Process Safety Management

Georgia Gulf Chemicals & Vinyls, Aberdeen Plant

Utilities Area, Hazard and Operability Study

Revalidation PHA

Start Date:	**October 28, 2002**
End Date:	**December 17, 2002**
Issue Date:	**December 18, 2002**

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Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.5 cont'd								
	2. cont'd						5. Manual activation of deluge system 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 7. Sloping ground beneath vessel to prevent flammables accumulating 8. Pressure relief valve 9. Pressure relief valve - isolation valve under relief valve is normally locked open	
	3. Relief valve plugged under relieving condition	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	7
	4. Relief valve isolated under relieving condition	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 3. Pressure relief valve - isolation valve under relief valve is normally locked open	7

Node: 17. Instrument air compressors, CP-708 and CP-709, and discharge line to aftercoolers.	
Type: Centrifugal Compressor + Line	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02
Design Conditions/Parameters: Compressor capacity: 526 ICFM at 100 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
17.1 Low/No Flow								
	1. Compressor shutdown - interlocks (High cooling water temperature, High outlet air temperature, Low oil pressure, Low water pressure)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 3	B C	5 4	1. Low instrument Air pressure alarm 2. Low sump level Alarm #2 cooling Tower 3. PM on #2 Cooling Tower Pumps and Tower 4. Routine cleaning of Y-strainer 5. Daily operator check of oil level 6. Oil pressure switch (shutdown switch) 7. Routinely change oil in compressors	11 30 31 32
	2. Closed valve	1. Loss of Instrument Air	S/E	4	D	5	1. Low instrument Air pressure alarm	1
	3. Compressor fail to run (motor, internals, no power)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 3	B C	5 4	1. Low instrument Air pressure alarm 2. Daily operator check of oil level 3. Oil pressure switch (shutdown switch) 4. Routinely change oil in compressors 5. PM emergency generator	31 32
	4. Inlet air filter plugged	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B D	5 5	1. PM inlet air filter regularly 2. Low instrument Air pressure alarm	1
17.2 Low Pressure								
	1. Low air flow from compressors	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low instrument Air pressure alarm 2. PM inlet air filter regularly	1
	2. Leak	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	3. Compressor internals failure (valves, innercooler, etc.)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low instrument Air pressure alarm 2. Daily operator check of oil level 3. Oil pressure switch (shutdown switch) 4. PM inlet air filter regularly 5. Routine cleaning of Y-strainer 6. Routinely change oil in compressors	1

Node: 35. Chlorine supply line from chlorine container to ejector. Cooling Towers #'s 2, 4, and 6.	
Type: Line	Drawing: UT-090117-PID-D, 10/10/02
Design Conditions/Parameters: Up to 500 lb/day of chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
35.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to towers	S/E S/E	4 4	D D	5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to towers 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to cooling towers	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication 4. Drip leg heater 5. Operating Procedures/ Training for cylinder valve alignment 6. Chlorine area monitor and alarm 81A085 7. Buddy system when hooking and unhooking chlorine cylinders 8. Personal Protective Equipment	42 43
	4. Liquid Chlorine in the line	1. Tubing rupture/leak 2. Tubing rupture/leak-E 3. Overfeed chlorine to cooling towers	S E S/E	3 4 4	C C C	4 5 5	1. Chlorine regulator located on cylinder 2. Drip leg heater 3. Operating Procedures/ Training for cylinder valve alignment 4. Chlorine area monitor and alarm 81A085 5. Buddy system when hooking and unhooking chlorine cylinders 6. Personal Protective Equipment	41 42
35.2 Low/No Flow								
	1. Ruptured/cracked line	1. Loss of chlorine to towers	S/E	4	C	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	2. Blocked discharge	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	3. High upstream pressure	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	4. Chlorine cylinder is empty	1. Loss of chlorine to towers	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication	1

Node: 35. Chlorine supply line from chlorine container to ejector. Cooling Towers #'s 2, 4, and 6.	
Type: Line	Drawing: UT-090117-PID-D, 10/10/02
Design Conditions/Parameters: Up to 500 lb/day of chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
35.2 cont'd								
	4. cont'd						3. Regular cooling tower checks 4. Chlorine cylinder scale 5. Spare chlorine cylinder	
	5. Plugged regulator inlet filter	1. Loss of chlorine to towers	S/E	4	B	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
35.3 Leak								
	1. Corrosion	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Personal Protective Equipment	42 43
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use 6. Personal Protective Equipment	42 43

Node: 36. Chlorine supply line from chlorine container to ejector. Water Plant Chlorination System.	
Type: Line	Drawing: WP-090106-PID-D, 09/26/02
Design Conditions/Parameters: 360 PPD at ambient chlorine vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
36.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to water plant	S/E S/E	4 4	D D	5 5	1. Regular water plant checks 2. Daily visual checks 3. Eductor Vacuum indication	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to water plant 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to water plant	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular water plant checks 2. Daily visual checks 3. Eductor Vacuum indication 4. Drip leg heater 5. Operating Procedures/ Training for cylinder valve alignment 6. Chlorine area monitor and alarm AAH808 7. Buddy system when hooking and unhooking chlorine cylinders 8. Personal Protective Equipment	43 45 46
	4. Liquid Chlorine in the line	1. Tubing rupture/leak 2. Tubing rupture/leak-E 3. Overfeed chlorine to water plant	S E S/E	3 4 4	C C C	4 5 5	1. Drip leg heater 2. Operating Procedures/ Training for cylinder valve alignment 3. Chlorine area monitor and alarm AAH808 4. Buddy system when hooking and unhooking chlorine cylinders 5. Personal Protective Equipment	41 45 46
36.2 Low/No Flow								
	1. Blocked discharge	1. Loss of chlorine to water plant	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1
	2. Chlorine cylinder is empty	1. Loss of chlorine to water plant	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks 4. Chlorine cylinder scale 5. Spare chlorine cylinder	1
	3. High upstream pressure	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1
	4. Plugged regulator inlet filter	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1

Node: 36. Chlorine supply line from chlorine container to ejector. Water Plant Chlorination System.	
Type: Line	Drawing: WP-090106-PID-D, 09/26/02
Design Conditions/Parameters: 360 PPD at ambient chlorine vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
36.2 cont'd								
	4. cont'd						4. Spare chlorine cylinder with regulator	
	5. Ruptured/cracked line	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks 4. Isolation valves	1
36.3 Leak								
	1. Corrosion	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808	43 45 46
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use	43 45 46
	3. High pressure tubing crack/ rupture	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	B B	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808 3. Leak check cylinder connection with amonia every time cylinder is changed 4. Spare chlorine cylinder 5. Personal Protective Equipment	45 46

Node: 40. Emergency response to a chlorine leak of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawing: (OP) UT-CT-003, 09/29/99
Design Conditions/Parameters: Steps 1.0 - 4.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
40.1 Other than specified action								
	1. Inadequate personal training	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	13
		2. Personal evacuation	S/E	3	C	4		47
		3. Personal exposure	S/E	3	C	4		
	2. Emergency response material not available	1. Interuption of plant operations	EC	3	C	4	1. Annual inventory of ERT Team "B" kit	12
		2. Personal evacuation	S/E	3	C	4		
		3. Personal exposure	S/E	3	C	4		

Node: 43. Emergency response to a chlorine leak of Water Plant Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-WP-017, 07/20/00, (OP) UT-WP-018, 07/20/00
Design Conditions/Parameters: UT-WP-017 Steps 1-4; UT-WP-018 Steps 1.1-1.22, 2.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
43.1 Other than specified action								
	1. Inadequate personal training	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	13
		2. Personal evacuation	S/E	3	C	4		47
		3. Personal exposure	S/E	3	C	4		
	2. Emergency response material not available	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	12
		2. Personal evacuation	S/E	3	C	4		
		3. Personal exposure	S/E	3	C	4	2. Annual inventory of ERT Team "B" kit	

Node: 53. Regulator and line that supplies chlorine gas to chlorine ejector for Compound Cooling Tower #5	
Type: Line	Drawing: UT-090123-PID-D, 10/23/02
Design Conditions/Parameters: Up to 10 lb/day of chlorine gas at ambient vapor pressure before the regulator and at 0 psig or below after the regulator to the ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
53.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction	S/E	4	D	5	1. Regular cooling tower checks	43
		2. Loss of chlorine to towers	S/E	4	D	5	2. Daily visual checks	
							3. Eductor Vacuum indication	
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to towers	S/E	4	D	5	1. Regular cooling tower checks	42
		2. Tubing rupture/leak	S	3	C	4	2. Daily visual checks	43
		3. Tubing rupture/leak-E	E	4	C	5	3. Eductor Vacuum indication	44
		4. Overfeed chlorine to cooling towers	S/E	4	C	5	4. Drip leg heater	
							5. Operating Procedures/ Training for cylinder valve alignment	
							6. Chlorine area monitor and alarm 81A085	
							7. Buddy system when hooking and unhooking chlorine cylinders	
	4. Liquid Chlorine in the line	1. Tubing rupture/leak	S	3	C	4	1. Chlorine regulator located on cylinder	41
		2. Tubing rupture/leak-E	E	4	C	5		42
		3. Overfeed chlorine to cooling towers	S/E	4	C	5	2. Drip leg heater	44
							3. Operating Procedures/ Training for cylinder valve alignment	
							4. Chlorine area monitor and alarm 81A085	
							5. Buddy system when hooking and unhooking chlorine cylinders	
53.2 Low/No Flow								
	1. Ruptured/cracked line	1. Loss of chlorine to towers	S/E	4	C	5	1. Daily visual checks	1
							2. Eductor Vacuum indication	
							3. Regular cooling tower checks	
	2. Blocked discharge	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks	1
							2. Eductor Vacuum indication	
							3. Regular cooling tower checks	
	3. High upstream pressure	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks	1
							2. Eductor Vacuum indication	
							3. Regular cooling tower checks	
	4. Chlorine cylinder is empty	1. Loss of chlorine to towers	S/E	4	A	5	1. Daily visual checks	1
							2. Eductor Vacuum indication	
							3. Regular cooling tower checks	
							4. Chlorine cylinder scale	
	5. Plugged regulator inlet filter	1. Loss of chlorine to towers	S/E	4	B	5	1. Daily visual checks	1

Node: 53. Regulator and line that supplies chlorine gas to chlorine ejector for Compound Cooling Tower #5	
Type: Line	Drawing: UT-090123-PID-D, 10/23/02
Design Conditions/Parameters: Up to 10 lb/day of chlorine gas at ambient vapor pressure before the regulator and at 0 psig or below after the regulator to the ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
53.2 cont'd								
	5. cont'd						2. Eductor Vacuum indication 3. Regular cooling tower checks	
53.3 Leak								
	1. Corrosion	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085	42 43
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use	42 43

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 Low/No Power								
	1. Batteries/Starter Malfunction	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Battery Charger 4. Engine Block Heater 5. Fire Protection System	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Fixed point monitor 7. Operating procedures/training	
		4. Loss of power to Catalyst Freezers	S	3	C	4	8. Personal Protective Equipment	
		5. Loss of power to Catalyst Freezers -E	E	4	C	5	9. Reactor pressure/temperature indication 10. Automatic/Manual Emergency Kill 11. Beacon Light for catalyst freezers 12. Blowout door for catalyst freezer 13. Camera for catalyst freezer 14. Door open/close indication - 84Z953/954 east. Similar west freezer 15. Floor grating and aisle promote air circulation for catalyst freezer 16. Hydrocarbon detector - 84A962 east. Similar west freezer 17. Line in catalyst freezer showing max stacking height 18. High temperature Alarm and local temperature indicator for catalyst freezer.	
	2. No fuel	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Fire Protection System 4. Fixed point monitor 5. Operating procedures/training	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Personal Protective Equipment	
		4. Loss of power to Catalyst Freezers	S	3	C	4	7. Reactor pressure/temperature indication	
		5. Loss of power to Catalyst Freezers -E	E	4	C	5	8. Automatic/Manual Emergency Kill 9. Beacon Light for catalyst freezers 10. Blowout door for catalyst freezer 11. Camera for catalyst freezer 12. Door open/close indication - 84Z953/954 east. Similar	

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	2. cont'd						12. cont'd west freezer 13. Floor grating and aisle promote air circulation for catalyst freezer 14. Hydrocarbon detector - 84A962 east. Similar west freezer 15. Line in catalyst freezer showing max stacking height 16. High temperature Alarm and local temperature indicator for catalyst freezer.	
	3. Transfer switch fails to switch	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Fire Protection System 4. Fixed point monitor 5. Operating procedures/training	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Personal Protective Equipment	
		4. Loss of power to Catalyst Freezers	S	3	C	4	7. Reactor pressure/temperature indication	
		5. Loss of power to Catalyst Freezers -E	S/E	4	C	5	8. Automatic/Manual Emergency Kill 9. Beacon Light for catalyst freezers 10. Blowout door for catalyst freezer 11. Camera for catalyst freezer 12. Door open/close indication - 84Z953/954 east. Similar west freezer 13. Floor grating and aisle promote air circulation for catalyst freezer 14. Hydrocarbon detector - 84A962 east. Similar west freezer 15. Line in catalyst freezer showing max stacking height 16. High temperature Alarm and local temperature indicator for catalyst freezer.	
	4. Generator Mechanical failure	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31 40
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Engine Block Heater 4. Fire Protection System 5. Fixed point monitor	

