve and packing. Repeat steps 1.8 and 1.9. If the leak can't be stopped, tighten the cap nut and call the chlorine supplier to come get the defective container.

1.11 Using a **new** lead gasket, connect the vacuum regulator to the container valve.

2.0 Put Chlorine Container in Service

2.1 Ensure drip leg heater on vacuum regulator is "ON".

2.2 Open container valve 1/4 turn, then close. Check for leaks.

2.3 If no leaks, open container valve 1/4 to 1/2 turn. If leaks are present, close container valve and replace lead gasket.

2.4 Ensure all tubing connects are made and are in good shape.

2.5 Open the water supply valve to the chlorine eductors. This should establish chlorine flow from the vacuum regulator to the chlorine eductors. Check for flow to each eductor by inspecting chlorine rotameters located in panel box east of containers. Adjust if necessary. Check for leaks from the vacuum regulator to the eductors.

2.6 If no flow, close the container valve and check the following:

a) Make sure all water valves to the eductor and cooling tower are open.
b) Make sure water supply strainers are clean, and
c) Eductor is pulling a vacuum.

2.7 Using chlorine rate control valve on rotameter, set chlorine flow to maintain 0.4 and 0.8 ppm residual chlorine in the cooling towers. Refer to Procedure UT-WP-001 for testing procedure.

V. OPERATING PROCEDURE - Continued

****

WARNING

Never use chlorine rate control valve to shut off gas supply. Damage to valve may occur. Use chlorine container valve to shut off gas supply.

****

3.0 Normal and Emergency Shutdown of Chlorination System

3.1 Close chlorine container valve.

4.0 Shut Down and Disconnection of Vacuum Regulator

4.1 Close the chlorine container valve.

4.2 Continue operation of eductors until rotameters show no flow and a vacuum exits on chlorine tubing from regulator exists.

4.3 Close the water supply valve to eductors.

4.4 Remove the regulator from the chlorine container.

4.5 Replace the container cap nut and protective cover.

4.6 Turn off the vacuum regulator drip heater.

4.7 Chlorine container may be switched at this time.

VI. OPERATING LIMITS

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention or Corrective Action
Residual Chlorine in Cooling Tower	N/A	0.4 - 0.8 ppm	Under or over feed condition.	Adjust feed control knob on rotameter.
Supply Water Pressure to Eductor	N/A	> 40 psig	Eductor will not pull sufficient vacuum.	Check/clean strainers.

VII. SAFETY SYSTEMS AND THEIR FUNCTIONS

SAFETY SYSTEM	FUNCTION PERFORMED
Chlorine Detector/Alarm	Detect and warn of chlorine leak.

VIII. REVISION HISTORY

Description of the Change	Revision

CONDEA Vista Company - Aberdeen Plant	Page 1 of 4
Utilities Operation Procedures Manual	Revision 0
Chlorine Leak Response for CT-002, CT-004, CT-005, and CT-006	UT-CT-003

APPROVED BY: _____ **Date:** 5/12/97
Maintenance Manager

I. PURPOSE

The purpose of this procedure is to detail how to respond to a chlorine leak on the CT-002, CT-004, CT-006 cooling tower chlorination system or the CT-005 cooling tower chlorination system.

II. REFERENCES

Harcross Chlorine Leak Response Team; Phone number 601-969-3177.

III. SAFETY AND HEALTH CONSIDERATIONS

General - Do not use hydrocarbon oil, grease, etc. on the chlorine feed system since chlorine will react with these substances.

Chlorine and water form a corrosive solution.

A chlorine "B" kit is available at the water plant and in the chiller building in case of a container leak. A chlorine "A" kit is available in the emergency supply room behind the P-1 building.

A. Properties/Hazards of Chemicals - Refer to MSDS chlorine, Aqua Ammonia, Chlorine: greenish/yellow gas; clear amber colored liquid.

Disagreeable and suffocating odor with irritating effect on nose and throat.

Boing point: -29.3°F, 2.5 times heavier than air.

Aqua ammonia - 26°F Baume

Colorless liquid, pungent odor, boiling point: 81°F, 1.7 times heavier than air.

III. SAFETY AND HEALTH CONSIDERATIONS - Continued

B. Control Measures to Be Taken if Exposed - Refer to MSDS chlorine.

C. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories - N/A

D. Special or Unique Hazards - N/A

IV. DISCUSSION

See UT-CT-001 and UT-CT-002

V. OPERATING PROCEDURE

1.0 Chlorine Leak - Operator or Alarm Detected

1.1 No Visible Vapor Cloud - Notify Vinyl operations personnel (call 2200). Request assistance from person(s) equipped with SCBAs and rubber gloves. Obtain wind directions by calling the Security Guard or viewing wind socks.

Visible Vapor Cloud - Call 2200 and indicate that there is a **CHLORINE LEAK EMERGENCY**. Obtain wind directions. Request assistance from persons equipped with SCBAs, class "A" suits (total encapsulating), rubber boots, rubber gloves, and hardhats.

2.0 Locate the Leak

2.1 If the location of the leak is not immediately apparent:

2.1.1 Apply some aqua ammonia to a rag and hold it under the chlorine gas lines beginning at the container valve/vacuum regulator and ending at the chlorine gas eductor.

2.1.2 Using the aqua ammonia and rags, check the chlorine container itself.

2.2 Respond to the leak depending on location and type.

V. OPERATING PROCEDURE - Continued

3.0 Leak in the Vacuum Regulator, Regulator Vent, or Supply Lines to Eductor

3.1 Close the container valve.

3.2 Allow the metering ball in the rotameter to fall to the bottom and remain there.

3.3 Disconnect damaged items and replace/repair as needed.

3.4 When repairs have been made, follow appropriate startup procedure to start chlorination system.

4.0 Leak at Container Valve, Fusible Plug, or Container

4.1 If the leak is in the container valve packing, tighten the packing nut without using excessive force. If this does not eliminate the leak, proceed to the next step.

4.2 Close the chlorine container valve.

4.3 Stop/contain leak as indicated in chlorine "B" kit manual. Chlorine "B" kit and manual is located in the chiller building and at the water plant.

4.4 Notify Harcross Chemical (or current chlorine supplier) of leaking container. See reference for phone number. Follow Harcross handling instructions until they are onsight.

4.5 Swap container using UT-CT-001 or UT-CT-002 as required.

VI. SAFETY SYSTEMS AND THEIR FUNCTIONS

SAFETY SYSTEM	FUNCTION PERFORMED
Chlorine Detection Alarm	Detects and warns of chlorine leak.
Chlorine "B" Kit and Manual	Provides special tools and instructions for dealing with one-ton chlorine container leaks.
Chlorine "A" Kit and Manual	Provides special tools and instructions for dealing with 150 lb. chlorine container leaks.

VII. REVISION HISTORY

REVISION NO.	DATE	REASON FOR REVISION

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Back-up System Operation	UT-WP-002

Approved: _____ Date: 5/31/94
D. A. Miller - Mech. Superintendent

I. Purpose - The purpose of this procedure is to detail the procedure for normal operation of the back-up chlorine system.

II. References - The Chlorine Manual: Chlorine Institute, The Chlorine Handling Manual: Material Safety Data Sheet for Chlorine and Aqua Ammonia, Harcross Chemical chlorine training information sheet, and Chlorine "B" Kit Manual.

III. Safety and Health Considerations - SEE UT-WP-003

IV. Discussion - The back-up chlorine system is meant to be used during a chlorine feeder system failure and repair period. The procedure to be described here is based on the assumptions that the main chlorine feeder has been properly shut down and the well pumps have been turned OFF.

The chlorine feeder system feeds chlorine gas at a controlled rate into a water stream. This water stream is injected into the aerator 14" downcomer.

The function of various chlorine system parts are briefly described below.

****

1. Chlorine Container Valve - When the container is in use the valves MUST be aligned vertically. Only the top valve (the one used for supplying chlorine gas) should be connected to the chlorine feeder system. NEVER CONNECT THE BOTTOM VALVE TO THE CHLORINE FEEDER SYSTEM AS LIQUID CHLORINE WILL BE FED.

****

2. Vacuum Regulator - The vacuum regulator has a capacity of 200 pounds per day, and is mounted directly on the ton container valve by means of a yoke assembly. Therefore, chlorine gas is conveyed under vacuum from the regulator to the ejector/check valve assembly to ensure complete system safety. Vacuum is controlled by a spring-opposed diaphram which will close tight upon loss of vacuum.

   The regulator is equipped with an intergrally mounted rotameter. The rotameter indicates the rate at which chlorine gas is being fed. Feed rate adjustments are set manually and remain constant until manually changed. Adjustments can be made by turning the adjustment knob clockwise (to reduce the feed rate) or counterclockwise (to increase the feed rate).

   The vacuum regulator gas inlet assembly is equipped with a drip leg heater and a gas filter to deflect, trap, and vaporize any liquid chlorine carried from the container.

   Pressure will be prevented from building in the system by means of a spring-loaded, diaphram-actuated pressure relief valve located at the vacuum regulator. The gas shall vent at the vacuum regulator.

   The chlorine ejector is where the chlorine gas is mixed with a water stream. A vacuum is created as high pressure water passes through a restriction. This vacuum opens a check valve (in the ejector) and pulls the chlorine gas into the water stream. The check valve prevents water from backing up into the vacuum regulator. A water supply loss automatically closes the check valve and shuts off the gas flow.

****

NOTE: If the vacuum regulator is already connected to the ton container, put on a full face shield equipped with a chlorine cannister and some rubber gloves. Get some rags and aqua ammonia to check for leaks. Follow start-up procedures beginning with step 9 of START-UP PREPARATION.

****

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Back-up System Operation	UT-WP-002

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CAUTION: Even though the system was free of leaks during the previous shutdown, one should be aware of the possibility of a leak occuring when starting the system back up. Do not skip any leak checking steps in any part of the start-up procedure.

****

V. Operating Procedure -

START-UP PREPARATION

//////////

NOTE

Always keep full chlorine containers on both back-up system trunions.

//////////

1.0 At least two people must be present to connect a chlorine container, one to connect and one to stand watch. If a container needs to be connected during off-hours, vinyl must send someone to serve as a watch.

2.0 Put on a full face shield equipped with a chlorine cannister and some rubber gloves. Get some rags and aqua ammonia to check for leaks.

****

WARNING: If a chlorine leak develops at any time during normal handling when operators are protected only by a full face shield and chlorine cannister, leave immediately and follow chlorine leak response procedure UT-WP-017.

****

3.0 Remove the chlorine container valve protective cover and rotate the container until the container valves are aligned vertically.

4.0 Confirm that the chlorine container valve is **CLOSED**.

5.0 Wipe up any moisture on the container valves.

6.0 Loosen the top container valve cap nut and check for leaks.

7.0 If no leaks, remove cap nut. If a leak is detected tighten cap and tighten container valve. Repeat step 5. If leak can't be stopped tighten cap nut and call chlorine supplier to come get defective container.

8.0 Using a **new** lead gasket, connect the vacuum regulator to the top container valve.

START-UP

9.0 Plug in the drip leg heater.

10.0 Check ejector operation. Turn the back-up chlorine system water supply HOA switch to the **HAND** position and **OPEN** all water supply block valves except the solenoid bypass valve. Put your finger over the vacuum connector opening and feel the vacuum. A strong vacuum should exist. If not, refer to the Troubleshooting section of the vacuum regulator instruction manual. Leave ejector running.

11.0 With the chlorine container valve closed, connect the vacuum tubing to the vacuum regulator's upper outlet connection (lower connection is a vent). Remove the connector nut and slip it on the tubing. Push the tubing onto the connector and tighten **HAND TIGHT**.

12.0 Connect the vacuum tubing to the ejector vacuum connection. Remove the connector nut and slip it on the tubing. Push the tubing onto the connector and tighten **HAND TIGHT**.

13.0 With the chlorine container valve closed and the ejector running, the ball in the metering tube will drop to the bottom. If the ball does not drop or bounces, there is either a leak at the lead gasket or a loose connection in the system. Check and correct.

NOTE: The supply indicator on the face of the vacuum regulator will show **RED**. Turning the indicator knob to **RESET** will not stop the movement of the indicator and it will return to **RED**.

14.0 Turn the water supply HOA switch to the **AUTO** position.

15.0 **DISCONNECT** the vacuum tubing at the vacuum regulator to allow air to enter the system.

16.0 **RECONNECT** the vacuum tubing.

17.0 Open the container valve one quarter turn and close.

18.0 Check for leaks around the container valve yoke assembly and lead gasket. If gas is leaking, tighten yoke or replace lead gasket.

19.0 Test for leaks at other joints of the yoke assembly.

20.0 Open the container valve one-quarter turn and leave on. Check for leaks again.

21.0 Start the well pumps.

22.0 Adjust the chlorine feed rate to the required setting following procedure UT-WP-003.

****

WARNING: NEVER use the rate valve to shut off the gas supply. If used for shutoff, the valve will be damaged. To shut off gas, close the chlorine container valve.

****

SHUT-DOWN PROCEDURES

PERIODIC AND EMERGENCY SHUTDOWN

1.0 Turn **OFF** the well pump.

2.0 **CLOSE** the chlorine container valve.

LONG TERM SHUT-DOWN OR EMPTY CONTAINER REPLACEMENT

3.0 Continue ejector operation and **CLOSE** the chlorine container valve.

4.0 Watch the loss of gas supply indicator. When it shows RED, the gas flow will begin to decrease. The metering ball should drop to the bottom and remain there. If it does not or flutters, the container valve may not be completely shut. Attempt to reset loss of gas indicator. It should turn freely and always reset in the RED position.

5.0 After all the above steps have been taken, it is safe to remove the vacuum regulator from the ton container.

DISASSEMBLY AND STORAGE

6.0 **DISCONNECT** the chlorine vacuum tubing from the ejector and the vacuum regulator outlet.

7.0 **UNPLUG** the drip leg heater.

8.0 **DISCONNECT** the vacuum regulator from the chlorine container valve.

9.0 **DISCARD** the lead gasket.

10.0 Replace the chlorine container valve cap nut.

11.0 Replace the chlorine container valve cover.

****

NOTE: At this time, the ton containers can be swapped out and the system restarted. If long-term shut-down is desired, continue with step 12 of SHUTDOWN PROCEDURES.

****

12.0 Store the vacuum regulator and vacuum tubing in a dry place.

13.0 Plug the ejector vacuum tubing inlet.

15.0 **CLOSE** the block valve downstream of the ejector and the back-up chlorine system water supply block valve.

16.0 During cold weather, **OPEN** the drain valves downstream of the ejector and upstream of the solenoid valve.

17.0 Turn the back-up chlorine system water supply solenoid valve to the **OFF** position.

VI. Operating Limits -

Critical Parameter	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action
Water Pressure	< 40 psig	Insufficient vacuum to meet chlorine usage demand.	Boost water pressure.

VII. Safety Systems and Their Functions - N/A

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Feeder System Operation	UT-WP-003

Approved: _____ Date: 5/31/94
D. A. Miller - Mech. Superintendent.

I. Purpose - The purpose of this procedure is to provide the necessary information that, along with adequate training and responsible action, will enable safe operation of the chlorine feeder system.

II. References - The Chlorine Manual:Chlorine Institute, The Chlorine Handling Manual: W&T, Wallace & Tiernan Chlorine Feeder Manuals, Material Safety Data Sheet for Chlorine and Aqua Ammonia, Harcross Chemical chlorine training information sheet, and Chlorine "B" Kit Manual.

III. Safety and Health Considerations -
General - The fan and light for the chlorine container room should be turned on before entering the room (unless there is a leak in which case only the light should be turned on).

A full face canister gas mask with approved chlorine gas canister and rubber gloves should be worn when connecting or disconnecting a chlorine container.

All metal pipe, metal tubing, plastic tubing, and the chlorine feeder equipment contains chlorine gas and may contain chlorine liquid.

The chlorine feeder system (pipes, valves, fittings, feeder equipment, etc.) need to be evacuated before opening to atmosphere (which includes disconnecting chlorine containers).

Do not use hydrocarbon oil, grease, etc. on the chlorine feeder system since chlorine will react with these substances.

If chlorine gas is smelled while wearing the full face canister mask LEAVE the chlorine container room IMMEDIATELY. Follow the appropriate Emergency Operation Procedures.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Feeder System Operation	UT-WP-003

Chlorine and water form a corrosive solution.

A chlorine "B" kit is available in the Equipment Room for use in case of a container leak.

A. Properties/Hazards of Chemicals -
Reference MSDS

1. Chlorine
Greenish/yellow gas; clear, amber colored liquid.
Disagreeable and suffocation odor with irritating effect on nose and throat.
Boiling point: -29.3° F
Is 2.5 times heavier than air

2. Aqua Ammonia - 26° Baume
Colorless liquid
Pungent odor (ammonia)
Boiling point: 81° F
Is 1.7 times lighter than air

B. Precautions to Prevent Exposure -

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Chlorine Gas: Concentration does not exceed range on fixed chlorine monitor. (Less than 2 ppm)	SCBA, Gloves	Ventilation Fan, Fixed Monitor and Alarm	Operation Procedures, Limited Inventory, and Preventative Maintenance

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Chlorine Gas: Unknown concentration, no visible vapor cloud, no liquid leakage.	SCBA, Gloves	Ventilation Fan, Fixed Monitor (gas) and Alarm	Limited inventory. No more containers than available trunions will allow.
Chlorine Gas/ Liquid: Unknown concentration, Visible vapor cloud.	Class "A" Suit - Totally Encapsulating Suit, SCBA, Double Gloves, Hardhat, Rubber Boats.	Ventilation Fan, Fixed Monitor (gas) and Alarm	Limited inventory. No more containers than available trunions will allow.
Aqua Ammonia	Rubber gloves	N/A	Limited inventory: 3 bottles.

C. Control Measures to be Taken if Exposed - Refer to MSDS

D. Quality Control for Raw Materials and Control of Hazardous Chemical Inventories -

No full chlorine ton containers will be stored in the water plant other than on trunions.

No more than three bottles of aqua ammonia will be stored in the water plant equipment room.

E. Special or Unique Hazards -
Flexible tubing between the chlorine containers and the manifold may rupture due to fatigue at any time. Leak check entire tube when a new container is placed in service. Replace tubes immediately if leaking. Otherwise, replace at least once per year.

IV. Discussion -

The chlorine feeder system feeds chlorine gas at a controlled rate into a water stream. This water stream is injected into the aerator 14" downcomer.

The function of various chlorine system parts are briefly described below.

1. Tubing Yoke Valve - The tubing yoke valve isolates the chlorine gas in the chlorine feeder system at the closest possible point to the chlorine container valve (this ensures that a minimum of chlorine gas is released when disconnecting a chlorine container). The yoke is used to apply pressure to a disposable lead gasket to seal the tubing yoke valve to the chlorine container valve.

2. Chlorine Container Valve - When the container is in use the valves MUST be aligned vertically. Only the top valve (the one used for supplying chlorine gas) should be connected to the chlorine feeder system. NEVER CONNECT THE BOTTOM VALVE TO THE CHLORINE FEEDER SYSTEM AS LIQUID CHLORINE WILL BE FED.

3. Vacuum Regulator/Check Valve - The vacuum regulator/check valve functions as a check valve stopping chlorine gas flow to the feeder when no vacuum is present. This valve also enables automatic switch over from one chlorine container to another when the first becomes empty. Part of this unit is a drip leg heater (which should always be plugged in) which vaporizes liquified chlorine gas.

4. V-Notch Chlorine Feeder - The chlorine feeder contains four important parts.

a. The rotameter - The rotameter indicates the rate at which chlorine gas is being fed to the water plant. Feed rate adjustments can be made by turning the red adjustment knob clockwise (to reduce the feed rate) or counterclockwise (to increase the feed rate).