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	4. cont'd	3. Loss of power to seal oil pumps	S/E	4	C	5	6. Operating procedures/training	
		4. Loss of power to Catalyst Freezers	S	3	C	4	7. Personal Protective Equipment	
		5. Loss of power to Catalyst Freezers -E	E	4	C	5	8. Reactor pressure/temperature indication	
							9. Automatic/Manual Emergency Kill	
							10. Beacon Light for catalyst freezers	
							11. Blowout door for catalyst freezer	
							12. Camera for catalyst freezer	
							13. Door open/close indication - 84Z953/954 east. Similar west freezer	
							14. Floor grating and aisle promote air circulation for catalyst freezer	
							15. Hydrocarbon detector - 84A962 east. Similar west freezer	
							16. Line in catalyst freezer showing max stacking height	
							17. High temperature Alarm and local temperature indicator for catalyst freezer.	
	5. Generator not in auto	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	D	5	1. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	D	5	2. Fire Protection System	
		3. Loss of power to seal oil pumps	S/E	4	D	5	3. Fixed point monitor	
		4. Loss of power to Catalyst Freezers	S	3	D	5	4. Operating procedures/training	
		5. Loss of power to Catalyst Freezers -E	E	4	D	5	5. Personal Protective Equipment	
							6. Reactor pressure/temperature indication	
							7. Automatic/Manual Emergency Kill	
							8. Beacon Light for catalyst freezers	
							9. Blowout door for catalyst freezer	
							10. Camera for catalyst freezer	
							11. Door open/close indication - 84Z953/954 east. Similar west freezer	
							12. Floor grating and aisle promote air circulation for catalyst freezer	
							13. Hydrocarbon detector - 84A962 east. Similar west freezer	

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	5. cont'd						14. Line in catalyst freezer showing max stacking height 15. High temperature Alarm and local temperature indicator for catalyst freezer.	

Node: 59. Chlorine Ton Cylinder Backup Chlorination System at Water Plant.	
Type: Tank	Drawing:
Design Conditions/Parameters: Chlorine at ambient temperatures and pressures.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
59.1 Leak								
	1. Corrosion	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	3 4	D D	5 5	1. Chlorine "B" kit located at water plant 2. Emergency Response Procedures/Training	47 52 53
	2. Gasket or packing or valve seal failure	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	4 4	C D	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Personal Protective Equipment 3. Check packing on cylinder valves before use 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Use new washer every time cylinder is changed	47 52 53
	3. Fusible Plug blowout	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	2 4	D D	4 5	1. Personal Protective Equipment 2. Chlorine "B" kit located at water plant 3. Emergency Response Procedures/Training	47 52 53
	4. Vehicle collision with cylinder	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	2 4	D D	4 5	1. Chlorine "B" kit located at water plant 2. Emergency Response Procedures/Training	47 52 53 54

Node: 60. Chlorine supply line from chlorine container to ejector. Backup chlorination at Water Plant.	
Type: Line	Drawing:
Design Conditions/Parameters: Chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
60.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to water plant	S/E S/E	4 4	D D	5 5	1. Regular water plant checks 2. Daily visual checks	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction 2. Chlorine release	S/E S/E	4 4	D D	5 5	1. Screen on vent line	43 52
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to water plant 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to water plant	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular water plant checks 2. Daily visual checks 3. Drip leg heater 4. Operating Procedures/ Training for cylinder valve alignment 5. Buddy system when hooking and unhooking chlorine cylinders 6. Personal Protective Equipment	43 52
60.2 Low/No Flow								
	1. Blocked discharge	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks 2. Regular water plant checks	1
	2. Chlorine cylinder is empty	1. Loss of chlorine to water plant	S/E	4	B	5	1. Daily visual checks 2. Regular water plant checks 3. Spare chlorine cylinder	1
	3. High upstream pressure	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Regular water plant checks	1
	4. Plugged regulator inlet filter	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Regular water plant checks 3. Spare chlorine cylinder with regulator	1
	5. Ruptured/cracked line	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks 2. Regular water plant checks 3. Isolation valves	1
60.3 Leak								
	1. Corrosion	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders	43 52
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Use new washer every time cylinder is changed 3. Leak check cylinder connection with amonia every time cylinder is changed	43 52

Node: 60. Chlorine supply line from chlorine container to ejector. Backup chlorination at Water Plant.	
Type: Line	Drawing:
Design Conditions/Parameters: Chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
60.3 cont'd								
	2. cont'd						4. Check packing on cylinder valves before use	

VIII. List of Recommendations

A. Recommendations From Preliminary Hazard Review

- Evaluate need to replace corroded steam supply lines to propane vaporizers.

B. Recommendations From Past Incidents Review

- Consider use of excess flow valves on pressure gauges in VCM and Propane service to prevent large leaks of liquid or vapor in the event of pressure gauge failure. Also consider minimizing the number or pressure gauges in VCM/Propane service. Consider implementing an operating practice of keeping pressure gauge block valves closed except when reading the gauge.

- Consider developing a standard specification for pressure gauges in Propane and VCM service.

- Consider permanent stamping of blinds used for blanking.

C. Recommendations From Human Factors Review

- Audit all equipment, instrumentation, and process lines for necessary labeling.

- Consider requiring two operators on shift for start-up and continuous operation of propane system.

- Consider requiring a utility operator to remain with truck driver during unloading of propane.

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.

- 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, chlorine leak, etc.

D. Recommendations From Facility Siting Review cont.

- Investigate appropriateness of having chlorine containers inside building. See facility siting checklist.

- Consider installing a horn and light for propane at LEL of 20%.

- Consider PM of chlorine detection systems.

- Consider installing light and horn for chlorine at the Vinyl cooling tower chlorine station and at the back up chlorine station at the water plant.

- Consider relocating propane tank farm fence outside of Dow Fire & Explosion Index circle.

- Consider relocating propane truck unloading valve shut-off to a remote location.

- Consider developing map of Scott Air packs, shut off valves, fire equipment, safety systems, etc.

- Consider locating the automatic switchover for the water plant chlorinator on the chlorine cylinder instead of at a location off of the cylinder to prevent a chlorine leak under pressure in the tubing to the switchover valve.

- Consider a surveillance system for propane tank farm, VCM storage areas, and rail storage areas.

- Consider ways to discourage/prevent cropdusters and other low flying aircraft from flying over the storage areas of the plant.

- Consider restricting contractor traffic in the plant. Consider rerouting contractor traffic around the water plant instead of between the water plant and the control room.

- Consider relocating all spare equipment behind barn to area behind contractor yard to improve fire fighting access to propane tank farm area.

D. Recommendations From Facility Siting Review cont.

- Consider locating two Scott Air packs upstairs and two downstairs for boiler operator use in case of chlorine leak. Also consider locating the chlorine concentration indication in the control room.

- Consider checking glass on Control Room to determine if it is safety glass and consider replacing it if it isn't safety glass.

- Consider installing additional warning lights for chlorine leaks at more remote locations. Tie-in water plant and compound chlorine leak alarm to vinyl/compound control room.

- Consider PM of propane unloading valves to check functionality.

- Consider installing combustible gas indicators on the intake of the Emergency Generators to alarm or shut off generator in the event of a natural gas/VCM/propane leak.

- Evaluate the appropriate distance for storing kerosene and other materials incompatible with chlorine that are used at the Water Plant/Boiler House.

- Consider training all shift supervisors on chlorine/propane release/fire emergency handling.

- Consider relocating telephone/power lines on the South and West sides of the propane storage tanks to provide improved access for fire fighting.

- Consider periodic training of utility operators, utility supervisor, and shift supervisors on propane fire protection system.

- Consider marking propane storage area to indicate where hot work permits are required, entry, etc.

- Consider replacing corroded piping between the propane vaporizers and propane/air mixers.

E. Recommendations From Site Specific Hazards Review

- No site specific hazards were identified.

F. Recommendations Inadvertent Mixing Review

- Consider prohibiting storage of flammable materials in room next to chlorine cylinder room at the water plant.
- Evaluate the need for an Interaction Matrix for Propane.

G. Recommendations From MOCA Review

- Consider reducing the number of backup chlorine cylinders at the water plant to one. The MOCA requested one backup chlorine cylinder.

H. Recommendations From Safety Audits Review

- Include inadvertent mixing in PHA review.
- Consider making annual propane inspection reports available for HAZOP team review. An annual inspection is performed but reports are not readily available.

Recommendations	RX	Related Drawings
8. Evaluate need to replace old corroded steam supply lines to propane vaporizers. (No Linked Items)	0	
6. Evaluate need for emergency isolation valves on discharge of each propane storage tank. (See: 3.2.1, 3.4.2,3,4)	4	BP-090100-PID-D, 09/19/02
11. Evaluate the need for a low oil pressure alarm, high water temperature alarm, or low water pressure alarm that may give operators time to avoid an instrument air compressor shutdown. (See: 17.1.1)	4	UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02
12. Evaluate need for developing program to annually inventory all chlorine leak response equipment. (See: 40.1.2, 43.1.2)	4	(OP) UT-CT-003, 09/29/99, (OP) UT-WP-017, 07/20/00, (OP) UT-WP-018, 07/20/00
13. Evaluate need for annual chlorine A & B kit usage training for Utility Operators and Shift Supervisors (See: 40.1.1, 43.1.1)	4	(OP) UT-CT-003, 09/29/99, (OP) UT-WP-017, 07/20/00, (OP) UT-WP-018, 07/20/00
14. Consider installing deluge protection for propane delivery truck. (See: 1.1.4, 1.5.3)	4	BP-090100-PID-D, 09/19/02
15. Consider additional safeguards to reduce severity of fire/explosion at the propane storage tanks. (See: 3.1.1, 3.2.1, 3.5.1)	4	BP-090100-PID-D, 09/19/02
16. Consider fireproofing saddles for the propane storage tanks. (See: 3.1.1, 3.2.1, 3.5. 1)	4	BP-090100-PID-D, 09/19/02
30. Evaluate installation of remote start switches for the emergency generator, emergency cooling water pump, and CP-708 & CP-709 air compressor with remote run indication. (See: 17.1.1)	4	UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02
31. Consider providing an additional emergency source of air to operate critical valves in vinyl such as the reactor recovery valves and main charge and dump valves. (See: 17.1.1,3, 57.1.1,2,3,4,5)	4	GP-9721-62-6D,08/23/83, MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02
32. Consider regular PM of CP-708 & CP-709 Compressor instruments (See: 17.1.1,3)	4	UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02
40. Recommend audit of the catalyst material rotation practice to ensure that the procedure is sufficient in keeping material rotated in the walk-in freezers. (See: 57. 1.4)	4	GP-9721-62-6D,08/23/83, MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94
41. Consider regular PM of chlorine area monitors and alarms. (See: 35.1.4, 36.1.4, 38. 1.1,2, 39.1.1,2, 41.1.1,2, 42.1.1,2, 53.1.4)	4	(OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99, (OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00, UT-090117-PID-D, 10/10/02, UT-090123-PID-D, 10/23/02, WP-090106-PID-D, 09/26/02
42. Consider installing a light and horn to the chlorine area monitor at the Vinyl chlorination station to alert local traffic of a chlorine leak/release. (See: 35.1.3,4, 35. 3.1,2, 38.1.1,2, 39.1.1,2, 45.1.1,2,3, 53.1.3,4, 53.3.1,2)	4	(OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99, UT-090117-PID-D, 10/10/02, UT-090123-PID-D, 10/23/02
43. Consider periodic PM of chlorine valves, regulator, tubing, rotameters, and ejectors including periodic replacement as appropriate. (See: 35.1.1,2,3, 35.3.1,2, 36.1.1,2, 3, 36.3.1,2, 38.1.1,2, 39.1.1,2, 53.1.1,2,3, 53.3.1,2, 60.1.1,2,3, 60.3.1,2)	4	(OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99, UT-090117-PID-D, 10/10/02, UT-090123-PID-D, 10/23/02, WP-090106-PID-D, 09/26/02
44. Consider tying local chlorine area alarm into compound control room. (See: 52.1.1, 2,3, 53.1.3,4)	4	UT-090123-PID-D, 10/23/02
45. Consider tying in water plant chlorine area alarm to the vinyl control room. (See: 36. 1.3,4, 36.3.1,2,3, 37.1.1,2,3, 41.1.1,2, 42.1.1,2)	4	(OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00, WP-090106-PID-D, 09/26/02
46. Consider installing signs and additional flashing lights to stop traffic from driving by the chlorine room when chlorine area alarm is on - as indicated by the flashing light. Also consider using flashing light when unloading chlorine trucks. (See: 36.1.3,4,	4	(OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00, WP-090106-PID-D, 09/26/02

Recommendations	RX	Related Drawings
46. cont'd 36.3.1,2,3, 37.1.1,2,3, 41.1.1,2, 42.1.1,2)		
47. Consider annual chlorine emergency response training for utility operators, utility supervisor, and compound and vinyl shift supervisors. Also annual employee/ contractor training as to hazards, warnings, and evacuation procedures for chlorine release. (See: 37.1.1,2,3, 40.1.1, 43.1.1, 45.1.1,2,3, 52.1.1,2,3, 59.1.1,2,3,4)	4	(OP) UT-CT-003, 09/29/99, (OP) UT-WP-017, 07/20/00, (OP) UT-WP-018, 07/20/00, UT-090117-PID-D, 10/10/02, UT-090123-PID-D, 10/23/02, WP-090106-PID-D, 09/26/02
52. Consider installing a chlorine leak detection and alarm at backup chlorination area at water plant. (See: 59.1.1,2,3,4, 60.1.2,3, 60.3.1,2)	4	
53. Consider installing a cover or building over the backup chlorine cylinders to protect from direct sunlight and dampness. (See: 59.1.1,2,3,4)	4	
54. Consider installing more substantial vehicle barriers to protect backup chlorine cylinders at the water plant from vehicle damage. (See: 59.1.4)	4	
1. None (See: 1.1.3, 1.2.1,2, 1.3.1, 1.4.1,2,3, 1.5.1,2, 2.2.1,2,3, 2.4.1,2,3, 4.2.1,2, 4.3.1,2,3,4,5, 4.4.1,2,3,4,5,6, 4.5.1,2,3,4, 5.2.1,2,3,4,5, 6.1.1,3,4, 6.2.1, 6.3.1,2, 6.4.1,2, 7.1.1,2,3, 7.2.1,2, 8.1.1,2, 8.2.2,3,4, 8.3.1,2,3, 9.1.2,3,4, 9.3.1,2, 9.4.1,2, 10.1.1,2, 10.2.1,2,3, 11.1.1,2,3, 11.2.1,2,3,4, 12.1.1,2,4, 12.2.1,2,4, 13.1.1,2,4, 14.1.1,2,4, 17.1.2,4, 17.2.1,2,3, 18.1.2,3,4,5, 18.2.1,2, 19.1.1,2, 19.2.1,2, 20.1.1,2,3,4,5, 21.1.1,2, 21.2.1,2, 22.1.1, 22.2.1,2, 22.3.2, 23.1.1,2,3, 23.3.1,2, 24.1.1,2, 24.2.1,2, 25.1.1,2, 25.3.1,2,3,4,5, 26.2.1,2, 27.1.1,3, 28.1.1,3, 29.1.1,2,3, 30.1.1,2,3,4, 31.1.1,2, 31.2.1,2,3,4,5, 31.3.1,2,3, 31.4.1, 32.1.1,2, 32.2.1,2,3,4,5, 32.3.1,2,3, 32.4.1, 33.1.1,2, 33.2.1,2,3,4,5, 33.3.1,2,3, 33.4.1, 34.1.1,2,3,4, 35.2.1,2,3,4,5, 36.2.1,2,3,4,5, 44.2.1,2, 48.1.2,3, 48.2.1,2, 49.1.1,2,3,4,5,6,7, 50.1.1,2, 50.2.1,2,3,4,5, 50.3.1,2,3, 50.4.1, 51.1.1,2,3,4,5, 53.2.1,2,3,4,5, 54.1.1,2,3,4, 55.1.1,2,3,4, 56.1.1, 58.1.1,3,4, 58.2.1,2,3, 60.2.1,2,3,4,5)	5	(OP) UT-AS-001, 05/29/02, (OP) UT-AS-009, 07/26/00, (OP) UT-PR-001, 08/09/00, (OP) UT-PR-002, 08/09/00, (OP) UT-PR-003, 08/09/00, (OP) UT-PR-004, 08/09/00, (OP) VINYL-NM-E008, 05/01/99, (OP) VINYL-NM-E013, 04/27/99, (OP) VINYL-NM-N475, 08/31/00, (OP) VINYL-OM-E007, 05/01/99, (OP) VINYL-OM-E008, 05/01/99, BP-090100-PID-D, 09/19/02, BP-090101-PID-D, 12/11/02, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92, UT-090102-PID-D, 2/25/94, UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02, UT-090109A-PID-D, 10/15/02, UT-090111-PID-D, 09/26/02, UT-090112-PID-D, 12/11/02, UT-090113-PID-D, 12/11/02, UT-090114-PID-D, 12/11/02, UT-090115-PID-D, 10/09/02, UT-090117-PID-D, 10/10/02, UT-090122-PID-D, 12/11/02, UT-090123-PID-D, 10/23/02, WP-090106-PID-D, 09/26/02
2. Consider safeguards for blocked in thermal expansion. (See: 1.1.2, 2.1.6)	5	(OP) UT-PR-001, 08/09/00, BP-090100-PID-D, 09/19/02
3. Evaluate sizing basis and calculations for propane pump relief valve as well as basis for set pressure. Consider lowering set pressure to be less than or equal to vaporizer MAWP. (See: 2.1.1,2,3,4,5,6, 4.1.1,2,3,4)	5	(OP) UT-PR-001, 08/09/00, BP-090100-PID-D, 09/19/02, BP-090101-PID-D, 12/11/02
4. Consider LEL activated shutdown of propane transfer pumps and actuated block valves. (See: 2.1.1,2,3,4,5,6, 2.3.1,2,3,4,5, 2.5.1,2,3,4,5, 3.1.2,3,4,5)	5	(OP) UT-PR-001, 08/09/00, BP-090100-PID-D, 09/19/02
5. Consider high pressure shutdown of unloading valves and transfer pumps and valves. (See: 3.1.2,3,4,5, 3.3.2)	5	BP-090100-PID-D, 09/19/02
7. Consider placing a rain protection cover over the propane storage tank relief valve outlet stack to reduce the potential for plugging the stack during freezing weather (See: 3.1.5, 3.5.2,3,4)	5	BP-090100-PID-D, 09/19/02
9. Evaluate unloading procedures and safeguards to prevent unloading liquid propane into the propane surge tank, the vent line, or the flare through the surge/storage tank vent line. (See: 9.3.3, 11.3.1)	5	(OP) UT-PR-001, 08/09/00, (OP) UT-PR-004, 08/09/00, BP-090100-PID-D, 09/19/02, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92
10. Evaluate need to better label equipment, instrumentation, and process lines in all utilities areas. (See: 12.1.3, 12.2.3, 13.1.3, 14.1.3)	5	(OP) UT-PR-002, 08/09/00, (OP) UT-PR-003, 08/09/00

Recommendations	RX	Related Drawings
17. Evaluate current technology of propane storage tank level gauging devices with continuous level indication and high level alarm capability to replace existing gauging devices (See: 3.3.1,2,3)	5	BP-090100-PID-D, 09/19/02
18. Evaluate requiring operator to double verify valve line up for unloading. (See: 3.3.2)	5	BP-090100-PID-D, 09/19/02
19. Evaluate sizing basis for Vaporizer relief valve including the basis for blocked in vaporizer with the propane transfer pump running. (See: 4.1.1,2,4)	5	(OP) UT-PR-001, 08/09/00, BP-090101-PID-D, 12/11/02
20. Consider installing a pressure controller just upstream of the pressure tap for PIC 2706 that will control the pressure and flow to the vaporizers to 125 psig when the pressure in the storage tanks exceed 125 psig. (See: 4.3.6)	5	(OP) UT-PR-001, 08/09/00, BP-090101-PID-D, 12/11/02
21. Consider relocating the relief valve protecting the vaporizer steam tube to a location upstream of the tube bundle. (See: 5.1.1,2,3,4)	5	(OP) UT-PR-001, 08/09/00, BP-090101-PID-D, 12/11/02
22. Evaluate set up to determine if the vaporizer steam system is consistent with vaporizer manufacturer's recommendations and if high propane pressure in the absence of steam is a problem. (See: 6.1.2)	5	(OP) UT-PR-001, 08/09/00, BP-090101-PID-D, 12/11/02
23. Consider establishing a PM on inlet air filter for Propane/Air Mix Cabinet Inlet Air Filter. (See: 8.2.1)	5	(OP) UT-PR-001, 08/09/00, BP-090102-PID-D, 12/11/02
24. Consider installing a flame arrester on the propane surge tank relief header to prevent flash back during a relief condition with the flare lit. Or consider relocating the surge tank relief header stack to a location other than next to the flare stack. (See: 9.1.1)	5	(OP) UT-PR-001, 08/09/00, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92
25. Consider fireproofing the supports for the propane surge tanks (See: 9.2.1,2)	5	(OP) UT-PR-001, 08/09/00, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92
26. Consider marking area where propane lines run underground or restricting traffic in the area. (See: 10.2.4)	5	(OP) UT-PR-001, 08/09/00, (OP) UT-PR-002, 08/09/00, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92, UT-090102-PID-D, 2/25/94
27. Consider changing the pump run interlock to include a shutdown interlock when any one of the actuated block valves loses an open indication. (See: 2.1.3)	5	(OP) UT-PR-001, 08/09/00, BP-090100-PID-D, 09/19/02
28. Evaluate adding instructions for manually setting off the deluge when a fire is observed or a vapor release is identified. (See: 15.1.1,2)	5	(OP) UT-PR-006, 08/09/00
29. Evaluate section 2 of UT-PR-006 for appropriate action. Should the manual valves under the propane storage tank be left open when the propane system is not in use to prevent thermal expansion of blocked in propane. (See: 16.1.1,2)	5	(OP) UT-PR-006, 08/09/00
33. Consider leaving the header valves on the #6 cooling supply and return header to CP-708&CP-709 OPEN for use during an emergency or consider installing a chain operator for the header valves with PM lubrication of chain operator. (See: 18.1.1, 48.1.1)	5	UT-090109-PID-D, 12/11/02, UT-090113-PID-D, 12/11/02, UT-090115-PID-D, 10/09/02
34. Consider regular PM of instrument air coolers (See: 19.3.1)	5	UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02, UT-090109A-PID-D, 10/15/02
35. Consider providing a DCS/boilerhouse alarm for Airtek malfunction (See: 22.3.1)	5	UT-090109A-PID-D, 10/15/02
36. Consider installing air line filter / moisture trap upstream of critical control valves. (See: 23.2.1,2, 25.2.1,2)	5	UT-090109-PID-D, 12/11/02, UT-090109A-PID-D, 10/15/02, UT-090111-PID-D, 09/26/02
37. Consider checking DM-300 and DM-810 for water on some regular basis. (See: 26.1.1,2, 44.1.1,2)	5	UT-090111-PID-D, 09/26/02

Recommendations	RX	Related Drawings
38. Consider performing a lighting survey to determine if additional lights need to be installed. Consider encouraging operator to report lights that are not working and tag them for repair. (See: 27.1.2, 28.1.2)	5	(OP) UT-AS-001, 05/29/02
39. Determine source of emergency cooling water. P&ID shows that it is coming from process water loop. Procedure indicates that it is deluge water. Correct P&ID or procedure. (See: 46.1.1,2,3, 47.1.1,2,3)	5	(OP) VINYL-NM-E008, 05/01/99, (OP) VINYL-OM-E008, 05/01/99, UT-090112-PID-D, 12/11/02, UT-090113-PID-D, 12/11/02
48. Review current code requirements for propane liquid unloading line pressure ratings and determine if changes to line pressure class or pressure relief is warranted. (See: 1.1.1)	5	BP-090100-PID-D, 09/19/02
49. Determine the high pressure shutoff for the propane mixers - UT-PR-001 indicates 8.5 psi NE-D606-57-4-D indicates 9.5 psi. Update procedures or drawing as appropriate. (See: 9.1.1)	5	(OP) UT-PR-001, 08/09/00, BP-090102-PID-D, 12/11/02, NE-D606-57-4-D, 06/29/92
50. Consider placing all chlorine containers in an enclosure or consider installing additional chlorine area monitors at different wind directions where chlorine cylinders are located . (See: 38.1.1,2, 39.1.1,2, 41.1.1,2, 42.1.1,2)	5	(OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99, (OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00
51. Document loop information on pressure switch and actuted valve on Instrument Air Line from the West Joy at DM-175. (See: 58.1.2)	5	UT-090108-PID-D, 12/11/02, UT-090109-PID-D, 12/11/02

IX. Items Needing Further Review

- Relief valve discharge from the propane surge tanks are run along and discharge near the propane flare. The relief valve discharge line does not have a flame arrester on it.