NOTE: Observe adjustment valve bushing (packing nut). Ensure that it doesn't rotate when adjusting the valve. Never close the adjustment knob tightly.

b. The feeder vacuum gauge and relief valve - The feeder vacuum gauge indicates the vacuum at the rotameter inlet. The relief valve relieves (opens) if the pressure upstream of the rotameter exceeds 10 to 20 inches of water (0.36 to 0.72 psig).

c. The High/Low vacuum switch - The High/Low vacuum switch triggers a control room panel alarm when a high or low vacuum upstream of the rotameter is reached.

d. The chlorine injector - The chlorine injector is where the chlorine gas enters and is mixed with a water stream. A vacuum is created as high pressure water passes through a restriction. This vacuum opens a diaphragm valve (in the injector) and pulls the chlorine gas into the water stream. A drain relief valves relieves (water, water/chlorine mixture, or chlorine gas) if the pressure in the injector becomes too high. This is to protect the feeder system from the back flow of water.

V. Operating Procedures -

1.0 **TRANSPORTING TON CONTAINERS TO AN EMPTY CHLORINE FEEDER ROOM**

1.1. Turn on the lights and ventilation fan for the chlorine container room.

1.2. Open doors of the chlorine container room wide open

1.3. Place barricades in the road with a sign indicating that chlorine transportation is in progress.

1.4. Zero the scale by turning the scale adjustment knob until the zero and the needle are aligned.

1.5. Using the hoist, put a ton container on each scale trunion and one on the spare trunion.

1.6. Record the scale weight of the two containers on the log sheet.

1.7. Remove the barricades.

2.0 **EVACUATE CHLORINE FEEDER SYSTEM BEFORE CONNECTING CHLORINE GAS CONTAINERS**

NOTE: Turn on the the ventilation fan (if there is no leak) and lights.

2.1. Turn the chlorine feeder water supply solenoid HOA switch to HAND. Open all water supply block valves upstream and downstream of the chlorine feeder. The chlorine feeder water supply solenoid bypass globe valve and associated block valves should remain closed.

2.2. Verify that water is flowing through the injector and that the injector suction (vacuum) is greater than 25 inches of mercury.

2.3. Close the tubing yoke valves.

2.4. Open the following valves to evacuate the lines from the chlorine feeder to the chlorine container (for each container to be connected):
   a. The tubing/manifold valve
   b. The pressure gauge block valve
   c. The manifold valve
   d. The manifold yoke valve
   e. The vacuum regulator/check valve
   f. The plastic tubing valve.

2.5. Open the chlorine feed rate adjustment knob slightly (if closed) to allow the air to be evacuated.

2.6. Evacuate the chlorine system from the ejector to the container valves. Rotameter must show NO FLOW, and the supply pressure gauge must show greater than 100 inches of water.

2.7. Close both vacuum regulator/check valve units.

2.8. Close the following valves between the chlorine containers and the chlorine feeder injector:
   a. The tubing/manifold valve
   b. The plastic tubing valve.
   c. The chlorine feed rate adjustment valve (Do Not Tighten).

3.0. **CONNECT THE CHLORINE CONTAINERS**

3.1. At least two people must be present to connect a chlorine container, one to connect and one to stand watch. If a container needs to be connected during off-hours, vinyl must send someone to serve as a watch.

3.2. Put on a full face canister gas mask with an approved chlorine gas canister. Put on some rubber gloves.

****

WARNING: If a chlorine leak develops at any time during normal handling when operators are protected only by a full face shield and chlorine cannister, leave immediately and follow chlorine leak response procedure UT-WP-018.

****

//

NOTE

Ensure that the drip leg heaters for both North and South vacuum regulator/check valves are plugged in and operating.

//

3.4. Remove the chlorine container valve protective cover.

3.5. Verify that the tubing yoke valve is closed. Using the Standard Chlorine Container Wrench, make sure that the chlorine container valves are closed and that the valve packing nut is snug, but not too tight.

3.6. Align the chlorine container valves vertically. Rotate the container on the trunion as necessary.

3.7. Remove the container valve outlet cap from the TOP container valve (the valve used to supply chlorine gas). Inspect the face of the valve outlet to make sure it is clean, smooth and flat. Consult Harcross Chemical (or current chlorine supplier) if repairs are required.

3.8. Use a NEW lead gasket (yoke gasket) and connect the tubing yoke valve to the chlorine container valve.

a. Back off the yoke screw using the standard valve wrench.
b. Place a NEW lead gasket in the yoke
c. Place the yoke over the valve.
d. Properly align and engage the yoke inlet with the valve outlet.
e. Tighten the yoke screw with the standard valve wrench.

//

NOTE

Avoid excessive tightening of the lead gasket since that may squeeze it out of the joint.

//

3.9. Using an approved chlorine container valve wrench open the container valve one quarter turn. Close again.

3.10. Apply some aqua ammonia to a rag and hold under the area to be tested for leaks. DO NOT allow liquid aqua ammonia to come in contact with container, piping, or tubing surfaces.

3.11. If no leaks are found open the chlorine container valve one complete turn. Check for leaks again.

3.12. If no leaks are found open the tubing yoke valve one quarter turn. Close again. Check for leaks.

3.13. If no leaks are found open the tubing yoke valve all the way. Check for leaks.

3.14. If no leaks are found open the manifold/tubing valve one quarter turn. Close again. Check for leaks.

3.15. If no leaks are found open the manifold tubing valve all the way. Check for leaks again.

3.16. If no leaks are found open the vacuum regulator/check valve until two clicks (close together) are heard. Check for leaks.

3.17. If no leaks are found open the plastic tubing valve. Check for leaks.

3.18. If no leaks are found slowly open the chlorine feed rate adjustment knob until the maximum flow is obtained.

3.18.1. Verify that the injector suction (vacuum) is greater than 6 inches of mercury at maximum flow. Less thn 6 inches of mercury indicate a possible vacuum leak downstream of the rotameter.

3.18.2. Adjust the chlorine feed rate adjustment knob until the desired feed rate is obtained.

3.19. Check the chlorine feeder equipment for leaks (including the chlorine feeder relief valve and injector relief valve discharge tubes).

3.20. Close the vacuum regulator/check valve for the chlorine container just connected.

3.21. Repeat steps 3.4 through 3.19 to connect the second chlorine container. The second container should be feeding.

3.23. Open the container vacuum regulator/check valve on the first container connected. This container should be in standby.

//

NOTE

The standby condition is indicated by the regulator's valve stem protruding up from the center of the open-close knob.

//

3.24. Observe and record which container is feeding and which container is in standby.

4.0 WRAP UP PROCEDURE

4.1. Close the doors and turn off the ventilation fan and the lights.

4.2. Turn the chlorine feeder water supply solenoid valve HOA switch to AUTO.

4.3. Turn the well pumps ON at appropriate time in water plant start-up procedure.

5.0. CONTAINER CHANGE-OUT PROCEDURE

5.1. At least two people must be present to change-out a chlorine container, one to connect and one to stand watch. If a container needs to be changed-out during off-hours, vinyl must send someone to serve as a watch.

5.2. Turn off the well pumps.

5.3. Turn the chlorine feeder water supply HOA switch to HAND.

5.4. Close the vacuum regulator/check valve for the container which is **NOT** being disconnected.

5.5. Close the container valve for the container to be disconnected.

5.6. Evacuate the chlorine system from the ejector to the container valve of the container to be disconnected. Rotameter must show NO FLOW, and the supply pressure gauge must show greater than 100 inches of water.

5.7. Close the following valves on supply line to the empty container:
a. Tubing yoke valve.
b. Tubing manifold valve.
c. Vacuum regulator check valve.
d. Plastic tubing block valve.
e. Chlorine feedrate adjustment valve. (Rotameter)

5.8. Disconnect the empty container, and replace the cap nut and protective cover.

5.9. Barricade the road that passes in front of the chlorine room.

5.10. Remove the empty container using the hoist, and transport it to an empty trunion. If no empty trunion is available, set the container on the ground and scotch until an empty trunion is available.

5.11. Transport a full container to the chlorine room. Using the hoist, lift the container and place it on the empty trunion. Record the new scale weight.

5.12. Follow steps 3.2 to 3.19 to connect the container.

5.13 Close the vacuum regulator/check valve for the container just connected.

5.14. Open the vacuum regulator/check valve for the container NOT disconnected. Re-establish appropriate chlorine feedrate.

5.15. Open the vacuum regulator/check valve for the container just connected. The container should be in standby.

5.16. Close the door and turn off the light.

5.17. Turn the water supply HOA switch to AUTO.

5.18. Turn on the well pumps.

6.0. HIGH/LOW VACUUM ALARM

6.1. If a HIGH/LOW VACUUM alarm is received without a CHLORINE LEAK alarm, check the reading of the chlorine feeder vacuum gauge. If at any time while in the chlorine room chlorine is smelled or a chlorine leak alarm is heard, leave immediatly and follow procedures for chlorine leak response (UT-WP-018).

6.1.1. If a positive pressure (or lack of vacuum) is indicated, follow Emergency Operation procedures for Chlorine Leak Cylinder Room (Alarm) 1.7 through 1.22.

6.1.2. If no leak is found and the chlorine feeder is still operating under alarm condition follow **Chlorine Feeder Failure** procedures 9.0 - 9.10 .

6.1.3. If a high vacuum is indicated by the feeder vacuum gauge check the weight on scale for a possible empty container(s). Also check to see if the proper valves are open so that both containers can feed chlorine.

6.1.4. If a high vacuum is due to one empty container and a closed vacuum regulator/check valve on the full container: Follow Start Up after Emergency or Normal Shutdown Procedures for the full container.

7.0. CHLORINE INTERLOCK FAILURE ALARM

7.1. Check the position of the chlorine feeder water supply solenoid valve HOA switch. Turn HOA to AUTO and verify operation.

7.2. If the solenoid valve will not operate with the HOA in the AUTO position, operate the chlorine feeder water supply solenoid valve manually while the well pump is running.

7.3. Turn the HOA switch to HAND and verify operation.

7.4. If the solenoid will not operate with the HOA switch in the HAND position bypass the solenoid valve by opening the bypass globe valve and closing the solenoid block valves.

7.5. Have the automatic water supply solenoid valve and/or loop repaired.

8.0. **POWER FAILURE**

8.1. After power is restored, verify that the chlorine feed rate is the same as last recorded. Adjust if necessary.

9.0. **CHLORINE FEEDER FAILURE**

9.1. Turn off well pump.

9.2. Close chlorine container valves.

9.3. Start up back-up chlorine feeder (follow start up procedures UT-WP-002).

9.4. Evacuate chlorine system following steps 2.0 - 2.8.

9.5. Turn the lights and the ventilation fan off when leaving the chlorine container room.

9.6. Turn the chlorine feeder water supply solenoid HOA switch OFF.

9.7. When the feeder is operable follow back-up chlorine feeder shut down procedures and chlorine feeder system start up procedures.

10.0. **WATER SUPPLY SOLENIOD FAILURE**

10.1. Turn chlorine system water supply HOA switch to the **OFF** position.

10.2. **Close** the chlorine system water supply block valves that are on either side of the solenoid valve.

10.3. **Open** the block valves that are on each end of the solenoid valve bypass line.

10.4. **Open** the globe valve on the solenoid valve bypass line fully.

10.5. Write a priority **"A"** work order to have the solenoid valve replaced.

11.0. **CHLORINE FILTER REPLACEMENT/GENERAL REPAIR WORK**

11.1. Turn off the well pumps.

11.2. Turn the chlorine feeder water supply HOA switch to HAND.

11.3. Close the vacuum regulator/check valve for the chlorine supply line which is NOT being repaired.

11.4. Close the container valve for the chlorine supply line to be repaired.

11.5. Evacuate the chlorine system from the ejector to the container valve of the line to be worked on. Rotameter must show NO FLOW, and the supply pressure gauge must show greater than 100 inches of water.

11.6. Close the following valves on the chlorine supply line to be repaired:
   a. Tubing yoke valve.
   b. Tubing manifold valve.
   c. Vacuum regulator check valve.
   d. Plastic tubing block valve.
   e. Chlorine feedrate adjustment valve. (Rotameter)

11.7. Open the vacuum regulator/check valve for the container still in service and restore previous chlorine feed rate.

11.8. Turn the chlorine feeder water supply HOA switch to AUTO.

11.9. After repairs, open all valves on the chlorine supply line just repaired **except** the container valve.

11.10. Close the vacuum regulator/check valve for the container still in service.

11.11. Evacuate the chlorine system from the ejector to the container valve of the container just repaired. Rotameter must show NO FLOW, and the supply pressure gauge must show greater than 100 inches of water.

11.12. Close the following valves on the chlorine supply line just repaired:
   a. Tubing manifold valve.
   b. Vacuum regulator check valve.
   c. Plastic tubing block valve.
   d. Chlorine feedrate adjustment valve. (Rotameter)

11.13. Open the vacuum regulator/check valve for the container still in service and restore previous chlorine feed rate.

11.14. Open the following valves on the chlorine supply line just repaired:
   a. Tubing manifold valve.
   b. Vacuum regulator check valve.
   c. Plastic tubing block valve.

11.15. The container should be in standby.

12.0 **CHLORINE ADDITION**

12.1 The amount of chlorine that was found to be needed to oxidize raw coker water properly during the water plant start-up was approximately 12-13 ppm.

12.2 The chlorine feed rate is measured in pounds per day. Therefore, the water plant operator should set the chlorine feed rate to obtain a 12-13 ppm chlorine concentration in the coker water.

//

NOTE

The 12-13 ppm described in step 1.2 is not what the operator should expect to get during his regular checks of chlorine residual. The 12-13 ppm chlorine concentration is the desired concentration of chlorine immediately after injection in the coker tray downcomer, after that the chlorine is "used" to oxidize the iron. Any chlorine that is not "used" to oxidize iron will be detected with the operator's residual chlorine test.

//

12.3 To calculate the the chlorine feed rate in pounds per day (lb/day) for any well water flow rate use the following equation:

Chlorine Concentration (PPM)	×	**Well Water Flow Rate (GPM)**	÷	**83.27**	=	**Chlorine Feed Rate (lb/day**
	×		÷	83.27	=	

12.4 EXAMPLE:

Well Water Flow Rate = 1300 GPM
Desired Chlorine concentration = 9.5 ppm
Calculate what the chlorine feed rate in lb/day should be.

ANSWER:

$$FR = C \times WF \div 83.27$$
$$FR = 9.5 \times 1300 \div 83.27$$

$$\underline{FR = 148 \text{ lb/day}}$$

13.0 **NORMAL SHUTDOWN**

13.1. Turn on the ventilation fan (if there is no leak) and the lights for the chlorine container room before entering the room.

13.2. Close the chlorine container valves.

13.3. EVACUATE CHLORINE FEEDER SYSTEM

13.4. Turn off the well pumps.

13.5. Turn the chlorine feeder water supply solenoid HOA switch to HAND.

NOTE: The ventilation fan (if there is no leak) and lights should be turned on before entering the chlorine container room.

13.6. Verify that water is flowing through the injector and that the injector suction (vacuum) is greater than 25 inches of mercury.

13.7. Close the tubing yoke valves connected to the North and South chlorine container valves.

13.8. Open the following valves to evacuate the lines from the chlorine feeder to the chlorine container (for each container to be connected):
- a. The tubing/manifold valve
- b. The pressure gauge block valve
- c. The manifold valve
- d. The manifold yoke valve
- e. The vacuum regulator/check valve
- f. The plastic tubing valve.

13.9. Open the chlorine feed rate adjustment knob slightly (if closed) to allow the air to be evacuated.

13.10. Evacuate the chlorine system from the ejector to the container valves. Rotameter must show NO FLOW, and the supply pressure gauge must show greater than 100 inches of water.

13.11. Close both vacuum regulator/check valve units.

13.12. Close the following valves between the chlorine containers and the chlorine feeder injector:

a. The tubing/manifold valve
b. The plastic tubing valve.
c. The chlorine feed rate adjustment valve (Do Not Tighten).

13.13. Turn the chlorine feeder water supply solenoid HOA switch OFF.

13.14. Close the chlorine/water solution line block valve at the aerator downcomer injection point. (To prevent backflow into the chlorine injector).

13.15. Close the doors and turn off the fan and the lights.

13.16. The well pumps may be turned on at this time. The back-up chlorine feed system may also be used at this time.

VI. Operating Limits -

Critical Parameter	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action
Residual Chlorine, ppm	0.05 to 0.5 ppm	Below 0.05 ppm: Insufficient oxidation of iron and Manganese Above 0.5 ppm: Corrosion potential increase, detrimental to pond	Check feed rate daily, check residual chlorine analyzer every four hours, calibrate as needed. Adjust chlorine feed rate in increments of 10 Lbs/Day every four hours.
Chlorine Feeder pressure	10-400 inches water	Tube feeder equipment failure for positive internal pressure	Feeder Relief valve set to relieve at 10-20 inches water.
Chlorine injector pressure	0 - 39 inches mercury	Back flow of water into equipment and piping.	Injector Relief valve relieves at some positive pressure in the injector.

VII. Safety Systems and Their Functions -

Safety System	Function Performed
Fixed Point Chlorine Monitor	Monitors chlorine concentration in the chlorine container room. Triggers alarms (control panel alarm, flashing light and horn outside chlorine container room.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Leak Response-Backup System	UT-WP-017

Approved: _____ Date: 5/31/94
D. A. Miller - Mech. Superintendent

I. Purpose - The purpose of this procedure is to detail steps to be taken in the event of a chlorine leak in the chlorine back-up system.

II. References - The Chlorine Manual: Chlorine Institute, Wallace & Tiernan Manuals, Material Safety Data Sheet for Chlorine and Aqua Ammonia, Harcros Chemical training information sheet. Harcros Chlorine Leak Response Team, Phone 601-969-3177 (24 hrs.).

III. Safety and Health Considerations - SEE UT-WP-003

IV. Discussion - SEE UT-WP-002

V. Operating Procedure -

RESPONSIBILITY - UTILITY OPERATOR

1.0 CHLORINE LEAK - OPERATOR DETECTED

1.1 **NO VISIBLE VAPOR CLOUD** - Notify Vinyl operations personel of the leak (CALL 2200). Request assistance from person(s) equipped with SCBA(s). Obtain wind directions.

VISIBLE VAPOR CLOUD - Call 2200 and indicated that there is a chlorine leak EMERGENCY.

1.2 Turn off the well pumps.

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Leak Response-Backup System	UT-WP-017

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1.3 You (person responsible) and one or more emergency respondants or other Vista employees must have on the required protective gear/clothing before attempting to stop a chlorine leak. The amount of protection depends on the type, location, and severity of the leak. Follow the guidlines listed in the **Health and Safety section** of **UT-WP-003** to determine what protective gear/clothing is needed for a particular leak.

****

2.0 LOCATE THE LEAK

2.1 If the location of the leak is not immediately apparent:

a. Apply some aqua ammonia to a rag and hold it under the chlorine gas lines begining at the chlorine gas container and ending at the chlorine gas ejector.

b. Check the chlorine container if no leak is found in the vacuum regulator.

2.2 Respond to the leak depending on the location and type.

3.0 LEAK IN VACUUM REGULATOR VENT.

3.1 **CLOSE** the container valve.

3.2 Put the solenoid valve HOA switch in the **HAND** position.

3.3 Allow the metering ball to fall to the bottom and remain there.

3.4 Disconnect vacuum regulator and repair/replace regulator as required.

3.5 When the repairs have been made, follow the appropriate start up procedures to start chlorine feeder.

4.0 LEAK AT CONTAINER VALVE, FUSEABLE PLUG, OR CONTAINER.

4.1 If the leak is in the container valve packing, tighten the packing nut without using excessive force. If this does not eliminate the leak proceed to step 4.2.