- Update equipment files and P&ID with propane vaporizer information .

- PSV-PR-0035 is set at 375 psig. The A2-1 specification maximum pressure limit is 285 psig @ 100 F.

- Re-label FIC-2706 to PIC-2706 to match P&ID and operating procedures.

- Consider including steps for the lighting the propane flare in the appropriate propane system procedure.

- Determine the propane mixer shut off pressure and update the documentation. UT-PR-XXX indicates 8.5 psig and NE-D606-57-4-D indicates 9.5 psig.

- Determine if an adequate amount of firewater can be supplied to the Propane Tank Farm area with the existing equipment. The Firewater Hydraulic Analysis dated August 1998 (Rev. 1) indicates that the maximum flow rate achievable with existing equipment is 1200 gpm at 100 psig. The Class "A" Design for the Propane Deluge System dated October 13, 1988 indicates that 2267 gpm is required.

- Consider installing automatic switchover for #2A cooling tower pumps or consider leaving Lukenheimer valve slightly open. Consider remote ON/OFF for the #2A cooling tower pumps and pump run indication/alarm.

- Consider developing a procedure for V-11 standby generator.

- Consider including in UT-CT-001 a reference to the PSM procedure that states the maximum intended inventory of chlorine in the plant.

- Update procedures which reference the location of the Chlorine "B" kits. The chlorine "B" kits are currently located at the boilerhouse and the ERT team cart.

- Evaluate the appropriate size of the relief valve for DM-175 and verify that the correct size is installed.

- Consider improving the documentation of recommendation evaluation and action to allow future HAZOP teams to know not only that the recommendation was addressed, but what was done.

- Consider revising procedure UT-CT-001 to include Cooling Tower #7.

- Determine the relief valve sizing basis for relief valves where documentation is not available and determine if the installed valve is adequate.
- Determine the appropriate status for the valves downstream of the propane transfer pump relief valves.
- Evaluate the piping components on the propane transfer line to the propane vaporizers to determine if they are consistent with the B2-1 specification and/or the propane transfer pump relief valve setting.
- Determine the source of emergency cooling water and update the P&ID's as appropriate.
- Update procedure UT-AS-001 and UT-AS-009 to reflect aftercooler change.
- Update the P&ID's to include the Backup chlorination system at the water plant.
- Evaluate the condition of the storage location for the 150# cylinders to determine if it is appropriate for chlorine storage.

APPENDIX A

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix A. Marked Up P&ID's

(OP) UT-AS-001, 05/29/02 (See: 27, 28)

(OP) UT-AS-009, 07/26/00 (See: 29, 30)

(OP) UT-CT-001, 09/29/99 (See: 38, 39)

(OP) UT-CT-002, 09/29/99 (See: 38, 39)

(OP) UT-CT-003, 09/29/99 (See: 40)

(OP) UT-PR-001, 08/09/00 (See: 2, 4, 5, 6, 7, 8, 9, 10)

(OP) UT-PR-002, 08/09/00 (See: 10, 12, 13)

(OP) UT-PR-003, 08/09/00 (See: 14)

(OP) UT-PR-004, 08/09/00 (See: 11)

(OP) UT-PR-006, 08/09/00 (See: 15, 16)

(OP) UT-WP-002, 07/20/00 (See: 41, 42)

(OP) UT-WP-003, 08/09/00 (See: 41, 42)

(OP) UT-WP-017, 07/20/00 (See: 43)

(OP) UT-WP-018, 07/20/00 (See: 43)

(OP) VINYL-NM-E008, 05/01/99 (See: 34, 47)

(OP) VINYL-NM-E013, 04/27/99 (See: 55)

(OP) VINYL-NM-N475, 08/31/00 (See: 56)

(OP) VINYL-OM-E007, 05/01/99 (See: 54)

(OP) VINYL-OM-E008, 05/01/99 (See: 34, 46)

BP-090100-PID-D, 09/19/02 (See: 1, 2, 3, 11)

BP-090101-PID-D, 12/11/02 (See: 4, 5, 6)

BP-090102-PID-D, 12/11/02 (See: 7, 8, 9, 10, 11)

GP-9721-62-6D,08/23/83 (See: 57)

MCC10A1-E-EL-D, 10/28/02 (See: 57)

MCC10A1-E1-EL-D, 08/24/94 (See: 57)

NE-D606-57-4-D, 06/29/92 (See: 9, 10)

UT-090102-PID-D, 2/25/94 (See: 10)

UT-090108-PID-D, 12/11/02 (See: 17, 19, 20, 21, 58)

UT-090109-PID-D, 12/11/02 (See: 17, 18, 19, 21, 23, 24, 58)

UT-090109A-PID-D, 10/15/02 (See: 19, 22, 23)

UT-090111-PID-D, 09/26/02 (See: 25, 26, 44)

UT-090112-PID-D, 12/11/02 (See: 31, 46)

UT-090113-PID-D, 12/11/02 (See: 32, 47, 48)

UT-090114-PID-D, 12/11/02 (See: 20, 33, 49)

UT-090115-PID-D, 10/09/02 (See: 20, 48, 49)

UT-090117-PID-D, 10/10/02 (See: 35, 45)

UT-090122-PID-D, 12/11/02 (See: 50, 51)

UT-090123-PID-D, 10/23/02 (See: 52, 53)

WP-090106-PID-D, 09/26/02 (See: 36, 37)

ABD00031376

PV-029/PV-030
PROPANE STORAGE TANK

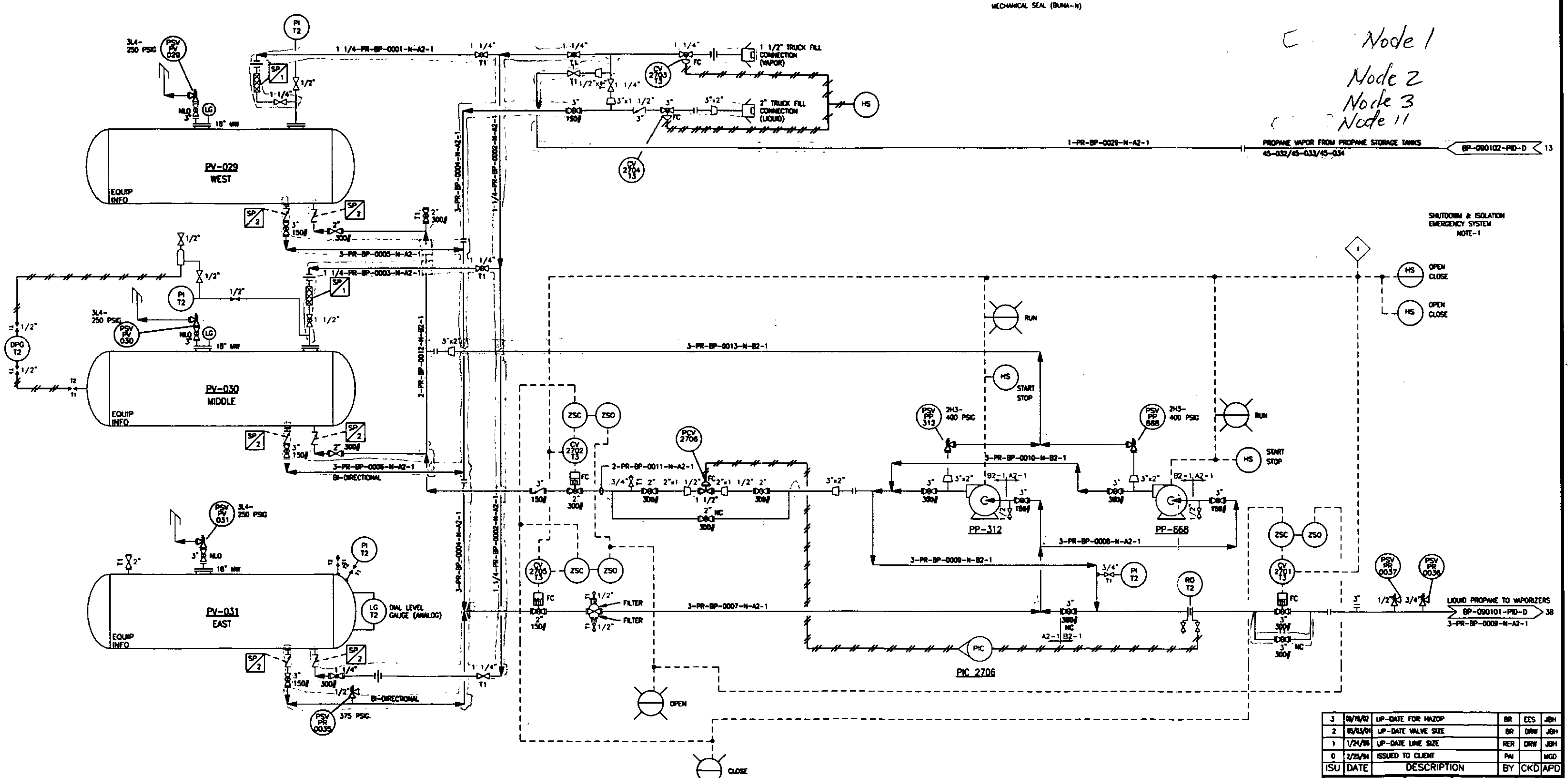
10'-3 9/16"x49'-11 1/2" SS
MAWP=250 PSIG @ 650°F
MOC:SA212-B

PV-031
PROPANE STORAGE TANK

96.824"OD X 50'-6 3/4"E/E
MAWP=250 PSIG @ 650°F
MOC:A212-B SHELL/CASE10568 HEADS

PP-312/PP-868
PROPANE TRANSFER PUMPS

3X3 SLIDING VANE
MOC:DI
PRESS.: 75 PSIG.
FLOW: 80GPM
MECHANICAL SEAL (BUNA-N)



LEGEND

SP/1 – 1 1/2" SS FLEX HOSE

SP/2 – EXCESS FLOW CHECK VALVE

NOTE

1-SEE DWG. ME-D667-57-3-D FOR DETAILS.

ISU	DATE	DESCRIPTION	BY	CKD	APD
3	09/19/02	UP-DATE FOR HAZOP	BR	EES	JBH
2	10/03/01	UP-DATE VALVE SIZE	BR	DRW	JBH
1	1/24/96	UP-DATE LINE SIZE	RER	DRW	JBH
0	2/25/94	ISSUED TO CLIENT	PW		MCD

APPD:
DATE:
SCALE NONE
LOCATION CODE
AREA

Georgia Gulf Chemical & Vinyls LLC
ABERDEEN PLANT
ABERDEEN, MS

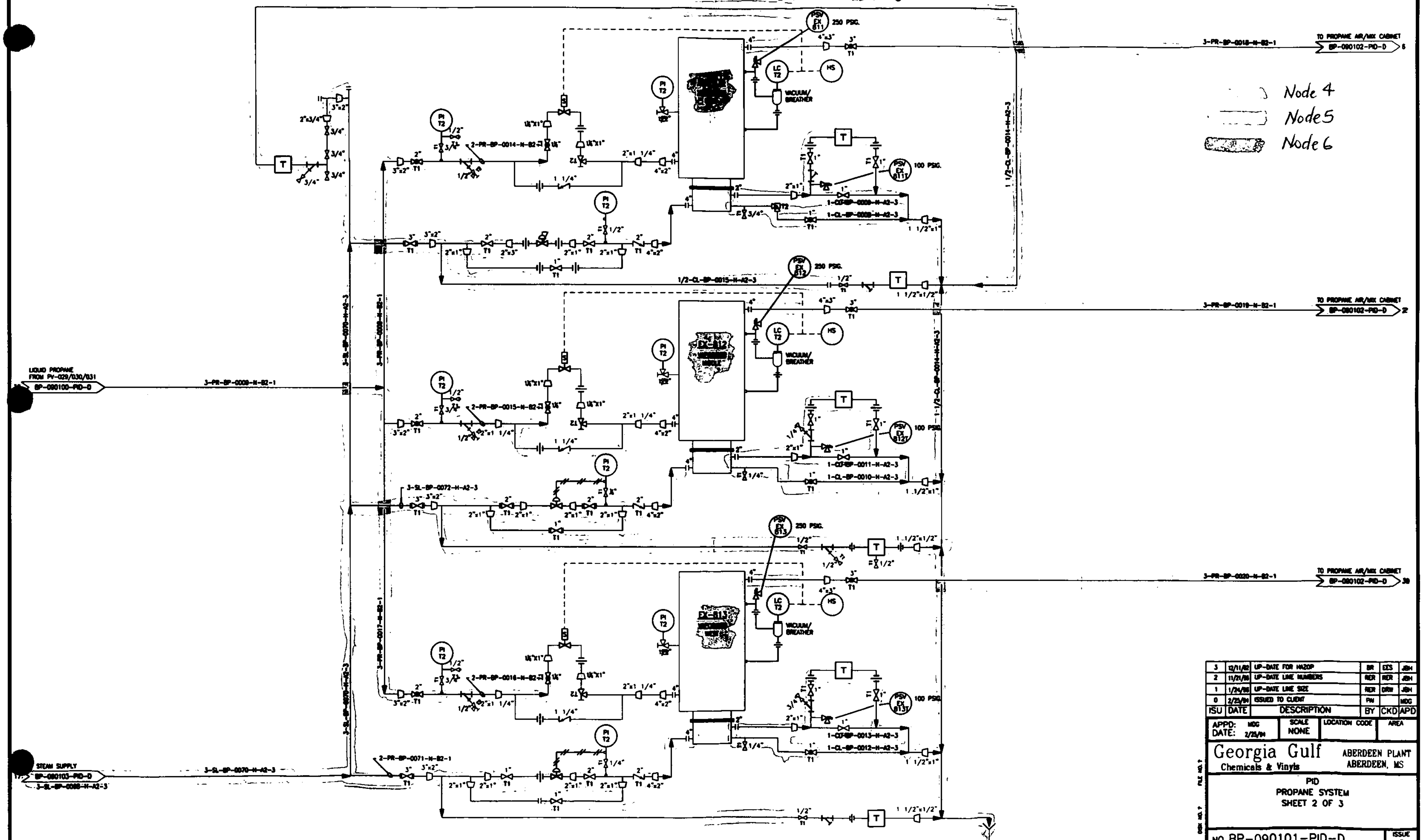
PID
PROPANE SYSTEM
SHEET 1 OF 3

FILE NO.?
DISK NO.?

NO. BP-090100-PID-D
ISSUE 3

EX-811/EX-812/EX-813
VAPORIZERS

TUBESIDE DP 101 PSIG @ ~~400F~~ 400F
SHELLSIDE DP 250 PSIG @ ~~400F~~ 400F



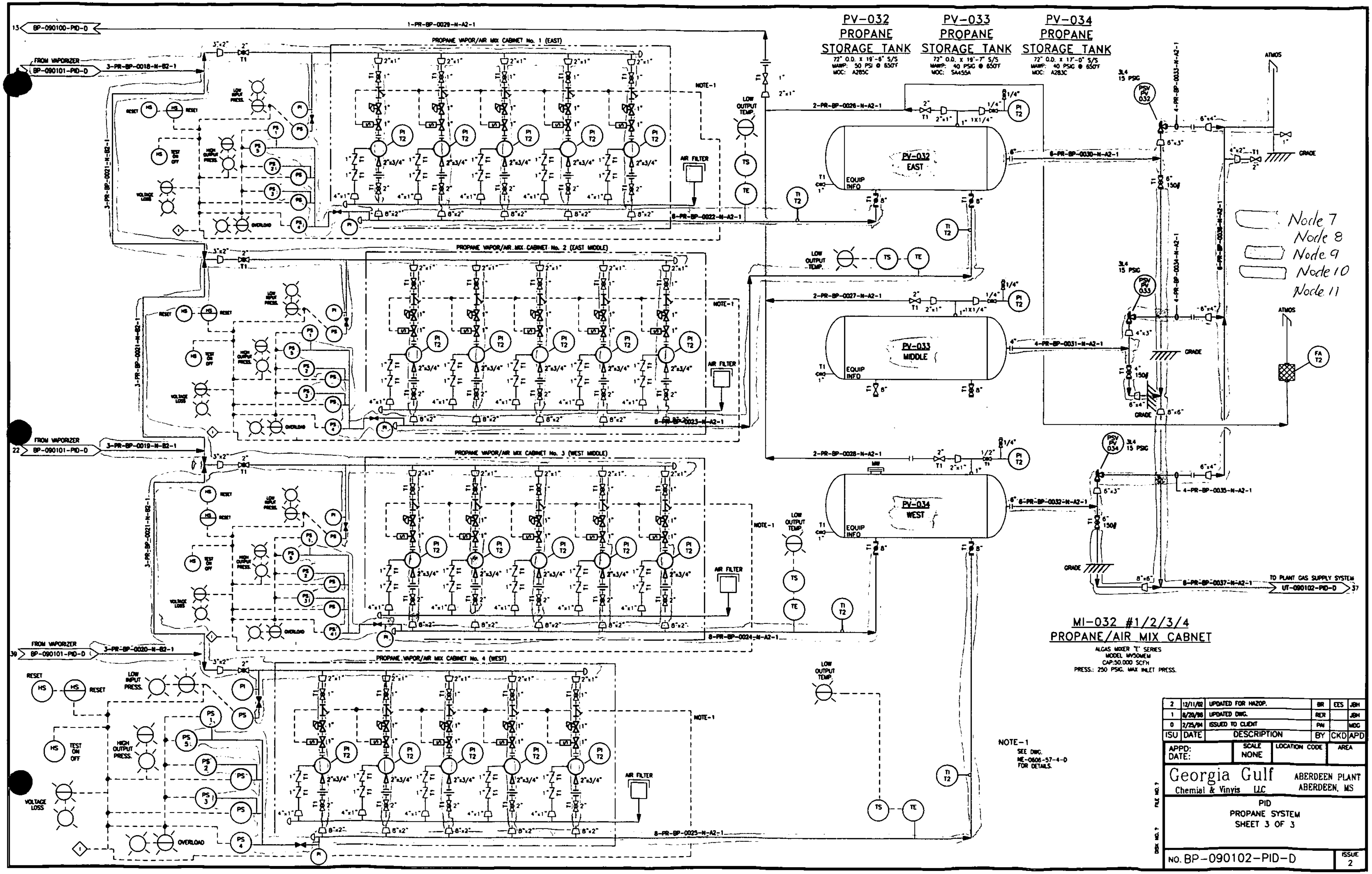
3	12/11/02	UP-DATE FOR HAZOP	BR	EES	JBH
2	11/21/00	UP-DATE LINE NUMBERS	RDR	RDR	JBH
1	1/24/00	UP-DATE LINE SIZE	RDR	DRW	JBH
0	2/25/94	ISSUED TO CLIENT	PW		MDG
ISU	DATE	DESCRIPTION	BY	CKD	APD

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

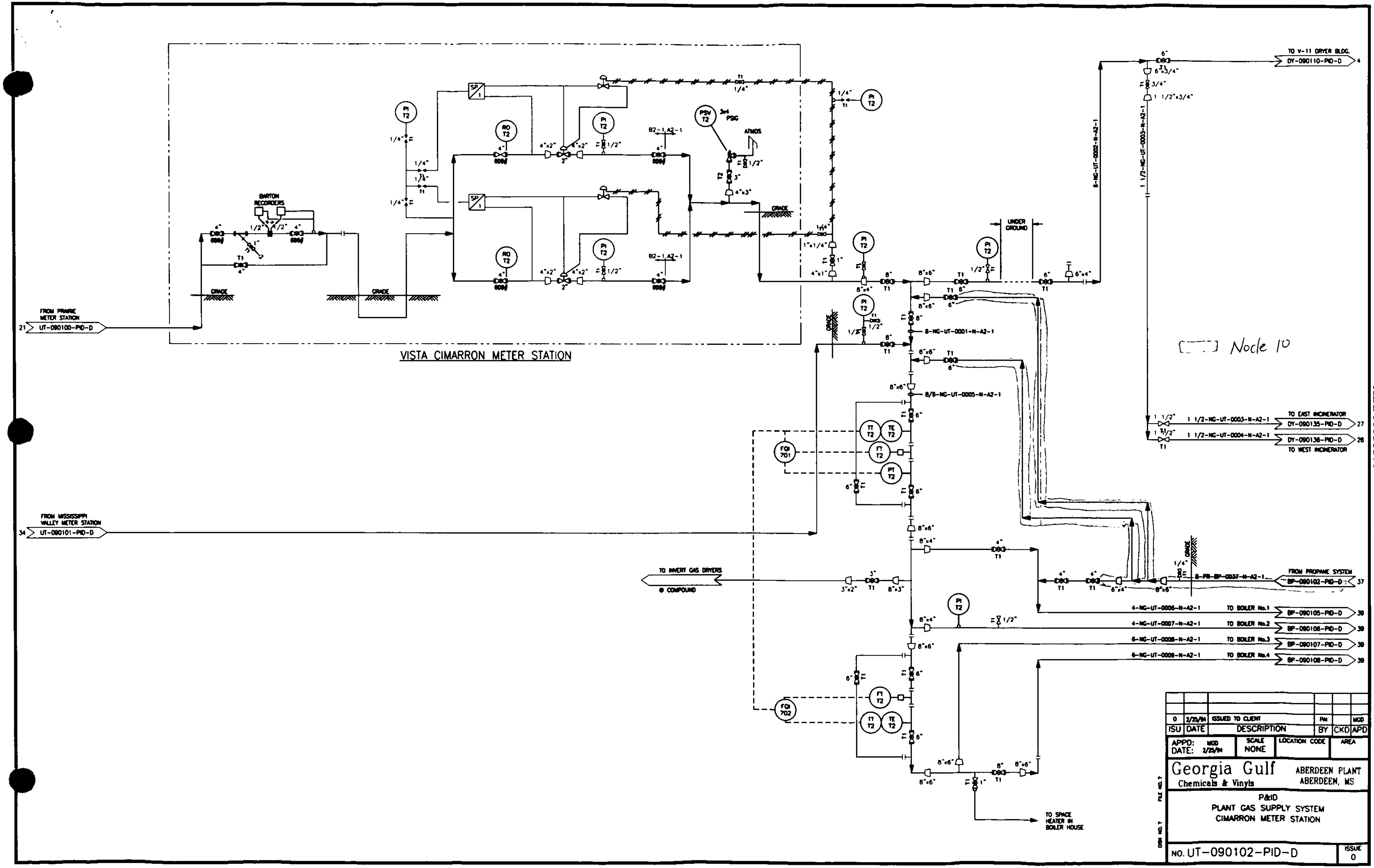
Georgia Gulf Chemicals & Vinyls — ABERDEEN PLANT ABERDEEN, MS