4.2 Close the chlorine container valve.

4.3 Stop/Contain leak as indicated in the Chlorine "B" Kit manual (Chlorine "B" kit and manual are located in the Equipment Room).

4.4 Notify Harcross Chemical (or current chlorine supplier) of leaking container (See references for phone number).

4.5 Swap out containers following procedure UT-WP-002.

VI. Operating Limits -
SEE NORMAL OPERATING PROCEDURE UT-WP-002

VII. Safety Systems and Their Functions - N/A

VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Leak Response	UT-WP-018

Approved: D. A. Miller - Mech. Superintendent Date: 5/31/94

I. Purpose - The purpose of this procedure is to respond to emergency situations concerning the chlorine feeder system. They include: Chlorine Leaks, High/Low Vacuum Alarms, Chlorine Feeder Interlock Failures, Power Failures, Chlorine Feeder Failures, and Water Supply Solenoid Failures.

II. References - The Chlorine Manual: Chlorine Institute, Wallace & Tiernan Manuals, Material Safety Data Sheet for Chlorine and Aqua Ammonia, Harcross Chemical training information sheet. Phone 601-969-3177.

III. Safety and Health Considerations - UT-WP-003

IV. Discussion - SEE UT-WP-003

V. Operating Procedure -

1.0 Chlorine Leak Cylinder Room (Alarm)

1.1. Notify Vinyl operations personel of the leak (CALL 2200). Request assistance from person(s) equipped with SCBA(s). Obtain wind directions.

1.2. Turn off the well pumps.

****

1.3 You (person responsible) and one or more emergency respondants or other Vista employees must have on the required protective gear/clothing before attempting to stop a chlorine leak. The amount of protection depends on the type, location, and severity of the leak. Follow the guidlines listed in the **Health and Safety section** of **UT-WP-003** to determine what protective gear/clothing is needed for a particular leak.

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VISTA CHEMICAL COMPANY - ABERDEEN PLANT

Utilities Operations Manual	
Chlorine Leak Response	UT-WP-018

****

1.4. Before entering the room check the chlorine concentration indicated on the fixed chlorine monitor meter. If the chlorine concentration is less than **2 ppm**, proceed with correcting the leak. If the fixed chlorine monitor meter indicates a concentration of greater than **2 ppm**, or if there is a visible vapor cloud or liquid leak, call 2200 and indicate that there is an emergency chlorine leak situation.

****

1.5. Turn the chlorine feeder water supply solenoid valve HOA switch to HAND.

1.6. Turn on the light in the chlorine container room. DO NOT TURN ON THE FAN.

1.7. LOCATE THE LEAK

1.8 Close the chlorine container valves.

1.9. If the location of the leak is not immediately apparent:

a. Apply some aqua ammonia to a rag and hold it under the chlorine gas lines begining at the chlorine gas container and ending at the chlorine gas injector.

b. Check the chlorine container if no leak is found in the piping.

c. If still no leak is found, it may be necessary to open the chlorine container valve and recheck the piping and container until the leak is found.

d. Verify the fixed chlorine monitor accuracy if leak cannot be found.

1.10. Respond to the leak depending on location and type.

1.11. **Leak in tubing, manifold, feeder equipment, and valves.**

1.12. Evacuate the chlorine feeder system

1.12.1. Verify that water is flowing through the injector and that the injector suction (vacuum) is greater than 25 inches of mercury.

1.12.2. Close the tubing yoke valves connected to the North and South chlorine container valves.

1.12.3. Open the following valves to evacuate the lines from the chlorine feeder to the chlorine container (for each container to be connected):
a. The tubing/manifold valve
b. The pressure gauge block valve
c. The manifold valve
d. The manifold yoke valve
e. The vacuum regulator/check valve
f. The plastic tubing valve.

1.12.4. Open the chlorine feed rate adjustment knob slightly (if closed) to allow the air to be evacuated.

1.12.5. Allow the system to evacuate for 10 minutes (The feeder vacuum gauge should indicate a vacuum of greater than 100 inches of water). If the rotameter float indicates flow after 10 minutes check for a vacuum leak upstream of the rotameter.

1.13. Attempt if possible to isolate the area of the leak from the North or the South manifold so that chlorine can be fed from one container while the leak is being repaired.

1.14. If chlorine system cannot be operated while leak is being repaired, switch over to the back-up chlorine feeder system (See back-up chlorine feeder operation procedures).

1.15. Repair/replace tubing, manifold, feeder equipment, and/or valves as required.

1.16. When the repairs have been made follow the appropriate start up procedures to start the chlorine feeder.

1.17 **Leak at container valve, fuseable plug, or container.**

1.18. Close the chlorine container valve.

1.19. Stop/Contain leak as indicated in the Chlorine "B" Kit manual (Chlorine "B" kit and manual are located in the Equipment Room).

1.20. Notify Harcross Chemical (or current chlorine supplier) of leaking container (See references for phone number).

1.21. If it is necessary to continue to feed chlorine from the leaking container:

a. Close both vacuum regulator/check valves.

b. Open the container valve (or valve installed as part of "B" kit containment procedures) of the leaking container.

c. Open the vacuum regulator/check valve of the leaking container. Verify that the feed rate is the same as last recorded. Adjust as necessary.

d. Open the container valve of the other container.

e. Open the vacuum regulator/check valve of the other container. This should be in stand by.

1.22 When the leaking container is ready for shipment follow Normal Operation Procedures for disconnecting a chlorine container and transportation.

2.0. Chlorine Leak - Operator detected.

Follow the same procedures as Chlorine Leak Cylinder Room (Alarm).

VI. Operating Limits - SEE UT-WP-003

VII. Safety Systems and Their Functions - SEE UT-WP-003

APPENDIX C

CONDEA VISTA

nteroffice
Communication

To: All Employees

From: Kelly Wood
Date: June 2, 1997

Subject: **Employee Participation In The Utilities Area Hazop Study**

To comply with OSHA regulations, Condea Vista must perform a Hazop (type of hazard analysis) on all its existing processes. Next week a Hazop team will begin analysis of the plant's utilities area. The regulations also state that employee participation is mandatory. To comply with the employee participation portion, the following team has been assembled to conduct the Utilities Area Hazop.

- Jimmy Brewer
- Jerald Uptain
- Charlie Peden
- Milton Threadgill
- Janice Minga
- Kelly Wood

To further promote employee participation and to hopefully perform the most thorough Hazop analysis possible, the team is asking you to contact one of the team members if you know of any safety or environmental issues regarding the utilities area you feel needs addressing.

Meetings will be held in the plant's training room. Meeting times will be 7:45 AM - 11:30 AM and 12:30 PM - 4:00 PM daily beginning Monday, June 9th, 1997. The meetings will continue until the Hazop is completed on or about Friday, June 13, 1997.

Posting Date 6-02-97
Removal Date 6-13-97

APPENDIX D

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

Appendix D. HAZOP Pre-Work Material List

Process Safety Information Per OSHA CFR 1910.199 (d)

I. Hazards Of The Highly Hazardous Chemicals In The Process

Item	Where Found
Toxicity	DMS-ABER-Safety-MSDS/Vendor
Permissible Exposure Limits	DMS-ABER-Safety-MSDS/Vendor
Physical Data	DMS-ABER-Safety-MSDS/Vendor
Reactivity Data	DMS-ABER-Safety-MSDS/Vendor
Corrosivity Data	DMS-ABER-Safety-MSDS/Vendor
Thermal & Chemical stability Data	DMS-ABER-Safety-MSDS/Vendor
Hazardous Effects of Inadvertant Mixing	DMS-ABER-Safety-MSDS/Vendor

II. Information On Technology of Process

Item	Where Found
PFDs	Not Available
Maximum Intended Inventory	DMS-ABER-UT-Procedures/PSM Compliance Manual/PSI
Process Chemistry	Not Applicable
Safe Upper/Lower Limits For Critical Parameters	DMS-ABER-UT-Procedures/Process Operation/Normal
Evaluation of Consequence of Deviation	DMS-ABER-UT-Procedures/Process Operation/Normal

III. Information on Equipment In Process

Item	Where Found
Materials of Construction	Equipment Files/DMS
P&ID's	DMS-ABER-UT-Engineering Drawings
Electrical Classification	DMS-ABER-UT-Engineering Drawings
Relief System Design & Design Basis	DMS-ABER-Saferty/Environmental/Relief Devises.
Ventilation System Design	Not Available
Design Codes/Standards	K: Eng_Std
Material & Energy Balances	Not Applicable
Safety Systems	DMS/Procedures/PSM Compliance Manual/PSI

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

Other Information Used

	Where Found
Chemical Interaction Matrix for Chlorine	DMS-ABER-PSM Compliance/Facility Siting
Documentation of previous incidents that had a likely potential for catastrophic consequences in the Utilities area.	Safety Dept. Files
Documentation of previous relevant safety audits that addressed the potential for catastrophic consequences in the Utilities area.	PSM File Room
Facility Siting Information. Dow Fire & Explosion Index	DMS-ABER-PSM Compliance/Facility Siting
Operating Procedures	DMS-ABER-UT-Procedures/Process Operations/Normal

UT-PR-001	12/13/94
UT-PR-002	12/13/94
UT-PR-003	12/13/94
UT-PR-006	12/13/94
VINYL-OM-E008	03/28/95
VINYL-NM-E008	03/28/95
UT-AS-001	08/02/95
UT-AS-009	08/02/95
UT-WP-002	05/31/94
UT-WP-003	05/31/94
UT-WP-017	05/31/94
UT-WP-018	05/31/94
UT-CT-001	05/12/97
UT-CT-002	05/12/97
UT-CT-003	05/12/97

Note: The above list of operating procedures show only those procedures for the Utilities area that contain start-up, shutdown, and/or emergency instruction. However, all procedures containing normal operation instruction for the Utilities area were available for review during the Hazop.

P&IDs — DMS-ABER-Engineering Drawings

BP-090100	01/24/96
BP-090101	11/21/96
BP-090102	02/25/94
UT-090102	02/25/94
UT-090109	08/12/94
UT-090111	02/25/94
UT-090112	02/17/95

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

Other Information Used

		Where Found
P&IDs		DMS-ABER-Engineering Drawings
UT-090113	02/17/95	
UT-090114	02/17/95	
UT-090117	08/23/94	
WP-090106	01/25/96	
Condea Vista Company Corporate Safety & Health Standards, Process Hazard Analysis, PSM-004		J: Safety & Health/PSM/PSM-004
Plant Plot Plan, GP-F005-42-2-1, DTD. 8/18/82		DMS-ABER-Engineering Drawings
Process Design For Deluge System- Propane Tank Farm		Safety Deptartment Files

PSM Covered Equipment

Where Found: DMS-ABER-(Use Folder Search Equipment/Equipment No.)

Location Code	Equipment Description	Equipment Number
PV-029	West Propane Storage Drum	450029
	Relief Valve	780456
PV-030	Middle Propane Storage Drum	450030
	Relief Valve	780457
PV-031	Out of Service	
PP-312	W. Propane Transfer Pump	720312
	Relief Valve	781117
PP-868	E. Propane Tansfer Pump	720868
	Relief Valve `	781118
EX-811	E. Propane Vaporizer	551081
EX-812	M.Propane Vaporizer	551082
EX-813	W. Propane Vaporizer	551083
MI-032	Propane Air Mixer	820007
	Propane Air Mixer	820006

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

PSM Covered Equipment

Where Found: DMS-ABER-(Use Folder Search Equipment/Equipment No.)

Location Code	Equipment Description	Equipment Number
	Propane Air Mixer	820008
	Propane Air Mixer	820004
PV-032	E. Propane Surge Tank	450032
	Relief Valve	781075
PV-033	Middle Propane Surge Tank	450033
	Relief Valve	780409
PV-034	West Propane Surge Tank	450034
	Relief Valve	780408
CP-708	Inst Air Comp	720708
	Relief Valve	781194 or 781208
CP-909	Inst Air Comp	72904
DR-028	Deltech Dryer	560028
	Inlet Filter	640046
	North Outlet Filter	641009
	South Outlet Filter	641010
	RV Deltech	781188
	RV Deltech	781119
EX-033	West Aftercooler	551030
EX-032	East Aftercooler	551031
DM-332	Inst Air Receiver	450332
	Relief Valve	781209
DM-301	Inst Air Receiver	450301
	Relief Valve	780060
DM-300	Plant Air Receiver	450302
	Relief Valve	781168
PP-243	#4 West CT Pump	720282
PP-281	#4 M CT Pump	720281

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

PSM Covered Equipment

Where Found: DMS-ABER-(Use Folder Search Equipment/Equipment No.)

Location Code	Equipment Description	Equipment Number
PP-955	#4 E CT Pump	720955
PP-906	#6 W CT Pump	720906
PP-907	# 6 M CT Pump	720907
PP-908	#6 E CT Pump	721199
PP-252	Cooling to OM (Charlie Miller Bldg)	720252
PP-253	# 2 Cooling Tower Pump	720253

APPENDIX E

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

Appendix E. List of Updates and Revalidations

1. Initial PHA. No updates or revalidations exist.

APPENDIX F

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
1.1 High Pressure						
	1. Back flow from high pressure downstream source 2. Blocked discharge 3. Blocked in liquid line on thermal expansion case 4. Fire case 5. High upstream pressure 6. Pump maximum discharge head	1. Downtime/Lost Production 2. Fire/Explosion 3. Personnel Evacuation 4. Propane leak 5. Propane release 6. Propane release - E 7. Fire/Explosion - E	4 4 4 4 4 4 4	D D D D D D D	5 5 5 5 5 5 5	1. Piping specification adequate for maximum pressures 2. Pressure relief valve
1.2 High Temperature						
	1. Fire 2. Hot work in close proximity	1. Fire/Explosion 2. Fire/Explosion - E 3. Propane release 4. Propane release - E	4 4 4 4	D D D D	5 5 5 5	1. Fire Protection Equipment 2. Hot work permits 3. Piping specification covering full temperature range possible
1.3 Low Temperature						
	1. Line freeze-up	1. Downtime/Lost Production 2. Environmental - No Consequence	4 4	D D	5 5	1. Piping specification covering full temperature range possible 2. Double block valves where freeze-up can occur
1.4 Low/No Flow						
	1. High downstream pressure 2. Low upstream pressure 3. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Environmental - No Consequence	4 4	D D	5 5	1. Excess flow valve snaps shut 2. Operating procedures for routing flows 3. Unique connectors for flexible lines 4. Valve position indicators

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
1.5 Reverse/Misdirected Flow						
	1. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Environmental - No Consequence	4 4	D D	5 5	1. Operating procedures on line routings 2. Unique connectors for flexible lines 3. Valve position indicators

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters: Propane flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	S	L	RR	Safeguards
2.1 High Pressure						
	1. Fire case	1. Downtime/Lost Production	4	D	5	1. Fire detection & prevention
	2. Maximum suction pressure at pump shutoff	2. Fire/Explosion	4	D	5	2. Pressure relief valve on pump discharge (upstream of block valve)
	3. Pump driver overspeeding	3. Fire/Explosion - E	4	D	5	
	4. Pressure control valve malfunction	4. Personnel Evacuation	4	D	5	
	5. Valve closed on valve discharge	5. Propane release	4	D	5	
		6. Propane release - E	4	D	5	
2.2 Cavitation						
	1. Inlet filter/strainer plugs	1. Low or no flow	4	D	5	1. Duplicate filter/strainer
	2. Low level in drum supplying pump	2. Damage to pump	4	D	5	
		3. Downtime/loss of production	4	D	5	
		4. Low or no flow - E	4	D	5	
		5. Damage to pump - E	4	D	5	
2.3 Rupture						
	1. Corrosion/erosion	1. Propane release	4	D	5	1. Fire detection & prevention
	2. High pressure	2. Propane release - E	4	D	5	2. Inspection & maintenance program to detect corrosion/erosion & replace affected components
	3. Improper maintenance	3. Fire/Explosion	3	D	5	3. Monitors to detect leakage from seal/packing
	4. Seal/packing failure	4. Fire/Explosion - E	3	D	5	4. Remote shutdown of pump
	5. Blown gasket					5. Remotely operable isolation valve on pump suction
2.4 High Temperature						
	1. Fire	1. Downtime/Lost Production	4	D	5	1. Fire Protection Equipment
	2. Hot work in close proximity	2. Fire/Explosion	3	D	5	2. Hot work permits
		3. Fire/Explosion - E	3	D	5	

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters: Propane flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	S	L	RR	Safeguards
2.4 cont'd						
	3. Pump malfunction	4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	
2.5 Low Pressure						
	1. Line Rupture/Leak	1. Downtime/Loss of production	4	D	5	1. Bypass around control valve
	2. Operator fails to align correct lines/valves	2. Environmental - No consequence	4	D	5	2. Pressure indication
	3. Upstream pump failure	3. Fire/Explosion	3	D	5	3. Spare pump on standby
		4. Fire/Explosion - E	3	D	5	
		5. Propane release	4	D	5	
		6. Propane release - E	4	D	5	

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
3.1 High Pressure						
	1. Fire case 2. Overfilling of vessel 3. Plugging of pressure relief valve 4. Pressure control valve failure 5. Relief valve isolated	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 2 3 4 4	D D D D D	5 4 5 5 5	1. Deluge system 2. Fire detection & prevention systems 3. High pressure indication 4. Pressure relief valve 5. Sloping ground to prevent accumulation of flammables beneath vessel
3.2 High Temperature						
	1. Fire case 2. Hot work in area	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 3 3 4 4	D D D D D	5 5 5 5 5	1. Automatic deluge 2. Emergency isolation 3. Fire detection & prevention system 4. Operating procedures 5. Pressure relief valve 6. Skirts and/or vessel supports fireproofed 7. Sloping ground beneath vessel to prevent flammables accumulating
3.3 High Level						
	1. Operator/truck driver overfill tank during filling 2. Recirculation valves misaligned to pull from one tank and return to another	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 3 3 4 4	D D D D D	5 5 5 5 5	1. Level gauge 2. Operating procedures 3. Pressure relief valve
3.4 Leak						
	1. Corrosion and/or erosion 2. Gasket or valve flange or packing leak 3. Inadequate torquing of bolts	1. Fire/Explosion 2. Fire/Explosion - E 3. Propane release 4. Propane release - E	3 3 4 4	D D D D	5 5 5 5	1. Isolation valves on instruments/bridles 2. Procedures for torquing bolts 3. Maintenance & inspection procedures

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 1/24/96
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
3.4 cont'd						
	4. Instrument connection leaks					4. Deluge
	5. Relief valve leak					5. Propane detection
3.5 Rupture						
	1. Material fatigue due to fire	1. Downtime/Lost Production	4	D	5	1. Relief valve locked open
	2. Overpressure	2. Fire/Explosion	3	D	5	2. Fire protection equipment
	3. Relief valve plugged	3. Fire/Explosion - E	3	D	5	3. Pressure relief valve
	4. Relief valve isolated	4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawing: BP-090101-PID-D, 11/21/96
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	S	L	RR	Safeguards
4.1 High Pressure						
	1. Blocked in liquid line on thermal expansion case 2. Fire case 3. High upstream pressure 4. Pressure control valve malfunction	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	D D D D D	5 5 5 5 5	1. Pressure control valve 2. Pipe specs 3. Operating procedure 4. Relief valve on upstream pump
4.2 High Temperature						
	1. Fire 2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	D D D D D	5 5 5 5 5	1. Fire Protection Equipment 2. Hot work permits 3. Piping specification covering full temperature range possible
4.3 High Flow						
	1. High upstream pressure 2. Operator fails to align correct lines/valves 3. Pressure control valve malfunction 4. Line leak 5. Both pumps running 6. High pressure in storage tanks	1. Liquid exiting vaporizer 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	C D D D D	5 5 5 5 5	1. Isolation valve, remotely operable 2. Operating procedures for routing flows 3. Valve position indicators 4. Pressure control valve
4.4 Low/No Flow						
	1. High downstream pressure 2. Low upstream pressure 3. Operator fails to align correct lines/valves 4. Plugged strainer/filter 5. Pump failure 6. Pressure control valve malfunction	1. Downtime/Lost Production	4	D	5	1. Operating procedures for routing flows 2. Spare pump on standby 3. Valve position indicators

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawing: BP-090101-PID-D, 11/21/96
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	S	L	RR	Safeguards
4.5 Leak						
	1. Corrosion 2. Gasket or packing or valve seal failure 3. Inadequate torquing of bolts 4. Line overstressed	1. Fire/Explosion 2. Fire/Explosion - E 3. Propane release 4. Propane release - E	4 4 4 4	D D D D	5 5 5 5	1. Flammable gas detection & alarm 2. Inspection & testing procedures 3. Isolation valve 4. Line adequately supported and guided 5. Maintenance procedures for torquing bolts 6. Water monitors & deluge system

Node: 5. Steam supply to vaporizers.	
Type: Line	Drawing: BP-090101-PID-D, 11/21/96
Design Conditions/Parameters: Steam supply at 150 psig then reduced to 25 psig. Flow to 1500 lb/hr.	