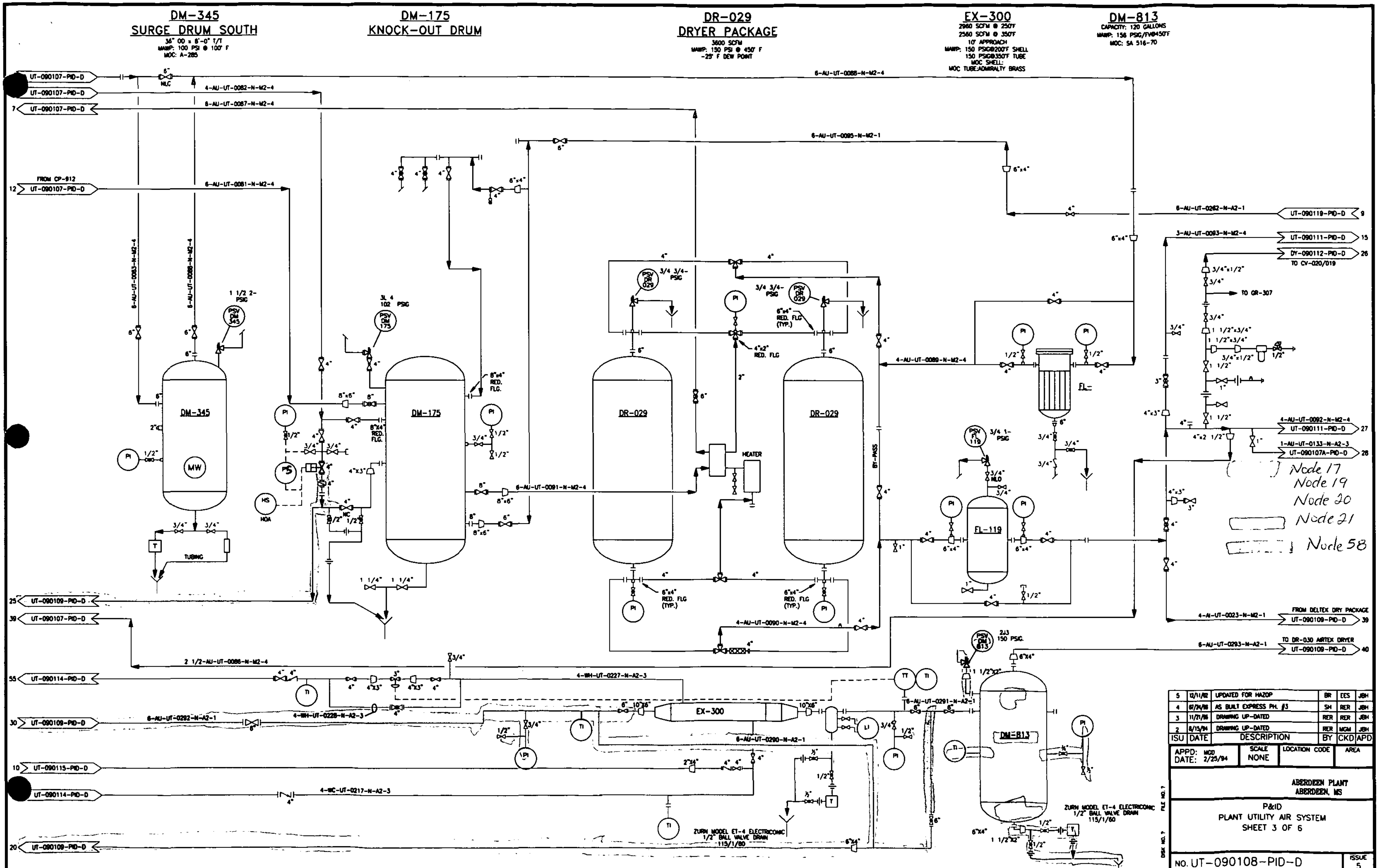
PID
PROPANE SYSTEM
SHEET 2 OF 3

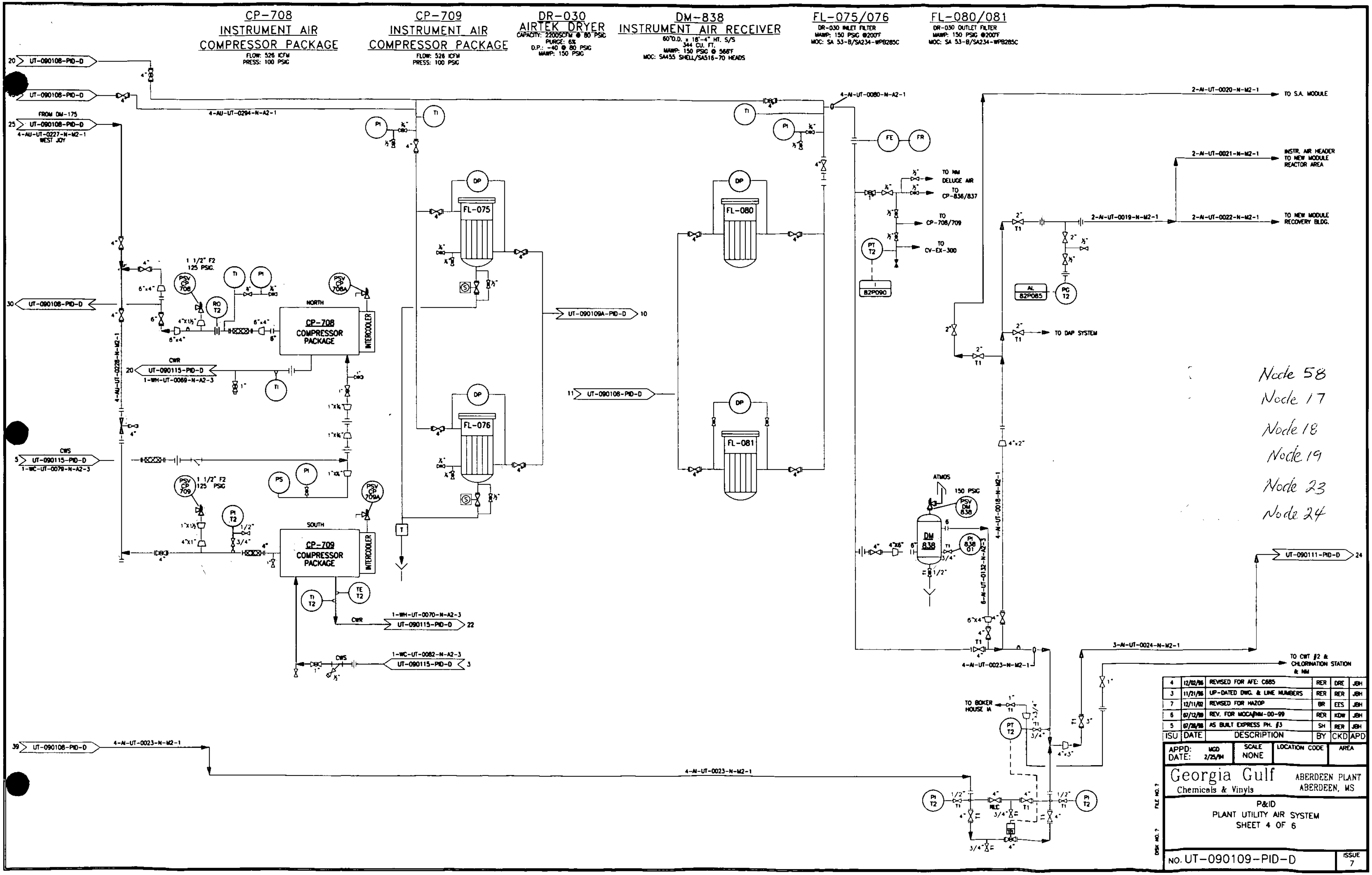
NO. BP-090101-PID-D — ISSUE 3



ABD00031378


VISTA CIMARRON METER STATION
FROM PRAIRIE METER STATION
21 UT-090100-PID-D
FROM MISSISSIPPI VALLEY METER STATION
34 UT-090101-PID-D
BARTON RECORDERS
GRADE
ATMOS
UNDER GROUND
TO V-11 DRYER BLDG.
DY-090110-PID-D 4
6-NG-UT-0002-N-A2-1
1 1/2-NG-UT-0003-N-A2-1
1 1/2-NG-UT-0004-N-A2-1
TO EAST INCINERATOR
DY-090135-PID-D 27
DY-090136-PID-D 28
TO WEST INCINERATOR
8-NG-UT-0001-N-A2-1
8/6-NG-UT-0005-N-A2-1
Node 10
TO INVERT GAS DRYERS
@ COMPOUND
FROM PROPANE SYSTEM
8-PR-BP-0037-N-A2-1
BP-090102-PID-D 37
4-NG-UT-0006-N-A2-1
TO BOILER No.1
BP-090105-PID-D 39
4-NG-UT-0007-N-A2-1
TO BOILER No.2
BP-090106-PID-D 39
6-NG-UT-0008-N-A2-1
TO BOILER No.3
BP-090107-PID-D 39
6-NG-UT-0009-N-A2-1
TO BOILER No.4
BP-090108-PID-D 39
TO SPACE HEATER IN BOILER HOUSE
FQI 701
FQI 702
0 2/25/94 ISSUED TO CLIENT PW MGD
ISU DATE DESCRIPTION BY CKD APD
APPD: MGD
DATE: 2/25/94
SCALE NONE
LOCATION CODE
AREA
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT GAS SUPPLY SYSTEM
CIMARRON METER STATION
NO. UT-090102-PID-D
ISSUE 0


DM-345
SURGE DRUM SOUTH
36" OD x 8'-0" T/T
MAWP: 100 PSI @ 100° F
MOC: A-285
DM-175
KNOCK-OUT DRUM
DR-029
DRYER PACKAGE
3600 SCFM
MAWP: 150 PSI @ 450° F
-25° F DEW POINT
EX-300
2960 SCFM @ 250°F
2560 SCFM @ 350°F
10° APPROACH
MAWP: 150 PSIG@200°F SHELL
150 PSIG@350°F TUBE
MOC SHELL:
MOC TUBE:ADMIRALTY BRASS
DM-813
CAPACITY: 120 GALLONS
MAWP: 156 PSIG/FV@450°F
MOC: SA 516-70
FROM CP-912
FROM DELTEX DRY PACKAGE
TO DR-030 AIRTEX DRYER
TO CV-020/019
TO GR-307
HEATER
BY-PASS
TUBING
ZURN MODEL ET-4 ELECTRICONIC 1/2" BALL VALVE DRAIN 115/1/60
Node 17
Node 19
Node 20
Node 21
Node 58
5 | 12/1/02 | UPDATED FOR HAZOP | BR | EES | JBH
4 | 07/24/98 | AS BUILT EXPRESS PH. #3 | SH | RER | JBH
3 | 11/21/96 | DRAWING UP-DATED | RER | RER | JBH
2 | 8/15/94 | DRAWING UP-DATED | RER | MGM | JBH
ISU | DATE | DESCRIPTION | BY | CKD | APD
APPD: MGD
DATE: 2/25/94
SCALE NONE
LOCATION CODE
AREA
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT UTILITY AIR SYSTEM
SHEET 3 OF 6
NO. UT-090108-PID-D
ISSUE 5



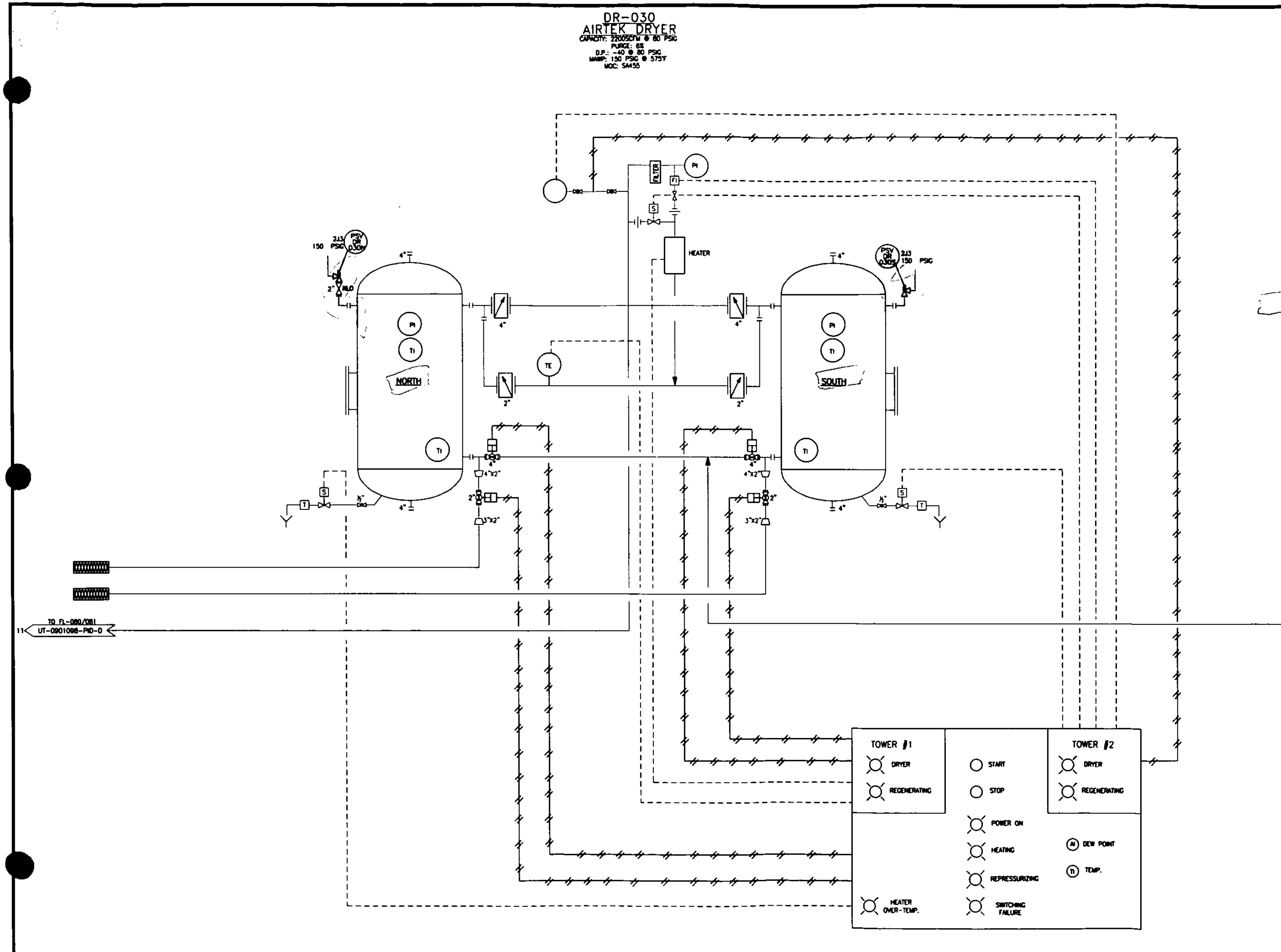
4	12/02/86	REVISED FOR AFE: C685	RER	DRE	JBH
3	11/21/86	UP-DATED DWG. & LINE NUMBERS	RER	RER	JBH
7	12/11/02	REVISED FOR HAZOP	BR	EES	JBH
6	07/12/99	REV. FOR MOCA/NM-00-99	RER	KDW	JBH
5	07/28/98	AS BUILT EXPRESS PH. #3	SH	RER	JBH
ISU	DATE	DESCRIPTION	BY	CKD	APD

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

Georgia Gulf Chemicals & Vinyls — ABERDEEN PLANT ABERDEEN, MS

P&ID
PLANT UTILITY AIR SYSTEM
SHEET 4 OF 6

NO. UT-090109-PID-D ISSUE 7



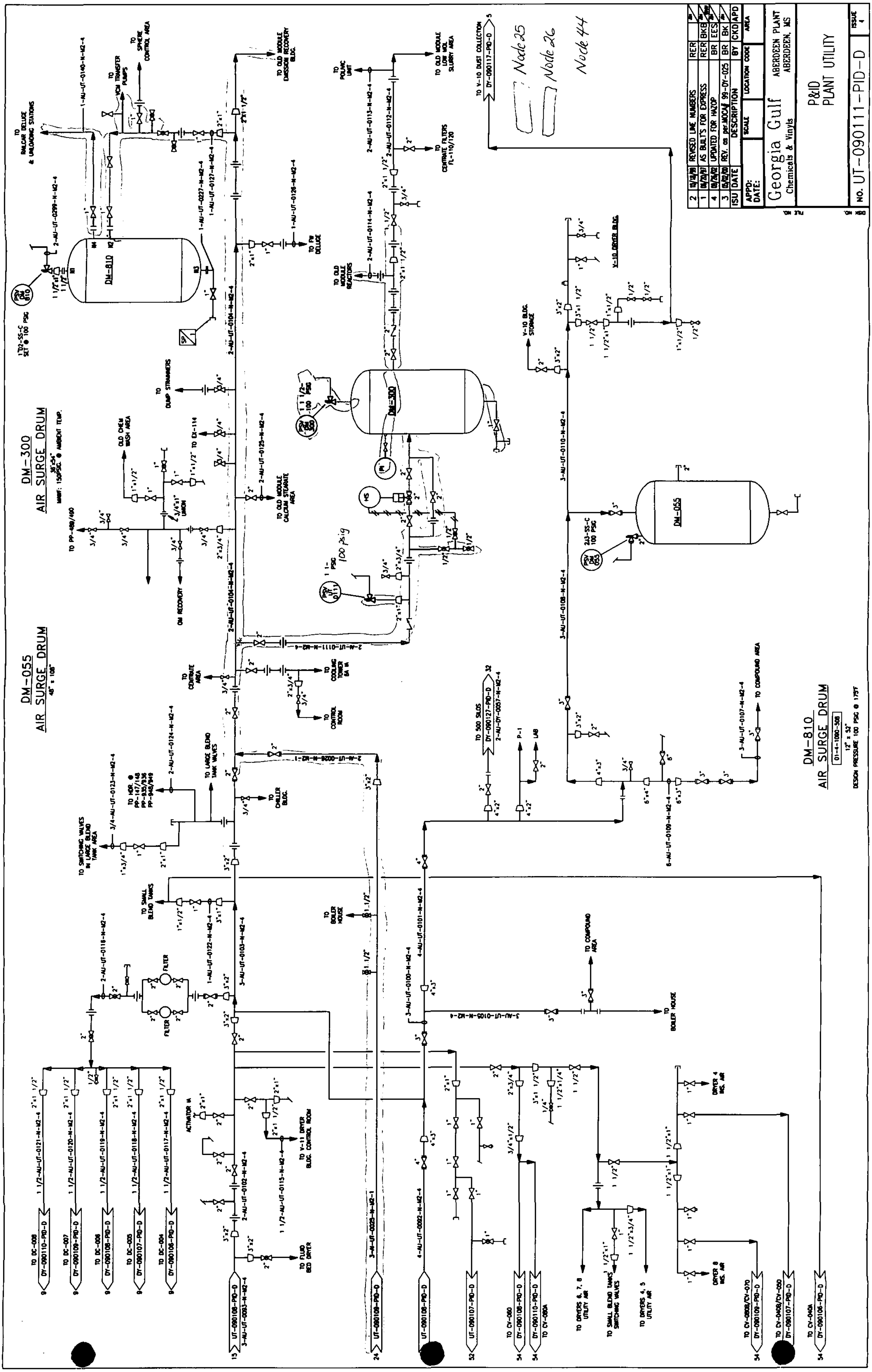
ISU	DATE	DESCRIPTION	BY	CKD	APD
1	10/15/02	UPDATED FOR HAZOP	BR	EES	JBH

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

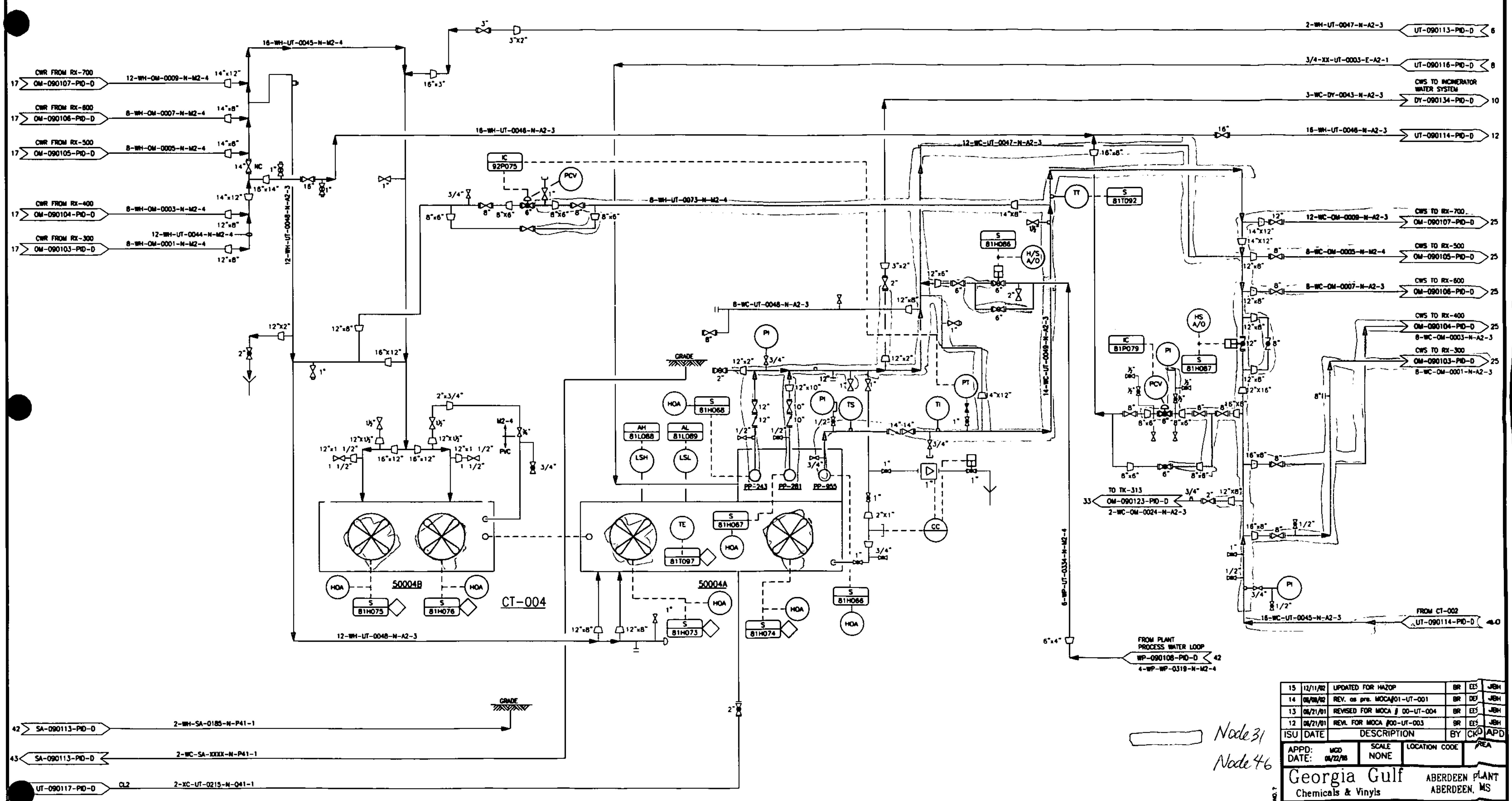
Georgia Gulf Chemicals & Vinyls — ABERDEEN PLANT ABERDEEN, MS

P&ID
PLANT UTILITY AIR SYSTEM
SHEET 6 OF 7

NO. UT-090109A-PID-D — ISSUE 1


Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT UTILITY
NO. UT-090111-PID-D
ISSUE 4
2 | 10/19/99 | REVISED LINE NUMBERS | RER | RER
1 | 08/21/97 | AS BUILT'S FOR EXPRESS | RER | BKB
4 | 09/26/02 | UPDATED FOR HAZOP | BR | EES
3 | 05/02/00 | REV. as per MOC# 99-DY-025 | BR | BK
ISU | DATE | DESCRIPTION | BY | CKD | APD
DM-300
AIR SURGE DRUM
36"x54"
MAWP: 150PSIG @ AMBIENT TEMP.
DM-055
AIR SURGE DRUM
48" x 108"
DM-810
AIR SURGE DRUM
DESIGN PRESSURE 100 PSIG @ 175°F
Node 25
Node 26
Node 44
100 psig

CT-004
WEST COOLING TOWER



PP-243
COOLING WATER PUMP
10 x 10 x 20
1500 GPM @ 210' HD
200 HP

PP-281
COOLING WATER PUMP

PP-955
COOLING WATER PUMP
4500 GPM @ 225' TDH
350 HP

Node 31
Node 46

ISU	DATE	DESCRIPTION	BY	CKD	APD
15	12/11/02	UPDATED FOR HAZOP	BR	EES	JBH
14	08/08/02	REV. as per MOCA#01-UT-001	BR	DD	JBH
13	08/21/01	REVISED FOR MOCA # 00-UT-004	BR	EES	JBH
12	08/21/01	REV. FOR MOCA #00-UT-003	BR	EES	JBH

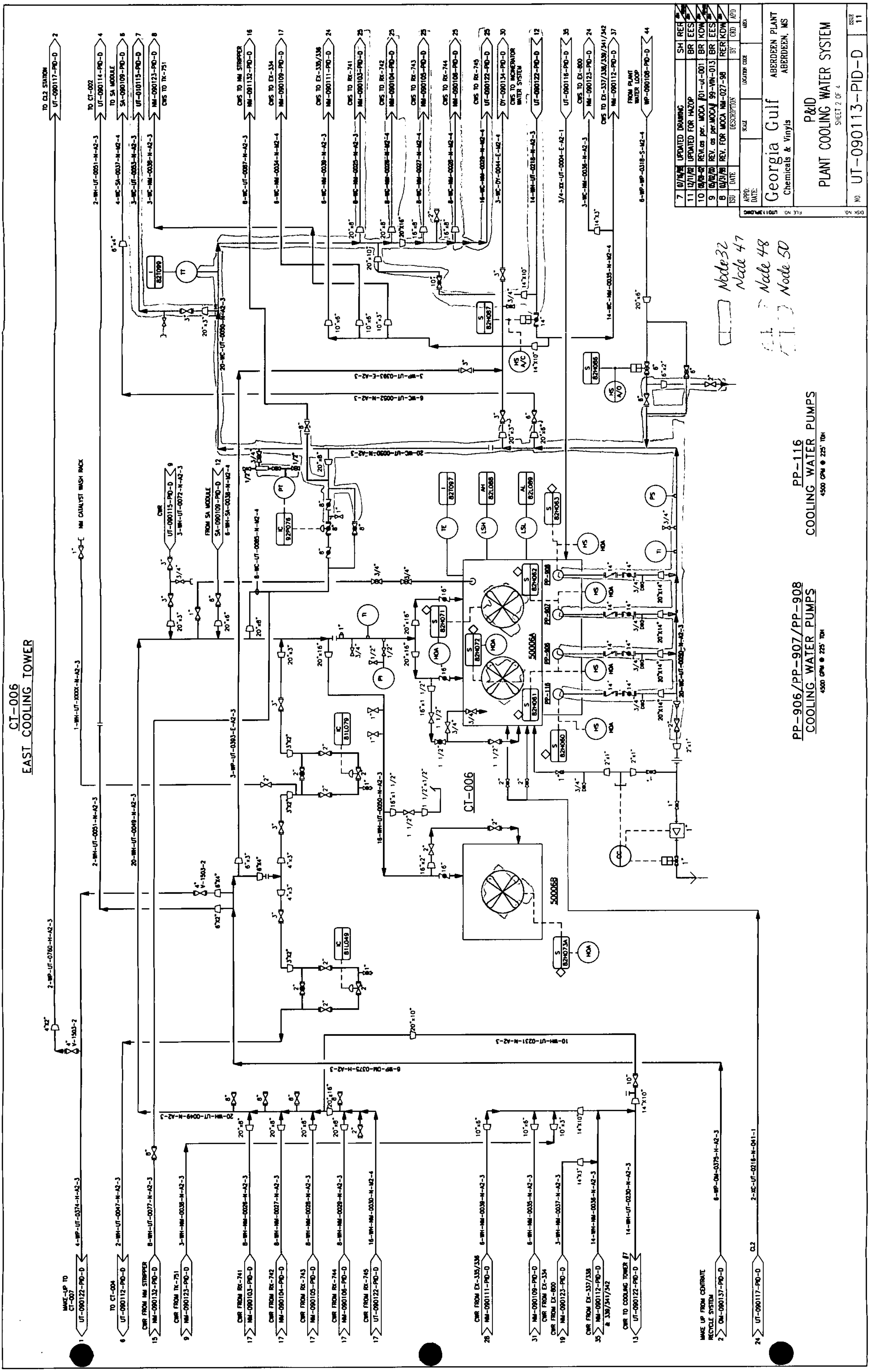
APPD: MCD
DATE: 08/22/86
SCALE NONE
LOCATION CODE
AREA