Dev	Causes	Consequences	S	L	RR	Safeguards
5.1 High Pressure						
	1. Blocked discharge	1. Lift relief valve	4	C	5	1. Piping specification
	2. High upstream pressure	2. Blow gasket	4	C	5	adequate for maximum
	3. Regulator malfunction	3. Lift relief valve - E	4	D	5	pressures
	4. Regulator bypass open	4. Blow gasket - E	4	D	5	2. Pressure relief valve
5.2 Low/No Flow						
	1. High downstream pressure	1. Liquid exiting vaporizer	4	B	5	1. Manual bypass around
	2. Low upstream pressure	2. Downtime/Lost Production	4	B	5	control valve
	3. Operator fails to align correct lines/valves					2. Operating procedures for routing flows
	4. Plugged strainer/filter					
	5. Line rupture					

Node: 6. Propane vaporizers, EX-811, EX-812, and EX-813.	
Type: Heat Exchanger	Drawing: BP-090101-PID-D, 11/21/96
Design Conditions/Parameters: Capacity: Vaporize 100,000 scfh propane each.	

Dev	Causes	Consequences	S	L	RR	Safeguards
6.1 High Pressure						
	1. Blocked-in condition	1. Fire/Explosion	4	D	5	1. Fire detection & prevention
	2. Tube rupture	2. Fire/Explosion - E	4	D	5	2. Maintenance steam vent connection on exchanger
	3. Discharge line closed	3. Propane leak	4	D	5	3. Pressure relief valve located on exchanger
	4. Relief valve malfunction	4. Propane release	4	D	5	4. Shell & tube sides having equal design pressures
		5. Downtime/Lost Production	4	D	5	
6.2 Low Temperature						
	1. Low steam flow	1. Downtime/Lost Production	4	B	5	1. Operating procedures
		2. Liquid exiting vaporizer	4	B	5	2. Insulated lines
		3. Liquid exiting vaporizer - E	4	D	5	3. Strainers
						4. Steam regulator
6.3 Tube Leak						
	1. Corrosion	1. Downtime/Lost Production	4	D	5	1. Inspection program
	2. Overpressure	2. Liquid exiting vaporizer	4	D	5	2. Relief Valve
		3. Fire/Explosion	4	C	5	
		4. Fire/Explosion - E	4	C	5	
		5. Propane release	4	D	5	
		6. Propane release - E	4	D	5	
6.4 Shell Leak						
	1. Corrosion	1. Downtime/Lost Production	4	D	5	1. Inspection procedures
	2. Overpressure	2. Fire/Explosion	4	D	5	2. Fire Protection
	3. Tube Leak	3. Fire/Explosion - E	4	D	5	3. Relief valve
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	
		6. Liquid existing vaporizer	4	B	5	
		7. Liquid existing vaporizer - E	4	B	5	

Node: 7. Propane transfer lines thru propane/air mixers, MI-032, mixers 1,2,3,and 4.	
Type: Line	Drawing: BP-090102-PID-D, 2/25/94
Design Conditions/Parameters: Propane flow: 5500 scfh, Air flow: 4500 scfh. Per individual mixer.	

Dev	Causes	Consequences	S	L	RR	Safeguards
7.1 High Pressure						
	1. Blocked discharge 2. Regulator malfunction 3. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E 6. Incorrect air propane mixture	4 4 4 4 4 4	D D D D D D	5 5 5 5 5 5	1. Regulator 2. Relief valve on surge tank
7.2 High Temperature						
	1. Fire 2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	D D D D D	5 5 5 5 5	1. Fire Protection Equipment 2. Hot work permits 3. Piping specification covering full temperature range possible

Node: 8. Air supply line to propane/air mixer.	
Type: Line	Drawing: BP-090102-PID-D, 2/25/94
Design Conditions/Parameters: 4500 scfh to each individual mixer.	

Dev	Causes	Consequences	S	L	RR	Safeguards
8.1 High Temperature						
	1. Fire	1. Downtime/Lost Production	4	D	5	1. Fire Protection Equipment
	2. Hot work in close proximity	2. Fire/Explosion	4	D	5	2. Hot work permits
		3. Fire/Explosion - E	4	D	5	
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	
8.2 Low/No Flow						
	1. Plugged strainer/filter	1. Incorrect air/propane mixture	4	C	5	1. Air inlet filter
	2. No propane flow					2. PM on air filter
	3. Check valve malfunction	2. Downtime/Lost Production	4	C	5	
	4. Line plugged	3. Environmental - No consequence	4	D	5	
8.3 Reverse/Misdirected Flow						
	1. Discharge of mixer plugged	1. Downtime/Lost Production	4	D	5	1. Check valve
	2. Eductor malfunction	2. Fire/Explosion	4	D	5	
		3. Fire/Explosion - E	4	D	5	
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	

Node: 9. Propane surge tanks, PV-032, PV-033, and PV-034.	
Type: Vessel	Drawing: BP-090102-PID-D, 2/25/94
Design Conditions/Parameters: Propane/Air mixture to 15 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
9.1 High Pressure						
	1. Blocked in condition with liquid present	1. Downtime/Lost Production	4	D	5	1. Deluge system
	2. Fire case	2. Fire/Explosion	3	D	5	2. Pressure relief valve
	3. Overfilling of vessel	3. Fire/Explosion - E	3	D	5	3. Pressure regulator
	4. Plugging of pressure relief valve	4. Propane release	4	D	5	
	5. Pressure control valve failure	5. Propane release - E	4	D	5	
	6. Relief valve isolated					
9.2 High Temperature						
	1. Fire case	1. Downtime/Lost Production	4	D	5	1. Automatic deluge
	2. Hot work in area	2. Fire/Explosion	3	D	5	2. Operating procedures
		3. Fire/Explosion - E	3	D	5	3. Skirts and/or vessel supports fireproofed
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	
9.3 High Level						
	1. Excess feed supply	1. Downtime/Lost Production	4	D	5	1. Operating procedures
	2. Upstream control valve fails open	2. Downstream equipment damage	3	D	5	2. Pressure relief valve
	3. Liquid exiting vaporizers	3. Overpressure system	4	B	5	3. Vent to flare
		4. Fire/Explosion	3	D	5	
		5. Fire/Explosion - E	3	D	5	
		6. Propane release	4	D	5	
		7. Propane release - E	4	D	5	
		8. Downstream eq. damage - E	3	D	5	
9.4 Rupture						
	1. Material fatigue due to fire	1. Downtime/Lost Production	4	D	5	1. Fire protection equipment
	2. Overpressure	2. Fire/Explosion	3	D	5	2. Pressure relief valve
		3. Fire/Explosion - E	3	D	5	3. Adequate vessel design
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	

Node: 10. Propane supply line to plant.	
Type: Line	Drawings: BP-090102-PID-D, 2/25/94, UT-090102-PID-D, 2/25/94
Design Conditions/Parameters: Propane/Air mixture at 15 psig and varying flows.	

Dev	Causes	Consequences	S	L	RR	Safeguards
10.1 High Temperature						
	1. Fire 2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	D D D D D	5 5 5 5 5	1. Hot work permits 2. Piping specification covering full temperature range possible
10.2 Leak						
	1. Corrosion 2. Gasket or packing or valve seal failure 3. Inadequate torquing of bolts 4. Line overstressed	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E	4 4 4 4 4	D D D D D	5 5 5 5 5	1. Adequate corrosion allowance 2. Isolation valve 3. Line adequately supported and guided 4. Maintenance procedures for torquing bolts

Node: 11. Propane storage/surge tank equalization line.	
Type: Line	Drawings: BP-090100-PID-D, 1/24/96, BP-090102-PID-D, 2/25/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
11.1 Low/No Flow						
	1. Operator fails to align correct lines/valves	1. Can't burn off propane storage/surge tanks	4	D	5	1. Operating procedures for routing flows
	2. Line plugged	2. Can't burn off storage/ surge tanks - E	4	D	5	
	3. Valve closed					
11.2 Leak						
	1. Corrosion	1. Fire/Explosion	4	D	5	1. Isolation valve
	2. Gasket or packing or valve seal failure	2. Fire/Explosion - E	4	D	5	2. Line adequately supported and guided
	3. Inadequate torquing of bolts	3. Propane release	4	D	5	3. Maintenance procedures for torquing bolts
	4. Line overstressed	4. Propane release - E	4	D	5	4. Deluge
11.3 Reverse/Misdirected Flow						
	1. Operator fails to align correct lines/valves	1. Downtime/Lost Production	4	D	5	1. Operating procedures on line routings
		2. Fire/Explosion	3	D	5	2. Valve position indicators
		3. Fire/Explosion - E	3	D	5	
		4. Propane release	4	D	5	
		5. Propane release - E	4	D	5	
		6. Unload truck into surge tank or out flare	3	D	5	

Node: 12. Put propane system into standby.	
Type: Procedural Step	Drawing: (OP) UT-PR-002, 12/13/94
Design Conditions/Parameters: Steps 1.1.1 thru 1.1.10 & 1.2.1 thru 1.2.6	

Dev	Causes	Consequences	S	L	RR	Safeguards
12.1 No execution of step						
	1. Insufficient information feedback 2. Insufficient knowledge 3. Operator omits step 4. Poor labeling 5. Poor layout 6. Procedure deficient or missing	1. Overpressure system 2. Put liquid to surge tanks 3. Overpressure system - E 4. Put liquid to surge tanks - E	4 4 4 4	C C C C	5 5 5 5	1. Independent monitors/ alarms 2. Indication of necessary variables 3. Individual safety interlocks 4. Training/qualification of personnel 5. Use of portable phones/two way radios
12.2 Other than specified action						
	1. Insufficient information feedback 2. Insufficient knowledge 3. Operator omits step 4. Poor labeling 5. Poor layout 6. Procedure deficient or missing	1. Overpressure system 2. Overpressure system - E 3. Put liquid to surge tanks 4. Put liquid to surge tanks - E	4 4 4 4	C C C C	5 5 5 5	1. Independent monitors/ alarms 2. Indication of necessary variables 3. Individual safety interlocks 4. Training/qualification of personnel 5. Use of portable phones/two way radios

Node: 13. Start-up of propane system.	
Type: Procedural Step	Drawing: (OP) UT-PR-002, 12/13/94
Design Conditions/Parameters: Steps 2.1.1-2.1.6; 2.2.1-2.2.4; 2.3.1-2.3.4	

Dev	Causes	Consequences	S	L	RR	Safeguards
13.1 Other than specified action						
	1. Communication failure between operators 2. Confused piping configurations 3. Inadequate lighting 4. Operating manual does not reflect latest changes to plant 5. Hold reset button down on mixer	1. Lost production/downtime 2. Overpressure system 3. Overpressure system - E 4. Put liquid to surge tanks 5. Put liquid to surge tanks - E	4 4 4 4 4	C C C C C	5 5 5 5 5	1. Independent monitors/ alarms 2. Indication of necessary variables 3. Individual safety interlocks 4. Training/qualification of personnel 5. Use of portable phones/two way radios

Node: 14. Shutdown of propane system.	
Type: Procedural Step	Drawing: (OP) UT-PR-003, 12/13/94
Design Conditions/Parameters: Steps 1.1.1-1.1.10; 1.2.1-1.2.4	

Dev	Causes	Consequences	S	L	RR	Safeguards
14.1 Other than specified action						
	1. Communication failure between operators 2. Confused piping configurations 3. Inadequate lighting 4. Poor labeling 5. Procedure deficient or missing	1. Overpressure system 2. Overpressure system - E 3. Put liquid to surge tanks 4. Put liquid to surge tanks - E	4 4 4 4	C C C C	5 5 5 5	1. Indication of necessary variables 2. Training/qualification of personnel 3. Use of portable phones/two way radios 4. Specific guidance in procedures

Node: 15. Emergency response to a propane system fire or vapor release.	
Type: Procedural Step	Drawing: (OP) UT-PR-006, 12/13/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
15.1 Other than specified action						
	1. Confusion in emergency situation	1. Fire/Explosion	3	D	5	1. Specific guidance in procedures
	2. Operator not trained properly	2. Fire/Explosion - E	3	D	5	2. Training/qualification of personnel
		3. Propane release	3	D	5	
		4. Propane release - E	3	D	5	

Node: 16. Response to propane system power failure.	
Type: Procedural Step	Drawing: (OP) UT-PR-006, 12/13/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
16.1 Other than specified action						
		1. No operator action or inaction would cause harmful or hazardous consequences.	4	D	5	

Node: 17. Instrument air compressors, CP-708 and CP-909, and discharge line to aftercoolers.	
Type: Centrifugal Compressor + Line	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Compressor capacity: 525 ICFM at 100 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
17.1 High water temperature						
	1. Loss of cooling water	1. Compressor shutdown	4	B	5	1. Cooling water supply strainer
		2. Compressor shutdown - E	4	B	5	2. PM on supply strainers
17.2 Low oil pressure						
	1. Low oil supply	1. Compressor shutdown	4	B	5	1. Low air pressure alarm
	2. Water in oil	2. Compressor shutdown - E	4	B	5	
17.3 Loss of electrical power						
	1. Emergency generator failure.	1. Compressor shutdown	4	B	5	1. PM emergency generator
	2. Breaker kicked out	2. Compressor shutdown - E	4	B	5	
	3. Motor failure					
	4. Wire grounded/shorted					
17.4 Compessor intergral instrument failure						
	1. Normal wear	1. Compressor shutdown	4	B	5	1. PM of instruments
		2. Compressor shutdown - E	4	B	5	

Node: 18. Cooling water supply and return lines to instrument air compressors, CP-708 and CP-909. Water is to the compressor's internal aftercooler which is part of the compressor itself.	
Type: Line	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
18.1 Low/No Flow						
	1. Low upstream pressure 2. Operator fails to align correct lines/valves 3. Plugged strainer/filter 4. Pump failure 5. Water line freeze up	1. Compressor shutdown 2. Compressor shutdown - E	4 4	B B	5 5	1. Operating procedures for routing flows

Node: 19. Instrument air aftercoolers, EX-033 and EX-032, and discharge line through knockout tank, DM-332, and Deltech inlet filter. Knockout tank is not included in node.	
Type: Heat Exchanger + Line	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Air flow to 1000 cfm and pressure to 100 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
19.1 High Temperature						
	1. High upstream temperature	1. Water in the air	4	B	5	1. Air temperature indication
		2. Loss of air supply	4	B	5	
	2. Loss of cooling water	3. Water in air - E	4	B	5	
		4. Loss of air supply - E	4	B	5	
19.2 Low Pressure						
	1. Low flow condition	1. Loss of instrument air	4	B	5	1. Pressure indication
	2. Line leak	2. Loss of instrument air - E	4	B	5	
19.3 Tube Leak						
	1. Corrosion	1. Water in air	4	B	5	1. Inspection program
		2. Water in air - E	4	B	5	
		3. Loss of instrument air	4	B	5	
		4. Loss of instrument air - E	4	B	5	

Node: 20. Cooling water supply lines to and from aftercoolers, EX-033 and EX-032.	
Type: Heat Exchanger + Line	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
20.1 Low/No Flow						
	1. Low upstream pressure	1. Hot, wet air	4	B	5	1. Water temperature indicator
	2. Operator fails to align correct lines/valves	2. Hot, wet air - E	4	B	5	2. Water pressure indicator
	3. Pump failure	3. Loss of instrument air supply	4	B	5	
	4. Line leak	4. Loss of instrument air supply - E	4	B	5	

Node: 21. Knockout tank, DM-332.	
Type: Vessel	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Air flow to 1000 cfm and pressure to 100 psig. MAWP: 150 psig at 650 F.	

Dev	Causes	Consequences	S	L	RR	Safeguards
21.1 High Level						
	1. Leakage from alternative sources	1. Water in air system	4	B	5	1. Level gauge
	2. Hot wet air	2. Water in air system - E	4	B	5	2. Operating procedures
	3. Plugged trap	3. Loss of air supply	4	B	5	3. Water trap
		4. Loss of air supply - E	4	B	5	
		5. Downstream instrument malfunction	4	B	5	
		6. Downstream instrument malfunction - E	4	B	5	
21.2 High Pressure						
	1. Compressor overspeeds	1. Overpressure vessel	4	B	5	1. Pressure relief valve
	2. Operator fails to align correct lines/valves	2. Loss of air supply	4	B	5	2. Relief valve PM
	3. Overfilling of vessel	3. Overpressure vessel - E	4	B	5	3. Pressure vessel inspection program
	4. Relief Valve Plugged	4. Loss of air supply - E	4	B	5	

Node: 22. Deltek Air Dryer Package, DR-028.	
Type: Air Dryer	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Air flow to 1000 CFM and pressure to 100 psig. Outlet dewpoint -40 F.	

Dev	Causes	Consequences	S	L	RR	Safeguards
22.1 High Flow						
	1. Valve misalignment	1. High dew point	4	B	5	1. Manual valve setting
	2. Line leak on discharge	2. High dew point - E	4	B	5	2. Piping specs
		3. Downstream instrument malfunction	4	B	5	3. Dew point indication
		4. Downstream instrument malfunction - E	4	B	5	
22.2 High Pressure						
	1. Valve blocked on discharge	1. Lift relief valve	4	B	5	1. Inspection, PM
	2. No air usage	2. Lift relief valve - E	4	B	5	
22.3 High Temperature						
	1. Instrument malfunction	1. Downstream instrument malfunction	4	B	5	1. Temperature indication
	2. Air cooler malfunction					2. Dew point indication
	3. Loss of cooling water	2. Downstream instrument malfunction - E	4	B	5	
		3. Water in air system	4	B	5	
		4. Water in air system - E	4	B	5	

Node: 23. Deltek discharge line to process. Includes Deltek outlet filters.	
Type: Line + Vessel	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Air flow to 1000 cfm and pressure to 80 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
23.1 Low/No Flow						
	1. Low upstream pressure 2. Operator fails to align correct lines/valves 3. Plugged strainer/filter	1. No air supply 2. No air supply - E	4 4	B B	5 5	1. Low upstream pressure indicator/alarm 2. Operating procedures for routing flows 3. Spare strainer/filter
23.2 Contamination						
	1. Failure of upstream separation equipment (dessicant/water) 2. Rust in process lines	1. Loss of instrument air supply 2. Loss of instrument air supply - E	4 4	B B	5 5	1. In-line filters
23.3 Leak						
	1. Corrosion 2. Drain or vent or sample valve leakage 3. Gasket or packing or valve seal failure 4. Inadequate torquing of bolts 5. Line overstressed	1. Loss of air supply 2. Loss of air supply - E	4 4	B B	5 5	1. Adequate corrosion allowance 2. Inspection & testing procedures 3. Line adequately supported and guided 4. Maintenance procedures for torquing bolts

Node: 24. Instrument air surge tank, TK-301.	
Type: Vessel	Drawing: UT-090109-PID-D, 8/12/94
Design Conditions/Parameters: Pressure to 80 psig. MAWP: 150 psig at 140 F.	

Dev	Causes	Consequences	S	L	RR	Safeguards
24.1 High Level						
	1. Leakage from alternative sources	1. Water in air system	4	B	5	1. Operating procedures
	2. Hot wet air	2. Water in air system - E	4	B	5	2. Water trap
	3. Plugged trap	3. Loss of air supply	4	B	5	
		4. Loss of air supply - E	4	B	5	
		5. Downstream instrument malfunction	4	B	5	
		6. Downstream instrument malfunction - E	4	B	5	
24.2 High Pressure						
	1. Operator fails to align correct lines/valves	1. Overpressure vessel	4	B	5	1. Pressure relief valve
	2. Relief Valve Plugged	2. Loss of air supply	4	B	5	2. Relief valve PM
		3. Overpressure vessel - E	4	B	5	3. Pressure vessel inspection program
		4. Loss of air supply - E	4	B	5	

Node: 25. Instrument air supply line to plant.	
Type: Line	Drawing: UT-090111-PID-D, 2/25/94
Design Conditions/Parameters: Air flows to1000 CFM and pressure to 80 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
25.1 Low/No Flow						
	1. Low upstream pressure 2. Operator fails to align correct lines/valves 3. Plugged strainer/filter	1. No air supply 2. No air supply - E	4 4	B B	5 5	1. Operating procedures for routing flows
25.2 Contamination						
	1. Failure of upstream separation equipment (dessicant/water) 2. Rust in process lines	1. Loss of instrument air supply 2. Loss of instrument air supply - E	4 4	B B	5 5	1. Y-strainer
25.3 Leak						
	1. Corrosion 2. Drain or vent or sample valve leakage 3. Gasket or packing or valve seal failure 4. Inadequate torquing of bolts 5. Line overstressed	1. Loss of air supply 2. Loss of air supply - E	4 4	B B	5 5	1. Adequate corrosion allowance 2. Inspection & testing procedures 3. Line adequately supported and guided 4. Maintenance procedures for torquing bolts

Node: 26. Instrument air surge drum, DM-300.	
Type: Vessel	Drawing: UT-090111-PID-D, 2/25/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
26.1 High Level						
	1. Leakage from alternative sources	1. Water in air system	4	B	5	1. Operating procedures
	2. Hot wet air	2. Water in air system - E	4	B	5	
		3. Loss of air supply	4	B	5	
		4. Loss of air supply - E	4	B	5	
		5. Downstream instrument malfunction	4	B	5	
		6. Downstream instrument malfunction - E	4	B	5	
26.2 High Pressure						
	1. Operator fails to align correct lines/valves	1. Overpressure vessel	4	B	5	1. Pressure relief valve
	2. Relief Valve Plugged	2. Loss of air supply	4	B	5	2. Relief valve PM
		3. Overpressure vessel - E	4	B	5	3. Pressure vessel inspection program
		4. Loss of air supply - E	4	B	5	

Node: 27. Start-up of instrument air compressors, CP-708 and CP-909.	
Type: Procedural Step	Drawing: (OP) UT-AS-001, 8/2/95
Design Conditions/Parameters: Steps 1.1-1.6	

Dev	Causes	Consequences	S	L	RR	Safeguards
27.1 Other than specified action						
	1. Confused piping configurations 2. Inadequate lighting 3. Communication failure between operators	1. Failure to get compressor running 2. No instrument air supply 3. Damage to compressor 4. Failure to get compressor running - E 5. No instrument air supply - E 6. Damage to compressor - E	4 4 4 4 4 4	B B B B B B	5 5 5 5 5 5	1. Separate alarm/interlock systems 2. Specific guidance in procedures 3. Training & qualification of personnel

Node: 28. Shut down of instrument air compressors, CP-708 and CP-909.	
Type: Procedural Step	Drawing: (OP) UT-AS-001, 8/2/95
Design Conditions/Parameters: Steps 4.1, 4.2	

Dev	Causes	Consequences	S	L	RR	Safeguards
28.1 Other than specified action						
	1. Confused piping configurations 2. Inadequate lighting 3. Shut wrong compressor down	1. Damage to compressor 2. Damage to compressor - E 3. No instrument air supply 4. No instrument air supply - E	4 4 4 4	B B B B	5 5 5 5	1. Specific guidance in procedures 2. Training & qualification of personnel

Node: 29. Isolation and Tag Out/Lock Out of Deltek Air Dryer.	
Type: Procedural Step	Drawing: (OP) UT-AS-009, 8/2/95
Design Conditions/Parameters: Step 4	

Dev	Causes	Consequences	S	L	RR	Safeguards
29.1 Other than specified action						
	1. Insufficient information feedback 2. Insufficient knowledge 3. Operator omits step 4. Poor labeling 5. Poor layout	1. Possible personal injury 2. Possible personal injury - E 3. Possible plant loss of instrument air supply 4. Possible plant loss of instr. air supply - E	4 4 4 4	B D B B	5 5 5 5	1. Indication of necessary variables 2. Training/qualification of personnel 3. Use of portable phones/two way radios 4. Specific guidance in procedures

Node: 30. Returning the Deltek Air Dryer back to service.	
Type: Procedural Step	Drawing: (OP) UT-AS-009, 8/2/95
Design Conditions/Parameters: Step 5	

Dev	Causes	Consequences	S	L	RR	Safeguards
30.1 Other than specified action						
	1. Insufficient information feedback 2. Insufficient knowledge 3. Operator omits step 4. Poor labeling 5. Poor layout	1. Possible personal injury 2. Possible personal injury - E 3. Possible plant loss of instr. air supply - E 4. Possible plant loss of instrument air supply	4 4 4 4	B D B B	5 5 5 5	1. Indication of necessary variables 2. Specific guidance in procedures 3. Training/qualification of personnel 4. Use of portable phones/two way radios

Node: 31. Cooling Tower #4 cooling water pumps, PP-243, PP-281, and PP-955, and supply line to Old Module Reactors.	
Type: Centrifugal Pump + Line	Drawing: UT-090112-PID-D, 2/17/95
Design Conditions/Parameters: Flow rates up to 2000 gpm and pressures to 125 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
31.1 Cavitation						
	1. Low sump level	1. No cooling water supply	4	B	5	1. Quality control procedures & checks during design
		2. Equipment damage	4	B	5	2. Sump level control
		3. No cooling water supply - E	4	B	5	3. Emergency cooling water
		4. Equipment damage - E	4	B	5	4. Spare pump/pump parts
31.2 Low/No Flow						
	1. Sump empty	1. Equipment damage	4	B	5	1. Emergency cooling water
	2. Control valve or controller fails CV closed	2. Equipment damage - E	4	B	5	2. Quality control procedures & checks during design
	3. Operator fails to align correct lines/valves	3. No cooling water supply	4	B	5	3. Spare pump/pump parts
	4. Pump failure	4. No cooling water supply - E				4. Sump level control
	5. Line leak					

Node: 32. Cooling Tower #6 cooling water pumps, PP-906, PP-907, and PP-908, and supply lines to New Module Reactors.	
Type: Centrifugal Pump + Line	Drawing: UT-090113-PID-D, 2/17/95
Design Conditions/Parameters: Flows to 10,000 gpm and pressures to125 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
32.1 Cavitation						
	1. Low sump level	1. No cooling water supply	4	B	5	1. Quality control procedures & checks during design
		2. Equipment damage	4	B	5	2. Sump level control
		3. No cooling water supply - E	4	B	5	3. Emergency cooling water
		4. Equipment damage - E	4	B	5	4. Spare pump/pump parts
32.2 Low/No Flow						
	1. Sump empty	1. Equipment damage	4	B	5	1. Emergency cooling water
	2. Control valve or controller fails CV closed	2. Equipment damage - E	4	B	5	2. Quality control procedures & checks during design
	3. Operator fails to align correct lines/valves	3. No cooling water supply	4	B	5	3. Spare pump/pump parts
	4. Pump failure	4. No cooling water supply - E				4. Sump level control
	5. Line leak					

Node: 33. Cooling Tower #2 cooling water pumps, PP-252 and PP-253, and supply line to various process areas.	
Type: Centrifugal Pump + Line	Drawing: UT-090114-PID-D, 2/17/95
Design Conditions/Parameters: Flows to 3500 gpm and pressures to 125 psig.	

Dev	Causes	Consequences	S	L	RR	Safeguards
33.1 Cavitation						
	1. Low sump level	1. No cooling water supply	4	B	5	1. Quality control procedures & checks during design
		2. Equipment damage	4	B	5	2. Sump level control
		3. No cooling water supply - E	4	B	5	3. Emergency cooling water
		4. Equipment damage - E	4	B	5	4. Spare pump/pump parts
		5. Shut plant air compressors down	4	B	5	
		6. Shut air compressors down - E	4	B	5	
33.2 Low/No Flow						
	1. Sump empty	1. Equipment damage	4	B	5	1. Emergency cooling water
	2. Control valve or controller fails CV closed	2. Equipment damage - E	4	B	5	2. Quality control procedures & checks during design
	3. Operator fails to align correct lines/valves	3. No cooling water supply	4	B	5	3. Spare pump/pump parts
	4. Pump failure	4. No cooling water supply - E	4	B	5	4. Sump level control
	5. Line leak	5. Shut plant air compressors down	4	B	5	
		6. Shut plant air compressors down - E	4	B	5	

Node: 34. Operation of Deluge Water to Emergency Cooling Water System.	
Type: Procedural Step	Drawings: (OP) VINYL-NM-E008, 3/28/95, (OP) VINYL-OM-E008, 3/28/95
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
34.1 Other than specified action						
	1. Communication failure between operators 2. Confusion in emergency situation 3. Inadequate lighting 4. Insufficient training	1. VCM release 2. VCM release - E 3. Fire/Explosion - E 4. Fire/Explosion	3 3 1 1	C C D D	4 4 4 4	1. Specific guidance in procedures 2. Training & qualification of personnel

Node: 35. Chlorine supply line from chlorine container to ejector. Cooling Towers #'s 2, 4, and 6.	
Type: Line	Drawing: UT-090117-PID-D, 8/23/94
Design Conditions/Parameters: 200 lb/day at 0 psig or below.	

Dev	Causes	Consequences	S	L	RR	Safeguards
35.1 High Pressure						
	1. Back flow from high pressure downstream source 2. Blocked discharge 3. High upstream pressure 4. External Heat	1. Damage equipment 2. Equipment shutdown 3. Chlorine leak 4. Chlorine leak - E 5. Equipment damage - E 6. Equipment shutdown - E	4 4 4 4 4 4	D D D D D D	5 5 5 5 5 5	1. Chlorine regulator stops chlorine flow if line not under vacuum 2. Check valve in ejector to prevent backflow 3. Flow indicator
35.2 Low/No Flow						
	1. Ruptured line 2. Blocked discharge 3. High upstream pressure 4. No water to ejector 5. Bottle empty	1. Damage equipment 2. Equipment shutdown 3. Equipment damage - E 4. Equipment shutdown - E	4 4 4 4	C C C C	5 5 5 5	1. Spare bottle 2. Strainer on water supply 3. Operator training/ qualification
35.3 Leak						
	1. Corrosion 2. Drain or vent or sample valve leakage 3. Gasket or packing or valve seal failure	1. Personal injury 2. Plant evacuation	3 3	D D	5 5	1. Chlorine regulator stops chlorine flow if line not under vacuum 2. Environmental monitors to detect leaks 3. Operating procedure 4. Chlorine B kit 5. Personal protective equipment

Node: 36. Chlorine supply line from chlorine container to ejector. Water Plant Chlorination System.	
Type: Line	Drawing: WP-090106-PID-D, 1/25/96
Design Conditions/Parameters: 200 PPD at ambient chlorine vapor pressure and temperature.	

Dev	Causes	Consequences	S	L	RR	Safeguards
36.1 High Pressure						
	1. Back flow from high pressure downstream source 2. Blocked discharge 3. High upstream pressure 4. External Heat	1. Equipment shutdown 2. Chlorine leak 3. Chlorine leak - E 4. Equipment shutdown - E	4 4 4 4	D D D D	5 5 5 5	1. Check valve in ejector to prevent backflow 2. Chlorine detector 3. Chlorinator relief valve 4. Chlorine personal protective equipment 5. Chlorine bottle B kit
36.2 Low/No Flow						
	1. Ruptured line 2. Blocked discharge 3. High upstream pressure 4. No water to ejector 5. Bottle empty	1. Equipment shutdown 2. Equipment shutdown - E	4 4	D D	5 5	1. Spare bottle 2. Strainer on water supply 3. Operator training/ qualification 4. Flow indicator
36.3 Leak						
	1. Corrosion 2. Drain or vent or sample valve leakage 3. Gasket or packing or valve seal failure 4. Personal collision with feed line	1. Personal injury 2. Plant evacuation	3 3	D D	5 5	1. Environmental monitors to detect leaks 2. Operating procedure 3. Chlorine B kit 4. Personal protective equipment

Node: 37. Chlorine one ton container. Cooling Towers and Water Plant	
Type: Vessel	Drawings: UT-090117-PID-D, 8/23/94, WP-090106-PID-D, 1/25/96
Design Conditions/Parameters: Chlorine at ambient vapor pressure and temperature.	

Dev	Causes	Consequences	S	L	RR	Safeguards
37.1 Leak						
	1. Corrosion 2. Drain or vent or sample valve leakage 3. Gasket or packing or valve seal failure	1. Personal injury 2. Plant evacuation	3 3	D D	5 5	1. Chlorine regulator stops chlorine flow if line not under vacuum 2. Environmental monitors to detect leaks 3. Operating procedure 4. Chlorine B kit 5. Personal protective equipment

Node: 38. Start-up of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-CT-001, 5/12/97, (OP) UT-CT-002, 5/12/97
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
38.1 Other than specified action						
	1. Inadequate operator training 2. Operator doesn't adhere to procedure	1. Chlorine leak 2. Chlorine leak - E 3. Equipment shutdown 4. Equipment shutdown - E 5. Personal exposure	4 4 4 4 4	B B B B C	5 5 5 5 5	1. Conformance to standard procedures enforced 2. Specific guidance in procedures 3. Training & qualification of personnel 4. Chlorine leak detection device 5. Personal protection equipment

Node: 39. Shut down of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-CT-001, 5/12/97, (OP) UT-CT-002, 5/12/97
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
39.1 Other than specified action						
	1. Inadequate operator training 2. Operator doesn't adhere to procedure	1. Chlorine leak 2. Chlorine leak - E 3. Equipment shutdown 4. Equipment shutdown - E 5. Personal exposure	4 4 4 4 4	B B B B C	5 5 5 5 5	1. Conformance to standard procedures enforced 2. Specific guidance in procedures 3. Training & qualification of personnel 4. Chlorine leak detection device 5. Personal protection equipment

Node: 40. Emergency response to a chlorine leak of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawing: (OP) UT-CT-003, 5/12/97
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
40.1 Other than specified action						
	1. Inadequate personal training 2. Emergency response material not available 3. Lack of operator communication 4. Confusion in emergency situation	1. Personal exposure 2. Personal exposure - E 3. Personal evacuation 4. Personal evacuation - E 5. Interuption of plant operations	3 3 3 3 3	C C C C C	4 4 4 4 4	1. Emergency response plan in place 2. Specific guidance in procedures 3. Training & qualification of personnel

Node: 41. Start-up of Water Plant Chlorination System	
Type: Procedural Step	Drawings: (OP) UT-WP-002, 5/31/94, (OP) UT-WP-003, 5/31/94
Design Conditions/Parameters: UT-WP-002, Steps 1-22; UT-WP-003, Steps 3.1-3.24	

Dev	Causes	Consequences	S	L	RR	Safeguards
41.1 Other than specified action						
	1. Inadequate operator training 2. Operator doesn't adhere to procedure	1. Chlorine leak 2. Chlorine leak - E 3. Equipment shutdown 4. Equipment shutdown - E 5. Personal exposure	4 4 4 4 4	B B B B B	5 5 5 5 5	1. Conformance to standard procedures enforced 2. Specific guidance in procedures 3. Training & qualification of personnel 4. Chlorine leak detection device 5. Personal protection equipment

Node: 42. Shut down of Water Plant Chlorination System	
Type: Procedural Step	Drawings: (OP) UT-WP-002, 5/31/94, (OP) UT-WP-003, 5/31/94
Design Conditions/Parameters: UT-WP-002, SHUTDOWN Procedure Steps 1-5; UT-WP-003 Steps 13.1-13.16	

Dev	Causes	Consequences	S	L	RR	Safeguards
42.1 Other than specified action						
	1. Inadequate operator training 2. Operator doesn't adhere to procedure	1. Chlorine leak 2. Chlorine leak - E 3. Equipment shutdown 4. Equipment shutdown - E 5. Personal exposure	4 4 4 4 4	B B B B B	5 5 5 5 5	1. Conformance to standard procedures enforced 2. Specific guidance in procedures 3. Training & qualification of personnel 4. Chlorine leak detection device 5. Personal protection equipment

Node: 43. Emergency response to a chlorine leak of Water Plant Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-WP-017, 5/31/94, (OP) UT-WP-018, 5/31/94
Design Conditions/Parameters:	

Dev	Causes	Consequences	S	L	RR	Safeguards
43.1 Other than specified action						
	1. Inadequate personal training 2. Emergency response material not available 3. Lack of operator communication 4. Confusion in emergency situation	1. Personal exposure 2. Personal exposure - E 3. Personal evacuation 4. Personal evacuation - E 5. Interuption of plant operations	3 3 3 3 3	C C C C C	4 4 4 4 4	1. Emergency response plan in place 2. Specific guidance in procedures 3. Training & qualification of personnel

APPENDIX G

FIRE & EXPLOSION INDEX

AREA / COUNTRY	DIVISION	LOCATION	DATE
USA	M'S	Aberdeen	5/1/97
SITE	**MANUFACTURING UNIT**	**PROCESS UNIT**	
Condea Vista Co.	Utilities	Propane Tank Farm	
PREPARED BY:	**APPROVED BY: (Superintendent)**	**BUILDING**	
Kelly Wood			
REVIEWED BY: (Management)	**REVIEWED BY: (Technology Center)**	**REVIEWED BY: (Safety & Loss Prevention)**	
MATERIALS IN PROCESS UNIT			
Propane			
STATE OF OPERATION		**BASIC MATERIAL(S) FOR MATERIAL FACTOR**	
__ DESIGN __ START UP X NORMAL OPERATION __ SHUTDOWN		Propane	

MATERIAL FACTOR (See Table 1 or Appendices A or B) Note requirements when unit temperature over 140 °F (60 °C)	21

1. General Process Hazards	Penalty Factor Range	Penalty Factor Used(1)
Base Factor	1.00	1.00
A. Exothermic Chemical Reactions	0.30 to 1.25	
B. Endothermic Processes	0.20 to 0.40	
C. Material Handling and Transfer	0.25 to 1.05	0.5
D. Enclosed or Indoor Process Units	0.25 to 0.90	
E. Access	0.20 to 0.35	0.2
F. Drainage and Spill Control 96.4 M (gal) or cu.m.	0.25 to 0.50	0.5
General Process Hazards Factor (F_1)		2.2
2. Special Process Hazards		
Base Factor	1.00	1.00
A. Toxic Material(s)	0.20 to 0.80	0.2
B. Sub-Atmospheric Pressure (< 500 mm Hg)	0.50	
C. Operation In or Near Flammable Range __ Inerted X Not Inerted		
1. Tank Farms Storage Flammable Liquids	0.50	
2. Process Upset or Purge Failure	0.30	
3. Always In Flammable Range	0.80	
D. Dust Explosion (See Table 3)	0.25 to 2.00	
E. Pressure (See Figure 2) Operating Pressure 200 psig or kPa gauge; Relief Setting 250 psig or kPa gauge		0.39
F. Low Temperature	0.20 to 0.30	0.3
G. Quantity of Flammable/Unstable Material: Quantity 219,200 lb or kg; H_C = 19,900 BTU/lb or kcal/kg	4.36×10^9	
1. Liquids or Gases in Process (See Figure 3)		
2. Liquids or Gases in Storage (See Figure 4)		0.65
3. Combustible Solids in Storage, Dust in Process (See Figure 5)		
H. Corrosion and Erosion	0.10 to 0.75	0.1
I. Leakage – Joints and Packing	0.10 to 1.50	
J. Use of Fired Equipment (See Figure 6)		0.1
K. Hot Oil Heat Exchange System (See Table 5)	0.15 to 1.15	
L. Rotating Equipment	0.50	
Special Process Hazards Factor (F_2)		2.74
Process Unit Hazards Factor ($F_1 \times F_2$) = F_3		6.03
Fire and Explosion Index (F_3 x MF = F&EI)		127

(1) For no penalty use 0.00.

Rev/01-94

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

DOW FIRE & EXPLOSION INDEX CALCULATION
PROPANE TANK FARM, PV-029 & PV-030

- **Basic Material(s) for Material Factor (MF)**

PV-029 & PV-030 contain up to 25,800 gallons of Propane at ambient temperature and ambient temperature vapor pressure (200 psig at 120 °F). Note: PV-031 is out of service.

Propane has the following NFPA Classification and properties.
Health = 1, Fire = 4, Reactivity = 0
Flash point: Gas Boiling Point: -44 °F Heat of Combustion: 19,900 Btu/lb

- **Material Factor (MF)** **21**

- **General Process Hazards**

BASE FACTOR		1.00
A.	Exothermic Chemical Reactions (Factor .30 to 1.25) Penalty applies only to reactors where a reaction takes place.	0.00
B.	Endothermic Processes (Factor .20 to .40) Penalty applies only to reactors where a reaction takes place.	0.00
C.	Material Handling and Transfer (Factor .25 to 1.05) Propane is loaded into tanks from tanker truck via connection hose. Penalty = 0.50	0.50
D.	Enclosed or Indoor Process Units (Factor .25 to .90) This penalty does not apply to outdoor processes.	0.00
E.	Access (Factor .20 to .35) Propane tank farm has access on one side from a gravel road off Matuby St. and from the within plant. It also has three adjacent fire monitors, one of which is on the same side as the road. However, since the monitors are close to the tanks, an intense fire may affect one's ability to man a monitor. In addition, one or two monitors will be shielded from a single burning tank depending on the burning tank's location.	0.20
F.	Drainage & Spill Control (Factor .25 to .50) Process area is flat which will allow a spill to spread and expose a larger area to fire. Penalty = 0.50. Drainage is calculated as the liquid contents of PV-029 and 10% of PV-030 (about 28.4 M gallons) and 30 minutes of firewater accumulation for area or 68 M gallons in 30 minutes. Total = 96.4 M gallons.	0.50

General Process Hazards Factor (F1) **2.20**
(Sum of base factor plus penalties listed for A through F)

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

- **Special Process Hazards**

BASE FACTOR		1.00
A.	Toxic Material(s) (Factor .20 to .80) Propane has a health factor of 1. Penalty = 1 * 0.2 = 0.2	0.20
B.	Sub-Atmospheric Pressure (<500 mm Hg) Factor 0.5 PV-029 & PV-030 operate under pressure. Penalty = 0.00	0.00
C.	Operation In or Near Flammable Range	
1.	Because PV-029 & PV-030 operate under positive pressure, no air is admitted during normal operation. Penalty = 0.00	0.00
2.	PV-029 & PV-030 do not have an inert purge to keep it out of the flammable range. Penalty = 0.00	0.00
3.	The air-free vapor space is above the upper flammable limit. Penalty = 0.00	0.00
D.	Dust Explosion (Factor .25 to 2.00) Dust handling is not applicable.	0.00
E.	Relief Pressure: Fig.2, pg 23 Operating Pressure is 200 PSIG (Max.); Penalty 0.43 Relief Setting is 250 PSIG; Penalty 0.47 Penalty = .43 * (.43/.47) = 0.39	0.39
F.	Low Temperature (Factor .20 to .30) No MOC data (other than CS) or design temperature data exists for PV-029 & PV-030. Therefore, since default temp. for ductile/brittle transition for CS is 50 °F and operating temp. is ambient, the vessels will receive a penalty for low temp. operation.	0.30
G.	Quantity 219.2 M lbs., HC = 19.9 M BTU/lb.	
1.	Liquids, Gases and Reactive Materials in Process Not an issue.	0.00
2.	Liquids or Gases in Storage Total BTU in storage = 4,360 MM BTU, Penalty = 0.65	0.65
3.	Combustible Solids in Storage, Dust in Process Not an issue.	0.00
	During normal operation, both PV-029 & PV-030 are open to a header via manual valves. In case of a spill, location of each tank's isolation valve may prohibit access. Therefore, the quantity in process must be considered the entire contents of PV-029 & PV-030. Figure 4, Liquids and Gases in Storage, will be used instead of Fiqure 3, Liquids and Gases in Process, because PV-029 & PV-030 are in a storage "setting" and location.	
H.	Corrosion and Erosion (Factor .10 to .75) No apparent external corrosion from atmospheric corrosion and no internal corrosion is known to occur. Penalty = minimum = 0.10	0.10

PROCESS SAFETY MANAGEMENT
CONDEA VISTA, ABERDEEN PLANT UTILITIES HAZOP

I.	Leakage Joints and Packing (Factor .10 to 1.50) Historically, leakage has never been a problem. Penalty = 0.00	0.00
J.	Use of Fired Heaters (Factor .10 to 1.00) Boilers are located aproximately 200 feet away.	0.10
K.	Hot Oil Heat Exchange System (Factor .15 to 1.15) Not an issue.	0.00
L.	Rotating Equipment (Factor .50) There are no large pieces of rotating equipment (pumps larger than 75 HP or compressors larger than 600 HP). Penalty = 0.00	0.00

Special Process Hazards Factor (F2) **2.74**
(Sum of base factor plus penalties listed for A through L)

Unit Hazard Factor [(F1) * (F2) = (F3)] **6.03**

Fire and Explosion Index [(F3) * MF] = F&EI **127**

A Dow Fire and Explosion Index of 127 is considered to represent a "Intermediate" degree of hazard according to Table 6, p.38, 7th Edition Dow F&EI Classification Guide.

Radius of Exposure, ft **107**

Radius emulating from the outer edges of PV-029 & PV-030.

FIRE & EXPLOSION INDEX

AREA / COUNTRY	DIVISION	LOCATION	DATE
USA	Mississippi	Aberdeen	8-13-99
SITE	**MANUFACTURING UNIT**	**PROCESS UNIT**	
Condea Vista Co	Utilities	Propane TK Farm	
PREPARED BY:	**APPROVED BY: (Superintendent)**	**BUILDING**	
Kelly Wood			
REVIEWED BY: (Management)	**REVIEWED BY: (Technology Center)**	**REVIEWED BY: (Safety & Loss Prevention)**	

MATERIALS IN PROCESS UNIT: Propane

STATE OF OPERATION: ___ DESIGN ___ START UP X NORMAL OPERATION ___ SHUTDOWN

BASIC MATERIAL(S) FOR MATERIAL FACTOR: Propane

MATERIAL FACTOR (See Table 1 or Appendices A or B) Note requirements when unit temperature over 140 °F (60 °C): 21

1. General Process Hazards	Penalty Factor Range	Penalty Factor Used(1)
Base Factor	1.00	1.00
A. Exothermic Chemical Reactions	0.30 to 1.25	
B. Endothermic Processes	0.20 to 0.40	
C. Material Handling and Transfer	0.25 to 1.05	0.5
D. Enclosed or Indoor Process Units	0.25 to 0.90	
E. Access	0.20 to 0.35	0.2
F. Drainage and Spill Control 96.4 (gal) or cu.m.	0.25 to 0.50	0.5
General Process Hazards Factor (F_1)		2.2
2. Special Process Hazards		
Base Factor	1.00	1.00
A. Toxic Material(s)	0.20 to 0.80	0.2
B. Sub-Atmospheric Pressure (< 500 mm Hg)	0.50	
C. Operation In or Near Flammable Range ___ Inerted X Not Inerted		
1. Tank Farms Storage Flammable Liquids	0.50	
2. Process Upset or Purge Failure	0.30	
3. Always in Flammable Range	0.80	
D. Dust Explosion (See Table 3)	0.25 to 2.00	
E. Pressure (See Figure 2) Operating Pressure 200 psig or kPa gauge; Relief Setting 250 psig or kPa gauge		0.39
F. Low Temperature	0.20 to 0.30	0.3
G. Quantity of Flammable/Unstable Material: Quantity 109600 lb ~~or kg~~		
Fig 4 Curve B — H_C = 19,900 BTU/lb or kcal/kg	2.18×10^9	0.53
1. Liquids or Gases in Process (See Figure 3)		
2. Liquids or Gases in Storage (See Figure 4)		
3. Combustible Solids in Storage, Dust in Process (See Figure 5)		
H. Corrosion and Erosion	0.10 to 0.75	0.1
I. Leakage – Joints and Packing	0.10 to 1.50	
J. Use of Fired Equipment (See Figure 6)		0.1
K. Hot Oil Heat Exchange System (See Table 5)	0.15 to 1.15	
L. Rotating Equipment	0.50	
Special Process Hazards Factor (F_2)		2.62
Process Unit Hazards Factor (F_1 x F_2) = F_3		5.764
Fire and Explosion Index (F_3 x MF = F&EI)		121

(1) For no penalty use 0.00.

F&EI of 121 signifies "Intermediate" Hazard

Radius of Exposure 102 ft

Rev/01-94

[redacted]

APPENDIX H

CERTIFICATE OF EDUCATIONAL ACHIEVEMENT

This is to acknowledge that

Kelly D. Wood

Has completed the course entitled

HAZOP Study Team Training

October 27 & 28, 1993

Presented by

NUS TRAINING CORPORATION

Instructor

Manager

APPENDIX I

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis

Issue Date: May 19, 1997

Supersedes: February 18, 1997

Approved By: Harry D. Garrison
Manager Safety, Health & Environment

1. SCOPE

This standard applies to all existing CONDEA Vista processes covered by the PSM regulation [Reference: CONDEA Vista Corporate Standard PSM-001]. It includes provisions that address some anticipated requirements of the EPA Risk Management Programs for Accidental Release Prevention [40 CFR Part 68].

The procedure does not include all potential requirements that may be included in State or EPA regulations. Nor does it include requirements for hazard reviews that may be required or implied by other paragraphs of the OSHA PSM Standard such as Management of Change or Pre-Startup Safety Reviews.

2. PURPOSE

This standard defines the minimum requirements for complying with the Process Hazard Analysis requirements, paragraph (e), of the OSHA Process Safety Management of Highly Hazardous Chemicals (PSM) regulation, 29 CFR 1910.119.

3. DEFINITIONS

3.1 Catastrophic Release or Incident - means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals (HHC), that presents a serious danger to employees in the workplace.

3.2 Covered Process - This is the group(s) of equipment and systems to which all PSM elements except for the Mechanical Integrity element (which is a subset of the Covered Process) apply. It is possible to have one or more covered process equipment groups.

3.3 Process - refers to any activity involving a highly hazardous chemical (HHC) including any use, storage, manufacturing, handling, or the on-site movement of chemicals, or combination of these activities. For purposes of this definition, any group of vessels which are interconnected and separate vessels which are located such that a highly hazardous chemical could be involved in a potential release shall be considered a single process.

3.4 Process Hazards - for purposes of clarification for this standard only, the term "process hazards" means findings resulting from a Process Hazard Analysis that have safety (on-site or offsite), environmental, or community consequences having a scenario ranking requiring mitigation as determined by this standard.

3.5 Flammable Gas - means (a) a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or (b) a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit. (29 CFR 1910.1200, Hazard Communication)

3.6 Flammable Liquid - means any liquid having a flashpoint below 100°F, except any mixture having components with flashpoints of 100°F or higher, the total of which make up 99 percent or more of the total volume of the mixture. (29 CFR 1910.1200, Hazard Communication) Refer to 1910.1200 for definitions of flashpoint.

3.7 HAZOP - A Hazards and Operability (HAZOP) study is a systematic method to identify hazards and operability problems. A HAZOP study involves a systematic, methodical examination of design documents that describe a process. The study is performed by a multi-discipline team. Deviations from the design value of key parameters are studied using guide words to control the examination evaluation. This presumes that the design values of flows, temperatures, and other process variables are inherently safe and operable.

3.8 Highly Hazardous Chemical (HHC) - A Highly Hazardous Chemical (HHC) means a substance possessing toxic, reactive, flammable, or explosive properties and specified in Appendix A of the OSHA PSM Standard or a flammable liquid or gas on site in one location, in a quantity of 10,000

pounds or more. See 1910.119 (a)(1)(A), (a)(1)(B) and (a)(2) of the OSHA PSM standard for exceptions.

3.9 PHA - Process Hazard Analysis (PHA) is a thorough, orderly, systematic approach for identifying, evaluating and controlling the hazards of processes involving highly hazardous chemicals.

3.10 Threshold Quantity (TQ) - Quantity at or above which the OSHA PSM Standard applies. The threshold quantities listed in Appendix A of the standard apply only to pure (or "commercial grade") chemicals unless otherwise specified.

4. PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

Each covered facility shall conduct Process Hazard Analyses (PHA's) on each of its existing covered processes. PHA methods used will depend on the nature and complexity of the process under consideration.

4.1 Each covered facility shall perform an initial process hazard analysis (hazard evaluation) on each of its existing covered processes as soon as possible but not later than the following schedule:

4.1.1 No less than 50 percent of the initial PHA's will be completed by May 26, 1995.

4.1.2 No less than 75 percent of the initial PHA's will be completed by May 26, 1996.

4.1.3 No less than 100 percent of the initial PHA's will be completed by May 26, 1997.

A PHA on a process or part of a process should not be delayed even if it is of a lower priority than one where records and documentation are still being generated.

4.2 The initial process hazards analyses will be conducted using the Hazard and Operability Study (HAZOP) methodology **and** reviews of human factors, facility siting and other hazards common or specific to the location.

Except as limited by Section 9 (PHA Revalidation), subsequent process hazard analyses may utilize any of the hazard evaluation techniques accepted by OSHA.

4.3 Each facility shall determine and document the priority order for conducting the initial process hazard analyses based on a rationale which includes as a minimum such considerations as:

a. The extent of the process hazards,

b. The number of potentially affected employees,

c. The age of the process, and

d. The operating history of the process.

4.4 The documentation shall include a priority order listing of each covered process and a narrative explanation of the rationale for the priority order. A matrix similar to the one presented in Appendix A may be useful in documentation of the rationale.

4.5 If the facility contains large processes with different risk factors within the process, the large processes can be broken down into sub-processes for the priority determination.

4.6 In addition to the considerations listed above in Section 4.3, it may be appropriate for the facility to consider other items when setting the priority for completing PHA's. Some examples are:

a. Previous safety studies.

b. Potential for off-site impacts.

c. Volume of highly hazardous chemicals on site.

d. Operating conditions of process containing HHC's.

4.7 Process Hazard Analysis Requirements

Except as provided in and 4.8 of this standard, all Process Hazard Analyses of existing covered processes in CONDEA Vista require:

4.7.1 Specifically including and addressing each of the following elements:

a. The hazards of the process.

b. Previous incidents which had a likely potential for catastrophic consequences in the workplace.

c. Engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies (acceptable examples include process monitoring and control instrumentation with alarms and hydrocarbon or inorganic vapor detection systems) to provide early warning of releases. Other controls include inventory reduction, substitution of less hazardous materials, protective systems (deluges, monitors, foams, etc.), increased separation distances, modification of process temperatures or pressures, redundancy in instrumentation, etc.

d. Consequences of failure of engineering and administrative controls.

e. Facility siting. An example includes taking into consideration safe distances for locating control rooms based on evaluations of the individual characteristics of equipment involved such as types of construction of the room, types and quantities of materials, types of reactions and processes, operating pressures and temperatures, presence of ignition sources, fire protection facilities, capabilities to respond to explosions, drainage facilities, location of fresh air intakes, etc. Other relevant siting factors such as equipment spacing, equipment spacing from potential ignition sources, and the potential of an incident spreading from one unit to another should also be considered.

f. Human factors (the interaction between the process and the employees on the scenarios being evaluated). Examples may include review of operator-process and operator-equipment interfaces, the number and frequency of tasks operators must perform, the evaluation of extended or unusual work schedules, the clarity and simplicity of control displays, operator feedback and communications, clarity of signs and codes, etc.

g. A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.

4.7.2 The PHA must be conducted by a team of at least two individuals. The team members must have the following expertise:

a. Engineering - An engineer must have a minimum of four (4) years of engineering experience.

b. Process Operations - The individual filling this requirement shall have at least four (4) years of plant experience.

c. Knowledge specific to the process being evaluated. It is recommended that the individual with this expertise be from the unit Operations group. The individual should have at least four (4) years of experience with the unit's operation.

d. The team leader must have formal class room training in the PHA methodology being used. On-the-job training or participation in PHA's is not considered formal training.

e. The scope and type of process being studied will determine the make-up and number of the remainder of the team. Typically, representatives from the Mechanical Maintenance group will participate in evaluating processes involving mechanical equipment or piping and those from the Instrument Maintenance group will help evaluate processes involving instrumentation or electrical equipment. Safety Department representation is also typical. Members may

be full-time or may participate only on a part-time, as-needed basis as determined by the full-time members of the team.

4.8 PHA's Conducted Prior to Issuance of the Final Corporate Standard

If PHA's completed after May 26, 1987 and prior to the issuance of this FINAL corporate standard do not meet the requirements of this standard, facilities must evaluate the PHA's and take appropriate actions to ensure the safety of the facility and compliance with the OSHA PSM standard. Such evaluations shall be conducted by a team satisfying the requirements of 4.7.2 of this standard. The results of the evaluation(s) shall be documented, addressed as required by Section 7 of this standard (if applicable), communicated as required by Section 8 and retained with the original PHA.

4.9 Process Hazard Analysis Pre-work Requirements

The following information must be available to the PHA team when they conduct the PHA:

4.9.1 The information requirements contained in 1910.199 (d) - Process Safety Information.

4.9.2 A chemical interaction matrix.

4.9.3 Documentation of any previous incidents that had a likely potential for catastrophic consequences in the work place being evaluated.

4.9.4 Documentation of relevant safety audits or studies in the facility's files that addressed the potential for catastrophic consequences in the work place.

4.9.5 Facility siting information. At a minimum, this will include calculations for occupied plant buildings using the Dow Fire and Explosion Index.

4.9.6 Shutdown, startup, and emergency operating procedures.

4.9.7 Plant Safety & Health Manual.

4.10 Process Hazard Analysis Team Orientation

The orientation of the PHA team is a critical step in obtaining a good quality PHA. This is used to set the tone for the PHA and to meet some of the OSHA requirements that are not a direct result of some PHA methods. Attendance records must be kept.

All full-time (or core) team members must attend an orientation that includes the following elements:

4.10.1 A review of the purpose and scope of the PHA.

4.10.2 A review of why the PHA method chosen is appropriate for the PHA. Currently, only the HAZOP method is approved for CONDEA Vista's initial PHA's. Unlike most of the other methods, the HAZOP method was developed specifically for chemical plants and processes. In particular, it is an appropriate method for complex processes and when operating conditions are important.

4.10.3 A review of the PHA methodology that the team will use.

4.10.4 A review of all pre-work information. This is not intended to be an detailed review. The intent is to make the team members aware of the resources available to the team.

4.10.5 A review of the process description.

4.10.6 Process or Unit tour (if necessary to ensure all team members are physically oriented and familiarized with the process or unit being evaluated).

4.10.7 A review of the process chemistry description, chemical interaction matrix, and the hazards of the process. The review of the hazards of the process consists of identifying the process chemicals or streams and reviewing the chemical hazards, physical hazards, and corrosion potential for each. This review may result in recommendations to reduce the hazards of the

process. These should be listed but no scenario ranking should be assigned.

4.10.8 A review of previous incidents that had a likely potential for catastrophic consequences in the work place.

4.10.9 A review of human factors. If a separate human factors study has not been conducted, the human factors list in Appendix B will be used as a checklist of items that the team should discuss. This review may result in recommendations to reduce the risks associated with the operation of the process. These should be listed but no scenario ranking should be assigned.

4.10.10 A facility siting review. The primary intent is to determine if there are process hazards (as defined by this standard) associated with the facility location/layout that should be examined in detail. If a separate facility siting study has not been conducted, an evaluation of occupied plant buildings utilizing the Dow Fire and Explosion Index as required by 4.9.5 and the facility siting checklist contained in Appendix C will be used to conduct the facility siting study. This review may result in recommendations to reduce the risks associated with the operation of the process. These should be listed but no scenario ranking should be assigned.

4.10.11 A review of the site-specific hazards. This review may result in recommendations to reduce the risks associated with the operation of the process. These should be listed but no scenario ranking should be assigned. This review may also highlight specific areas of focus for the PHA.

5. HAZOP METHODOLOGY FOR PROCESS OR UNIT PHA's.

5.1 Scenario Ranking

The team will use the Consequence Rating Table, Likelihood of Occurrence Rating Table, and the Scenario Ranking Matrix included in Appendix D to rate each scenario. Each scenario can receive three (3) separate ratings - Safety (on-site), Economic, and Environmental/ Community (including off-site safety). Each scenario must receive a safety and environmental/community rating.

The information in Appendix D can not be modified without the approval of the corporate Manager of Safety, Health and Environment.

5.2 Team Responsibility

The team's responsibility is to define deviations from normal operating conditions that may represent an unacceptable risk level and to identify the problems. The team does not have the responsibility to engineer the solutions; however, it may recommend actions or solutions for consideration in remedying the hazard/risk identified for correction.

5.3 Process Parameters

Common process parameters are listed below. The team should review the list and select those appropriate for the process being evaluated. Other deviations may be added by the team if necessary.

Flow	Pressure	Temperature
Level	Time	Composition
Reaction	pH	Speed
Frequency	Viscosity	Voltage
Information	Mixing	Addition
Separation	Startup	Shutdown
Corrosion	Fouling	Atmospheric Temperature
Tube Leak	Tube Rupture	Leak
Utilities	Electricity	Steam
	Fuel Gas	Instrument Air
	Nitrogen	Cooling Water

5.4 Guide Words and Phrases

5.4.1 Common guide words and phrases for process design and operations are given below:

Guide Word/Phrase	Meaning
No	Negative of the design intent
Less or Lower	Quantitative decrease
More or Higher	Quantitative increase
Part Of	Qualitative decrease
As Well As	Qualitative Increase
Reverse	Logical opposite of intent
Other Than or Sooner/Later	Complete Substitution

5.4.2 Common guide words and phrases for procedures are given below:

Guide Word/Phrase	Meaning
Missing	A step is missing from the written procedure at, or just before, the step being examined.
Skip/Part of	The operator skips this step (or some part of it) and performs the rest of the procedure correctly.
More	The operator does too much of the specified action or does it too quickly.
Less	The operator does too little of the specified action or does it too slowly.
Out of Sequence / As well as	The operator performs the steps in a different order than specified by the procedure, possibly as a short cut.

Other Than/Reverse	The operator performs some action other than the one specified in the procedure, usually because of confusion or haste.

5.5 Study Nodes - P&I Diagrams

Each P&I Diagram is divided into study nodes. The study nodes should be as large as possible without the team having to apply the guide words to the parameters for parts of the study node.

Most utility connections are handled as one part of the study node if the utility is selected as a process parameter. The exception is process-generated fuel gas which may involve multiple nodes.

These nodes are reviewed as part of the HAZOP.

5.6 Study Nodes - Operating Procedures

Emergency, startup (initial introduction of HHC into the unit), and shutdown operating procedures are divided into nodes which are normally defined as the group of sequential steps with one intent. These nodes are reviewed as part of the HAZOP.

Other operating procedures are covered as part of the P&I Diagram node. These operating procedures are reviewed when the team believes that it is appropriate.

5.7 Team Process

The team will use the following process:

5.7.1 The team selects a study node and reviews the design intent of the study node. If the design intent is not documented, the team can develop it.

5.7.2 The team applies the first guide word to the first process parameter to form a deviation. Guide words and process

parameters that have no meaning (such as reverse temperature) are ignored.

5.7.3 The team defines the consequences associated with the deviation assuming that all equipment and procedural protection systems fail.

5.7.4 The team lists all possible causes of the deviation.

5.7.5 The team identifies all safeguards that prevent the deviation.

5.7.6 The team uses the tables found in the Appendix D to define the consequence rating, likelihood of occurrence rating, process hazards scenario ranking.

a. Economic scenario rankings can also be generated using the same process.

b. If information necessary to define scenario ranking is missing, then the scenario can not be ranked. The team will define an action step to obtain the missing information. If the information can not be found during the HAZOP, then the team will recommend an action step to obtain the information and for the scenario to be ranked at that time.

c. The team should not over-state or under-state the risk of the scenario. Making scenarios greater than reality as a method to get faster action or being conservative and playing it "safe" is unacceptable. Down playing the scenario because the solution may be perceived to be politically unacceptable is equally unacceptable.

d. To highlight the risk reduction afforded by existing safeguards and/or to evaluate the impact of any additional safeguards, teams may choose to first identify the scenario ranking without (or "before") considering the effects of safeguards and then arrive at a final (or "after") ranking considering all existing safeguards. If teams choose to do this, the final (or "after") ranking will be the ranking reported for mitigation as appropriate.

e. In each scenario where various combinations of consequences and probability are possible, only the consequence and corresponding probability yielding the maximum scenario ranking will be reported for mitigation.

5.7.7 If there are scenarios that result in catastrophic consequences even though some of the safeguards work properly, these scenarios should be risk ranked.

5.7.8 If the team has a recommendation to mitigate the risks, the team should recommend that the person or team responsible for mitigation evaluate that option. Since the team does not take the time to evaluate all options, the team should phrase recommendations as "consider" or "evaluate" rather than "do" or "install".

5.7.9 Repeat the process for each deviation until all deviations have been applied to the node. Then repeat the process for each node.

5.8 Scenarios with a Ranking of 1 or 2.

Any scenarios with a ranking of 1 or 2 shall be reported to the managers having engineering and operations responsibility for the process being evaluated as soon as possible but not greater than 24 hours of the determination.

6. PROCESS HAZARD ANALYSIS REPORT

The report shall contain sufficient detail such that a second PHA team can understand the findings and conclusions of the first team. At a minimum the report shall contain the following items:

6.1 A table of contents.

6.2 Start and end date of the PHA team work covered by the report.

6.3 Issue date.

6.4 The distribution of the report. Please note that either a paper copy or electronic copy must be available to employees affected by the findings and conclusions of the PHA.

6.5 The signatures of the team members and/or the team leader.

6.6 PHA methodology used. This shall include a rationale for the selection of the PHA method.

6.7 Description of the process evaluated.

6.8 The scope of the PHA. This will include a listing of the P&I Diagram(s) and operating procedures that were reviewed. The listing shall include the diagram or procedure number and issue date.

6.9 A listing of the team members and their qualifications. The documentation shall specify those individuals meeting the expertise requirements of Section 4.7.3 of this standard.

6.10 Attendance records.

6.11 Team orientation. This documentation should identify the steps covered in the PHA orientation and copies of any completed checklists.

6.12 Listing of updates and revalidations to the PHA report.

6.13 Copies of the P&I Diagrams with the study nodes marked and identified.

6.14 Work sheets from the team meetings.

6.15 A listing or index of resources utilized that were not included in the process safety information such as a list of previous incidents considered, technical experts who may have been consulted, research and engineering reports, etc.

6.16 A listing of actions steps requiring further evaluation including identifying nodes which require further evaluation due to missing process safety information.

6.17 Separate listings of the team's process hazards (as defined by this standard) findings and recommendations. This should include any recommendations or findings resulting from the review of human factors, facility siting, previous incidents, or hazards of the process. If economic or operability findings or recommendations are made, then these should be listed separately from the process hazards findings.

7. SYSTEM FOR ADDRESSING PHA TEAM'S FINDINGS

Utilizing the clarifications provided in Appendix E, each covered facility shall develop written procedures for the facility's management to address the PHA Team's process hazards (as defined by this standard) findings and recommendations. These procedures shall include the following elements:

7.1 Mitigation Requirements

7.1.1 1 Ranked Scenarios

A written schedule for responding to a scenario ranked 1 must be completed within five (5) working days of the managers having engineering and operations responsibility for the process being evaluated being made aware of the finding. If the unit is shut down at the time, the schedule must be completed prior to the unit resuming operations. The written schedule must include a plan for sufficient mitigation to drop the scenario ranking to at least a 3 level. The schedule shall include major milestones and responsibilities. This schedule will be updated monthly.

Within ten (10) working days of the managers having engineering and operations responsibility for the process being evaluated being

made aware of a 1 ranked scenario, the ranking level must be reduced to a 2 level or that portion of the process must be shut down.

Items can not be deleted from the schedule until all appropriate paperwork has been placed in the PHA file. A copy of each schedule shall be placed in the PHA file.

7.1.2 2 Ranked Scenarios

A written schedule for scenarios ranked 2 must be completed within ten (10) working days of the managers having engineering and operations responsibility for the process being evaluated being made aware of the team's findings. The written schedule must include a plan for sufficient mitigation to drop the scenario ranking to at least a 3 level. The schedule shall include major milestones and responsibilities. This schedule will be updated monthly.

A 2 ranked scenario shall be mitigated sufficiently to obtain a 3 ranking within sixty (60) working days of the managers having engineering and operations responsibility for the process being evaluated being made aware of the item. Exceptions must be approved by the facility S.H.E. Manager and the managers having engineering and operations responsibility for the process being evaluated.

Items can not be deleted from the schedule until all appropriate paperwork has been placed in the PHA file. A copy of each schedule shall be placed in the PHA file.

7.1.3 3 Ranked Scenarios

A written schedule for all 3 ranked scenarios must be completed within two (2) months of the issuance of the PHA report. Scenarios initially ranked 1 and 2 that have been mitigated to a 3 level should be incorporated into this schedule. The schedule shall include major milestones and responsibilities. This schedule shall be updated each quarter.

Scenarios ranked 3 should normally be mitigated to at least a 4 ranking within twelve (12) months unless significant engineering design work or a turnaround is required to make revisions.

Items can not be deleted from the schedule until all appropriate paperwork has been placed in the PHA file. A copy of each schedule shall be placed in the PHA file.

7.1.4 4 Ranked Scenarios

Within two (2) months of the issuance of the PHA report, all 4 ranked scenarios must be evaluated to determine whether mitigation is required, and a written schedule for all 4 ranked items requiring mitigation must completed. Scenarios initially ranked 1 and 2 that have been mitigated to a 4 level should be incorporated into this schedule. The schedule shall include major milestones and responsibilities. This schedule shall be updated each quarter.

Mitigation action steps shall be completed within two years of issuance of the report. Extensions to the next scheduled shutdown are permissible if a shutdown is required to implement.

Items can not be deleted from the schedule until all appropriate paperwork has been put in the PHA file. A copy of each schedule shall be placed in the PHA file.

7.1.5 5 Ranked Scenarios

Scenarios ranked 5 do not require mitigation.

7.2 Documentation of Resolution of Team Findings

The PHA file will include documentation of the resolution of each team's findings or recommendations. At minimum, there will be a typed page (or electronic equivalent) summarizing the corrective action taken in sufficient detail that the next PHA team can understand the corrective action that was taken and how the corrective action impacted the scenario ranking. This document can refer to other attached papers such as a Process Design. However, the design alone is not acceptable documentation.

7.3 Tracking System

Each facility must have a documented system to track the status of each team's findings.

8. PROCESS HAZARD ANALYSIS COMMUNICATIONS

8.1 Determination of Affected Employees

An affected employee is any operator, maintenance employee, contractor, or other employee whose:

8.1.1 Normal work assignment can significantly affect the likelihood of occurrence or consequences of the 1, 2, and 3 ranked scenarios;

or

8.1.2 Normal work assignment in occupied buildings takes them within a Dow Fire and Explosion Index radius for more than 2 hours per week.

Note: The immediate Supervisor of those individuals defined by items 8.1.1 and 8.1.2 above are also affected employees.

8.2 Pre-Process Hazard Analysis Communications

Prior to each process or unit PHA, affected employees and their representatives shall be provided notice of the scheduled PHA. The notice shall indicate the unit or process being analyzed, the team leader and other team members who will be conducting the PHA, the scheduled meeting place/dates/times, etc. The notice shall also solicit input from affected employees who have concerns or knowledge of issues that the team should consider in its analysis.

8.3 Post-Process Hazard Analysis Communications

8.3.1 Process or Unit PHA findings and mitigation plans shall be reviewed with affected employees within one month of the

issuance of the PHA report. Meetings for this purpose are required if scenarios ranked 1 or 2 were identified; otherwise, written communications to affected employees are acceptable.

8.3.2 The affected employees shall have access to a copy of the PHA and the latest mitigation plan.

8.3.3 Documentation including lists of affected employees, date(s) of reviews, meeting attendance records, etc. shall be prepared and placed in the PHA file.

8.3.4 Updates on the status of the mitigation plans for scenarios with rankings of 1, 2 or 3 can be handled through meetings or written communications as deemed appropriate by the facility management. Updates on scenarios ranked 4 or 5 are not required.

8.3.5 Where written communications are used or PHA's are provided to employees, management shall take measures if necessary to make sure recipients understand the information being communicated.

9. PROCESS HAZARD ANALYSIS REVALIDATION

9.1 At least every five (5) 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 of Section 4.7.2 to assure that the process hazard analysis is consistent with the current process.

9.2 Until another methodology is approved, the HAZOP methodology shall be used for the revalidation.

9.3 PHA's performed prior to the issuance of this FINAL standard and not meeting the requirements of this standard shall be evaluated on an accelerated timetable and actions shall be taken to remedy deficiencies as prescribed in 4.8.

10. RECORDS RETENTION

Process Hazard Analyses (report and other documentation generated by the team) and updates or revalidations for each covered process and documentation of the resolution of process hazards identified by each shall be retained for the life of the process.

Appendix A
PHA ORDER ANALYSIS MATRIX

Each facility shall determine and document the priority order for conducting the initial process hazard analyses based on a rationale which includes as a minimum such considerations as:

A - the extent of the process hazards,
B - the number of potentially affected employees,
C - the age of the process, and
D - the operating history of the process.
E - other as determined by facility

A matrix similar to the one presented below may be useful in documentation of the rationale. The documentation of this chart alone does not satisfy the narrative documentation required by Section 4.4 of this standard.

By force ranking the criteria above (and others the facility feel are appropriate) for each of the Processes (or Sub-Processes) for the Unit or Facility and comparing the composite scores, a PHA order may be established. Criteria are ranked from Highest Risk (1) to Lowest Risk (# of Processes being ranked).

E X A M P L E

Unit/Facility	Criteria	Rank	Total	Order	Comments/Remarks
Process A	A B C D E	1 2 2 1 2	8	1	
Process B	A B C D E	3 3 1 2 1	10	2	
Process C	A B C D E	2 1 3 3 3	12	3	

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

Appendix B
HUMAN FACTORS CHECKLIST

EQUIPMENT	+	-	OBSERVED PRACTICE
Labeling	equipment clearly labeled, uniform coding	mislabeled or not Labeled	
Access	immediately at hand	hard to reach or access	
Operability	power-assisted operation	difficult t to operate/change position	
Layout	well-planned, logical arrangement	confusing/inconsistent arrangement	
Uniqueness	only component of its kin in area	several components look similar	

CONTROLS	+	-	OBSERVED PRACTICE
Labeling	controls clearly labeled; uniform coding	mislabeled or not labeled	
Mode	fully automatic; well-tuned	manual operation; many manual steps	
Involvement	operator continually involved	operator detached from process	
Displays	clear, simple, representational	unclear, complex, non-representational	
	immediate, unambiguous	none or potentially misleading	

DEVIATIONS	+	-	OBSERVED PRACTICE
Alarms	first-out; safety-critical alarms	many simultaneous or false alarms	
Coverage	dual operator coverage at all times	operator not always present	
Time	no time pressure for response	inadequate time to respond	
Preparedness	periodic simulation exercises	no drills or simulation of scenarios	
Last-Resort	shutdown not discouraged; fast access	shutdown discouraged or unsafe	

TRANSIENT	+	-	OBSERVED PRACTICE
Procedures	complete, accurate, current, verified	incomplete/too general/out of date	
Identifying	ID, location of devices/actions given	ambiguous device/action identification	
Format	graphical identification aids	confusing/inconsistent; difficult to read	
Aids	checklist or supervisory check	task sequence done by memory	

"+" = FACTORS BEYOND STANDARD PRACTICE; MAY REDUCE HUMAN ERROR OR INADEQUATE RESPONSE LIKELIHOOD.

"-" = FACTORS THAT MAY TEND TO INCREASE THE LIKELIHOOD OF HUMAN ERROR OR INADEQUATE RESPONSE

Appendix B (continued)
HUMAN FACTORS CHECKLIST

SCHEDULING	+	-	OBSERVED PRACTICE
Overtime		extreme enough to affect performance	
Consistency	permanent shift assignments	inconsistent shift rotations/schedules	
# of Tasks	tasks, work force, and sills matched	tasks required exceed time available	
Task Frequency	routine task	very infrequent; no expertise base	
Intensity	regular task at normal pace	differing tasks in rapid succession	

COMMUNICATE	+	-	OBSERVED PRACTICE
Shift Changes	status communicated verbally, plus turnover sheet used	inadequate communication of plant status between shifts	
Field/Control	constant communication with field	no communication with field operator	
Supervision	frequent supervisory communication	little or no supervisory checks	
Emergency	rapid. unambiguous plant alarm system	no distinction between area, type	

ENVIRONMENT	+	-	OBSERVED PRACTICE
Noise Level	office environment noise level	area where hearing protection required	
Climate	indoors, climate controlled	temperature/humidity/precipitation/wind extremes	
Visibility	visibility enhancement of some kind	often foggy or other visibility limitation	
Lighting		inadequate lighting for task	

"+" = FACTORS BEYOND STANDARD PRACTICE; MAY REDUCE HUMAN ERROR OR INADEQUATE RESPONSE LIKELIHOOD.

"-" = FACTORS THAT MAY TEND TO INCREASE THE LIKELIHOOD OF HUMAN ERROR OR INADEQUATE RESPONSE

Appendix C (Pages 25 - 32)
FACILITY SITING CHECKLISTS AND MITIGATION GUIDANCE

Instructions:

The team will review each item on the checklist. After evaluation, each item is marked to indicate that the item has been reviewed. Comments and findings are attached on a separate sheet. No scenario rankings are given to the findings.

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		1. Location of on-site populations relative to the unit.
		2. Location of off-site populations relative to the unit. Location of environmentally sensitive areas.
		3. Location of critical and safety systems.
		4. Dominant Wind Direction.
		5. Climate and water extremes; earthquake; flooding; hurricanes; tornadoes; windstorms.
		6. Site topography
		7. External hazards and threats (fire, explosion, toxic release from nearby process or facilities; aircraft, subsidence, sabotage).
		8. On-site traffic flow patterns and clearances.
		9. Security and reliability of all critical feeds, utilities, and safety systems.
		10. Evacuation routes, emergency exits, safe rally spots.
		11. Passive mitigation systems such as dikes, berms, (control spills and fires) and blast walls (protect against explosions).
		12. Crane lifts over operating equipment and piping.
		13. Barricades between traffic and equipment and piping.
		14. Adequate lighting for normal operation, routine maintenance, power failure procedures, evacuation.
		15. Communication systems.
		16. House keeping - walkways, aisles, operating areas, evacuation routes.

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		17. Location of railroads to process equipment (derailment, access).
		18. Open ditches, sumps, low points (collect toxic and flammable vapors).
		19. Entry into confined spaces during emergencies- Trapped Gases, Hazards, Permit.
		Buildings
		20. Location of occupied building near process units. (Please note that the Dow Chemical Fire and Explosion Index will be used as a screening tool to determine if the building is located sufficiently remote from the process. If the building is not located sufficiently remote from the process, the team should suggest that a more detailed study be conducted.)
		Control Rooms
		21. Minimum occupancy; only essential functions during emergencies.
		22. Control Room Construction.
		23. Fresh air intake locations/isolation; Temporary safe havens; Access during an emergency.
		24. Control room location relative to unit, columns, and pipe bridges.
		25. Supply of breathing air in control room. Sufficient for emergency shutdown.
		26. Instrument labels up-to-date.
		Process Facilities
		27. Area electrical classification.
		28. Accessibility for mechanical integrity inspection and testing.
		29. Protection of piping and vessels from vehicles and forklifts.
		30. Protection of small bore lines, fittings, from external impact, personnel.
		31. Routing of process piping, critical controls cable trays, critical utilities.
		32. Vent, drain, and relief valve discharge locations.
		33. Remote shutoff valves for feed lines to the unit, accessible, functional in emergency.
		Loading, unloading, and storage facilities

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		34. Incompatible materials segregated; storage, dikes, sumps, drains, and waste.
		35. Siting, labeling of unloading spots for incompatible materials.
		36. Spacing consideration for flammable, combustible, and unstable liquid storage (note use the checklist - "Hazardous Analysis Review for Spacing Considerations for flammable, combustible, and Unstable Liquid Storage")
		39. Storage of flammable solids such as wood, paper, rags.
		Fire Protection
		40. Access for fire fighting and other emergency services - trains, vehicle parking, construction.
		41. Ignition sources, continuous, intermittent, uncontrolled, hot surfaces.
		42. Access to hydrants, monitors, and deluge valves.
		43. Grading drains flammables away from storage.
		44. Equipment spaced to minimize potential fire explosion damage.
		45. Coverage of fire monitors/sprinkler systems.
		46. Fire proofing of structures.
		Accident Mitigation
		47. Detection of leaks and ruptures.
		48. Emergency shutdown switch locations.
		49. Accessibility of isolation valves, size.
		50. Potential for fire/explosion in units affecting other equipment.
		51. Critical control, mitigation, communication after initial explosion or release.
		Personnel Protection
		52. Passageways, pedestrian traffic patterns vs. hazardous locations.
		53. SCBA/respirators locations; accessibility on all shifts.
		54. Sufficient escape routes from operating areas, shops, labs, offices.

NFPA 30 Table 2-2 & 2-7

Vessel Cap: 25,800 Gal

min Dist. to Prop. Line 20 ft
min Dist to Building 5 ft
} Table 2-7

2-2 for Propane

min Dist. to Prop. Line = 1.5 x 20 = 30 ft

min Dist to any building = 1.5 x 5 = 7.5 or 25 ft min = 25 ft

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

HAZARDOUS ANALYSIS REVIEW FOR SPACING APPLICATIONS FOR FLAMMABLE, COMBUSTIBLE AND UNSTABLE LIQUID STORAGE

Instructions: This checklist represents item #36 on the CONDEA Vista Company Facility Siting Checklist. The hazard review team will review each item and mark to indicate a review was completed. Comments and findings are shown in a separate report. No scenario rankings are given to these findings.

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		1. Tanks accessible for fire fighting purposes.
		2. Minimum distance between tank and property line or building as defined in paragraph 2-3 of NFPA 30, attached.
		3. Outside base tank dike at ground level at least ten (10) feet from property line.
		4. Minimum distance between any two storage tanks one third (1/3) of adjacent tank diameters, but at least three (3) feet. If unstable, flammable, or combustible liquids are stored, distance shall be minimum of one half (1/2) the sum of the diameters.
		5. Inside base of tank dike at ground level at least five (5) feet from storage tank.
		6. Minimum distance between liquefied petroleum gas (LPG) container and storage tank twenty (20) feet. If storage tank operates above 2.5 psig, or is equipped with emergency venting that will permit pressures to exceed 2.5 psig, then Item 4. above applies.
		7. Storage tanks not permitted inside buildings.
		8. When a storage tank is located in an area subject to flooding, the following shall be observed.
		a. The provisions of Item 8. shall apply only if the maximum flood stage exceeds the elevation of the dike wall.
		b. Provisions to prevent tank, either full or empty, from floating during rise in water level to established maximum flood stage.
		c. Independent water supply facilities available for loading partially empty tanks with water. If filling with water is impractical or hazardous due to tank contents, tank shall be protected by other means against movement or collapse.

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

REVIEWED YES	REVIEWED NO	DISCUSSION TOPIC
		d. Top of vertical tank extends above maximum flood stage by at least thirty (30) percent of its allowable storage capacity.
		e. In addition to Items a., b., c., and d. above, if tank is located such that seventy (70) to one hundred (100) percent of its allowable liquid storage capacity will be submerged at the established maximum flood stage, then the following also applies.
		i. Is tank raised, or height increased, until it extends above the level obtainable at maximum flood stage a distance equivalent to at least thirty (30) percent if its allowable liquid storage capacity. Submerged part of tank shall not exceed two and one-half (2 ½) times its diameter.
		ii. As an alternate to Item i. above, adequate noncombustible structural guides, designed to permit tank to float vertically without loss of product may be provided.
		f. Horizontal tanks located such that more than seventy (70) percent of storage capacity will be submerged at the established flood stage attached to foundation of concrete, or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood waters to the established flood stage.
		g. For tanks in Item f. above, are tank vents or other openings that are not liquid tight extended above the level obtainable by flood waters at maximum flood stage water level.
		h. Spherical or spheroid tanks protected by applicable methods specified for either vertical or horizontal tanks as described above.

Definitions:

Combustible Liquid. A liquid having a flash point at or above 100°F (37.8°C).

Flammable Liquid. A liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia at 100°F (37.8°C).

Unstable Liquid. A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure or temperature.

Reference Materials:

NFPA (National Fire Protective Association) 30, Flammable and Combustible Liquids Code

OSHA 1910.106

List of Short-term Mitigation Steps for Consideration for Normally Occupied Buildings Inside the Dow F&EI Radius

This list is intended to serve as a guide for measures to be considered as short-term mitigation steps for facility siting issues identified. It is not an all inclusive list.

MITIGATION STEP	APPLICATION
1. Provide a system on the buildings' fresh air intake to detect and alarm when hydrocarbons, smoke, or toxic chemicals are present above acceptable levels.	Fire Explosion Toxic
2. Provide the means to quickly shutdown the building's ventilation system to prevent entry of contaminated air. Locate this control inside the building at a readily accessible location and clearly mark its function.	Fire Explosion Toxic
3. All sewers, except sanitary sewers, leaving a building shall be sealed by installing a break tank or equivalent in the sewer system. The break tank shall be located outside the building, and must be between the building and any other inlet into the sewer line. There shall be no additional inlets into the sewer between the building and the break tank. Additional inlets into the break tank or into the sewer after the break tank are acceptable. Venting of the break tank shall be routed away from the building to an appropriate place.	Fire Explosion
4. The exterior surface of the building, at risk including its roof, shall be constructed of fire resistant materials, or a fire suppression system shall be provided to protect these exterior surfaces.	Fire
5. All office equipment, supplies, and other materials located within the building which could fall over or become mobile should be removed, relocated, or secured. This applies to all areas except for designated store rooms. Samples, office, janitorial supplies, and other liquids should be evaluated for potential hazards from spills.	Explosion
6. Interior fixtures, such as ceiling lighting fixtures, wall mounted video monitors, other wall mounted equipment, etc., shall be attached to a building structural member.	Explosion
7. Exterior windows shall not be permitted unless required for safety or regulatory compliance. If required, windows shall meet these criteria: a. Strength equivalent or better than the building wall, and safe construction that fails in a manner that minimizes risk to building occupants. Examples are 3/8" minimum thickness polycarbonate, toughened glass, laminated glass with internal catch bars. b. Window area is minimized.	Explosion

MITIGATION STEP	APPLICATION
8. Provide clearly marked utility (gas, electric, steam, etc.) shut-offs inside the building.	Fire Explosion
9. Occupant assignments should be reviewed to determine if individuals can be relocated to buildings that do not fall within the radius defined by the Dow Fire and Explosion Index, unless the building is blast resistant design (BRD). Develop a policy to minimize the use of conference areas in non-BRD buildings located within the radius of concern defined by the Dow Fire and Explosion Index. Non-BRD buildings within the radius of concern defined by the Dow Fire and Explosion Index shall not be used as shelter-in-place facilities for non-operating personnel when there is a potential for fire or explosion impacting such buildings.	Explosion
10. The building should be equipped with sufficient exits to allow personnel to exit in a direction away from potential fire and explosion sources. Doors shall open to the outside and be capable of resisting at a minimum the same external pressure as the building. The door frame shall support the door on all four sides. The door shall be weather stripped, and have a door closer of sufficient strength such that the door will remain closed and sealed against any positive pressure system that may be present in the building.	Fire Explosion
11. Other openings in a building shall be sealed to prevent flammable or toxic gases and smoke from entering the building. An opening is defined as penetration of the walls, roof, or floor by a system component. Any system component penetrating the wall, roof, or floor, shall be capable of resisting the same external pressure as the building until the system component is inside the building. Examples of system components that require openings include, but are not limited to, the following: 1) Pipes 2) Conduits 3) Cable trays	Explosion Toxic
12. Each building shall have an emergency response plan for fire, explosion, and toxic release situations. The normal occupants shall be trained in the plan. A brief summary of actions to take in the event of an emergency (evacuation, shelter-in-place, etc.) shall be posted in common areas, such as hallways, and conference or training rooms, so visitors can quickly see what they need to do in the event of an emergency.	Fire Explosion Toxic
13. Occupied temporary buildings will not be located within the radius calculated by the Dow Fire and Explosion Index.	Fire Explosion

DEFINITION: Normally occupied building

- The primary function is to house people on a routine basis.
- Examples of normally occupied buildings include:

    1. Control rooms that are staffed during emergencies
    2. Offices
    3. Laboratories
    4. Maintenance shops
    5. Buildings designated as gathering points for emergencies

- Examples of buildings that are not normally occupied buildings include:

    1. Motor control centers
    2. Electrical substations
    3. Temporary operator shelters
    4. Compressor sheds, etc.

Appendix D

NO INFORMATION IN THIS APPENDIX MAY BE MODIFIED WITHOUT THE APPROVAL OF THE CORPORATE MANAGER SAFETY, HEALTH & ENVIRONMENT.

If information necessary to define scenario ranking is missing, the scenario can not be ranked.

The team should not over-state or under-state the likelihood of occurrence or consequence of the scenario.

Making scenarios greater than reality as a method to get faster action or being conservative and playing it "safe" is unacceptable.

Down playing the scenario because the solution may be perceived to be politically unacceptable is equally unacceptable.

Note: The Environmental and Community column of the Consequence Rating Table was changed on May 19, 1997. PHAs done after May 19, 1997 should use the table as revised. PHAs done prior to May 19, 1997 do not need to be re-rated until the PHA is revalidated.

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

Appendix D (continued)

NO INFORMATION IN THIS APPENDIX MAY BE MODIFIED WITHOUT THE APPROVAL OF THE CORPORATE MANAGER OF SAFETY, HEALTH & ENVIRONMENT.

CONSEQUENCE RATING

	EXPECTED RESULT OR IMPACT		
CONSEQUENCE LEVEL	SAFETY (ON-SITE)	ECONOMIC	ENVIRONMENTAL AND COMMUNITY (OFF-SITE SAFETY)
I MAJOR	• LOSS OF LIFE • PERMANENT TOTAL DISABILITY OR PARTIAL DISABILITY. • HOSPITALIZATION OF 5 OR MORE PEOPLE.	• EQUIPMENT DAMAGE IN EXCESS OF $1,00,000 • RAW MATERIAL OR PRODUCT LOSSES IN EXCESS OF $1,000,000	• HOSPITALIZATION OF ONE COMMUNITY MEMBER • DAMAGE TO AN ENVIRONMENTALLY SENSITIVE AREA • SIGNIFICANT PROPERTY DAMAGE. • COMMUNITY EVACUATION • SHELTER IN PLACE THE COMMUNITY AND/OR AN OFF-SITE INDUSTRIAL FACILITY.
II HIGH	• MEDICAL TREATMENT FOR FIVE OR MORE PEOPLE. • HOSPITALIZATION OF TWO OR MORE PEOPLE.	• EQUIPMENT DAMAGE IN EXCESS OF $100,000. • RAW MATERIAL OR PRODUCT LOSSES IN EXCESS OF $500,000	• MINOR DAMAGE TO OFF-SITE STRUCTURES. • INJURY TO ONE OR MORE COMMUNITY MEMBERS. • OFF-SITE ENVIRONMENTAL DAMAGE.
III MEDIUM	• MINOR INJURY OR HEALTH EFFECTS. • MEDICAL TREATMENT OF ONE PERSON. • MULTIPLE EXPOSURES ABOVE OSHA LIMITS.	• EQUIPMENT DAMAGE IN EXCESS OF $10,000. • RAW MATERIAL OR PRODUCT LOSSES IN EXCESS OF $100,000	• REGULATORY REPORTABLE EVENT.
IV LOW TO NONE	• FIRST AID TREATMENT ONLY • SINGLE EXPOSURE ABOVE THE OSHA LIMITS • NO IMPACT	• EQUIPMENT DAMAGE LESS THAN 10,000. • RAW MATERIAL OR PRODUCT LOSSES LESS THAN $100,00.	• NO IMPACT

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

Appendix D (continued)

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LIKELIHOOD OF OCCURRENCE RATINGS

RATING	DESCRIPTION	LIKELIHOOD OF OCCURRENCE
A	FREQUENT	EXPECTED TO OCCUR ONE OR MORE TIMES WITHIN THE NEXT YEAR
B	PROBABLE	EXPECTED TO OCCUR ONCE WITHIN THE NEXT TEN (10) YEARS
C	POSSIBLE	EXPECTED TO OCCUR ONCE WITHIN THE NEXT 100 YEARS
D	REMOTE	EXPECTED TO OCCUR LESS FREQUENTLY THAN ONCE EVERY 100 YEARS OR IS PHYSICALLY IMPOSSIBLE

SCENARIO RANKING MATRIX

	A	B	C	D
I	1	2	3	4
II	2	2	3	4
III	3	3	4	5
IV	5	5	5	5

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

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Appendix D (continued)

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RESPONSE/MITIGATION
REQUIREMENTS FOR SAFETY & ENVIRONMENTAL RANKED ITEMS
(See Section 7.1 of this Standard for expanded detail)

SCENARIO RANK	WRITTEN SCHEDULE	MITIGATION REQUIREMENT
1	COMPLETE WITHIN 5 DAYS OF NOTIFICATION OF THE MANAGERS HAVING ENGINEERING AND OPERATIONS RESPONSIBILITY FOR THE UNIT BEING EVALUATED (SEE NOTE BELOW)	MITIGATE TO SCENARIO RANK 2 OR LOWER WITHIN 10 DAYS OF NOTIFICATION OF THE MANAGERS HAVING ENGINEERING AND OPERATIONS RESPONSIBILITY FOR THE UNIT BEING EVALUATED (SEE NOTE BELOW) OR SHUT DOWN UNIT
2	COMPLETE WITHIN 10 DAYS NOTIFICATION OF THE MANAGERS HAVING ENGINEERING AND OPERATIONS RESPONSIBILITY FOR THE UNIT BEING EVALUATED (SEE NOTE BELOW)	MITIGATE TO SCENARIO RANK 3 OR LOWER WITHIN 60 DAYS OF NOTIFICATION OF THE MANAGERS HAVING ENGINEERING AND OPERATIONS RESPONSIBILITY FOR THE UNIT BEING EVALUATED (SEE NOTE BELOW)
3	COMPLETE WITHIN 2 MONTHS OF ISSUANCE OF PHA REPORT	MITIGATE TO RISK RANK 4 OR LOWER WITHIN 12 MONTHS OF ISSUANCE OF PHA REPORT
4	COMPLETE WITHIN 2 MONTHS OF ISSUANCE OF PHA REPORT	MITIGATE (IF REQUIRED) WITHIN 2 YEARS OF ISSUANCE OF PHA REPORT
5	NOT REQUIRED	NO MITIGATION REQUIRED

NOTE: SCENARIOS RANKED "1" OR "2" REQUIRE NOTIFICATION OF THE MANAGERS HAVING ENGINEERING AND OPERATIONS RESPONSIBILITY FOR THE UNIT BEING EVALUATED WITHIN 24 HOURS OF DETERMINATION.

IF MITIGATION REQUIRES MORE TIME THAN DEFINED ABOVE, A MOCA EXTENSION IS REQUIRED.

CONDEA VISTA COMPANY
CORPORATE SAFETY & HEALTH STANDARDS

Subject: Process Hazard Analysis **Issue Date:** May 19, 1997

Appendix E

OSHA GUIDELINES ON ADDRESSING PHA TEAM FINDINGS AND RECOMMENDATIONS

Paragraph (e) of the OSHA PSM standard requires that a team with expertise in engineering and process operations conduct a process hazard analysis, containing specific findigs and recommendations for each covered process. The employer is then required to promptly "address" and resolve[ ]" the team's findings, document the actions taken, and communicate these actions to the affected employees. 29 CFR 1910.119(e)(5).

OSHA considers an employer to have "resolved" the team's findings and recommendations when the employer either has adopted the recommendations, or has justifiably declined to do so. Where a recommendation is rejected, the employer must communicate this to the team, and expeditiously resolve any subsequent recommendations of the team.

An employer can justifiably decline to adopt a recommendation where the employer can document, in writing and based upon adequate evidence, that one or more of the following conditions is true:

1. The analysis upon which the recommendation is based contains material factual errors;

2. The recommendation is not necessary to protect the health and safety of the employer's own employees, or the employees of contractors;

3. An alternative mesure would provide a sufficient level of protection; **or**

4. The recommendation is infeasible.