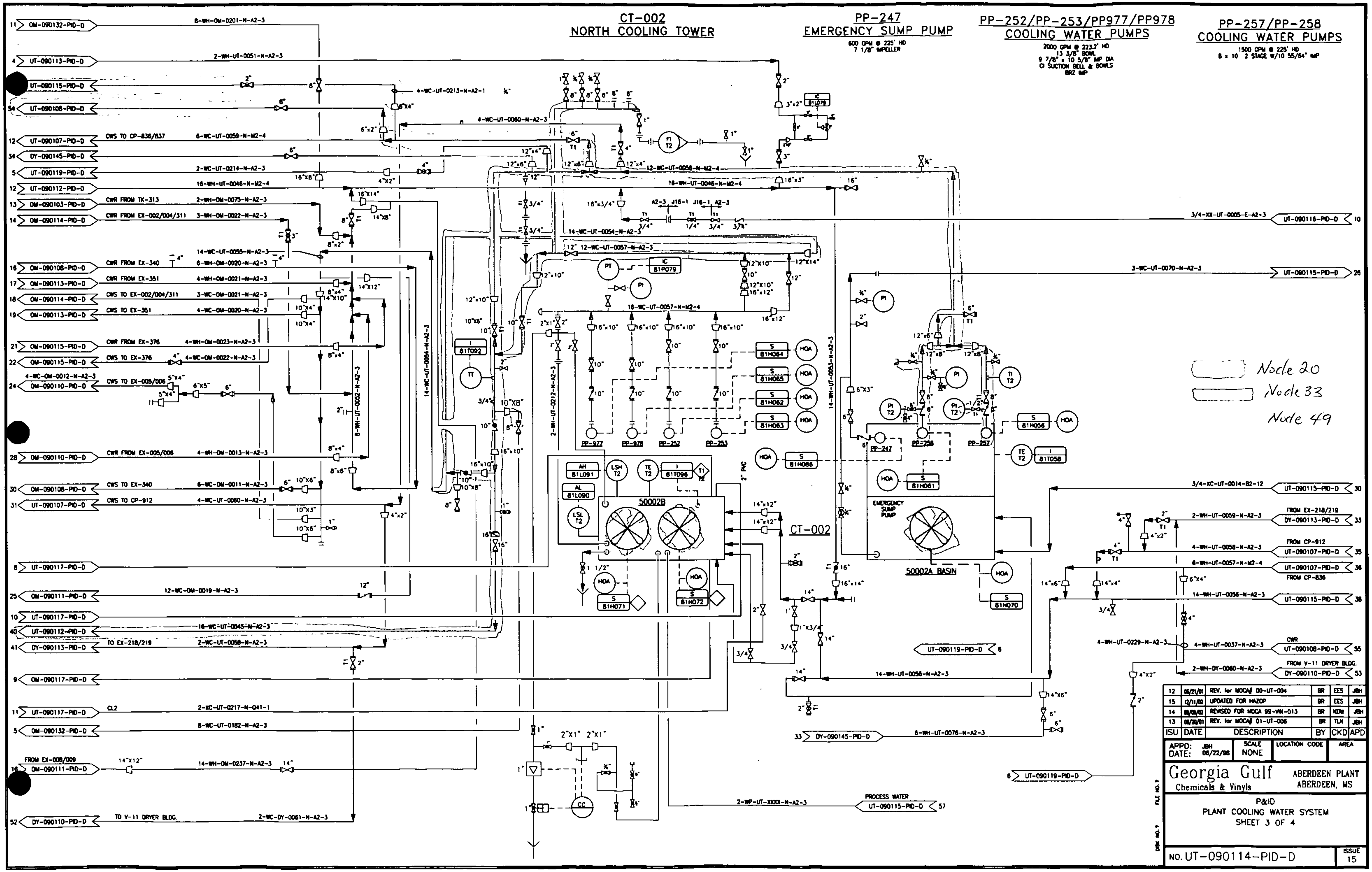
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS

FILE NO.?
DISK NO.?

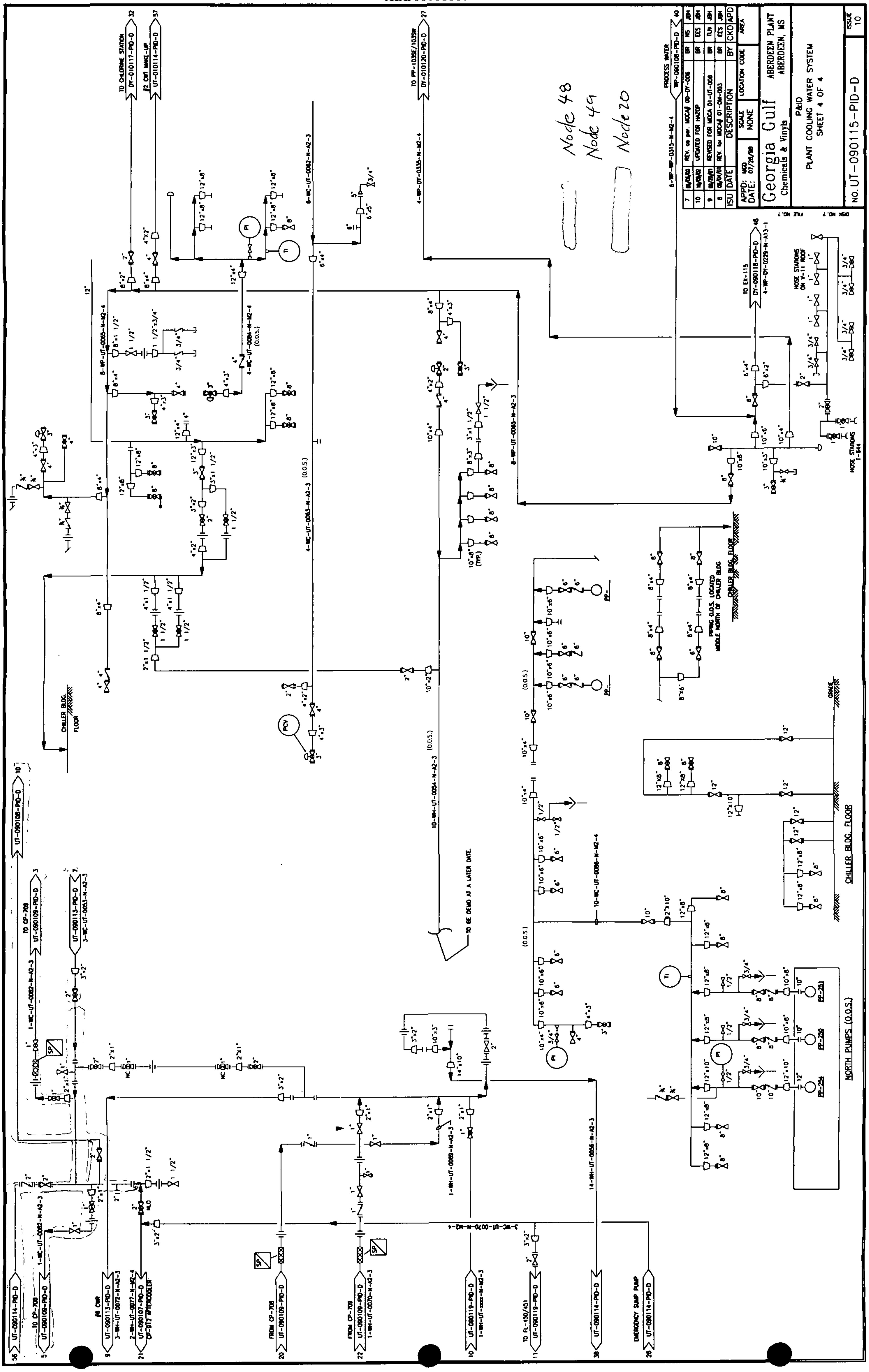
P&ID
PLANT COOLING WATER SYSTEM
SHEET 1 OF 4

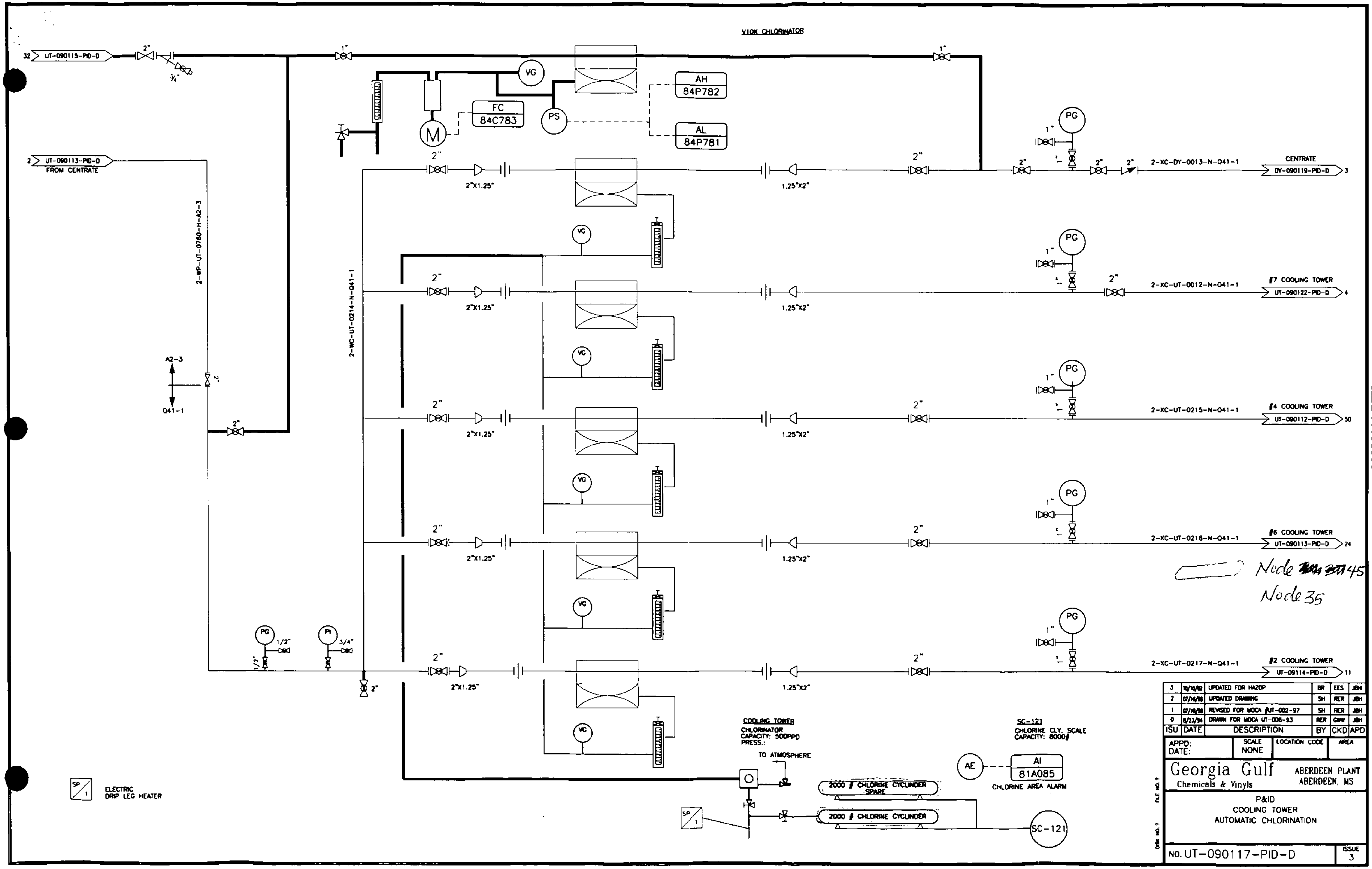
NO. UT-090112-PID-D
ISSUE 15

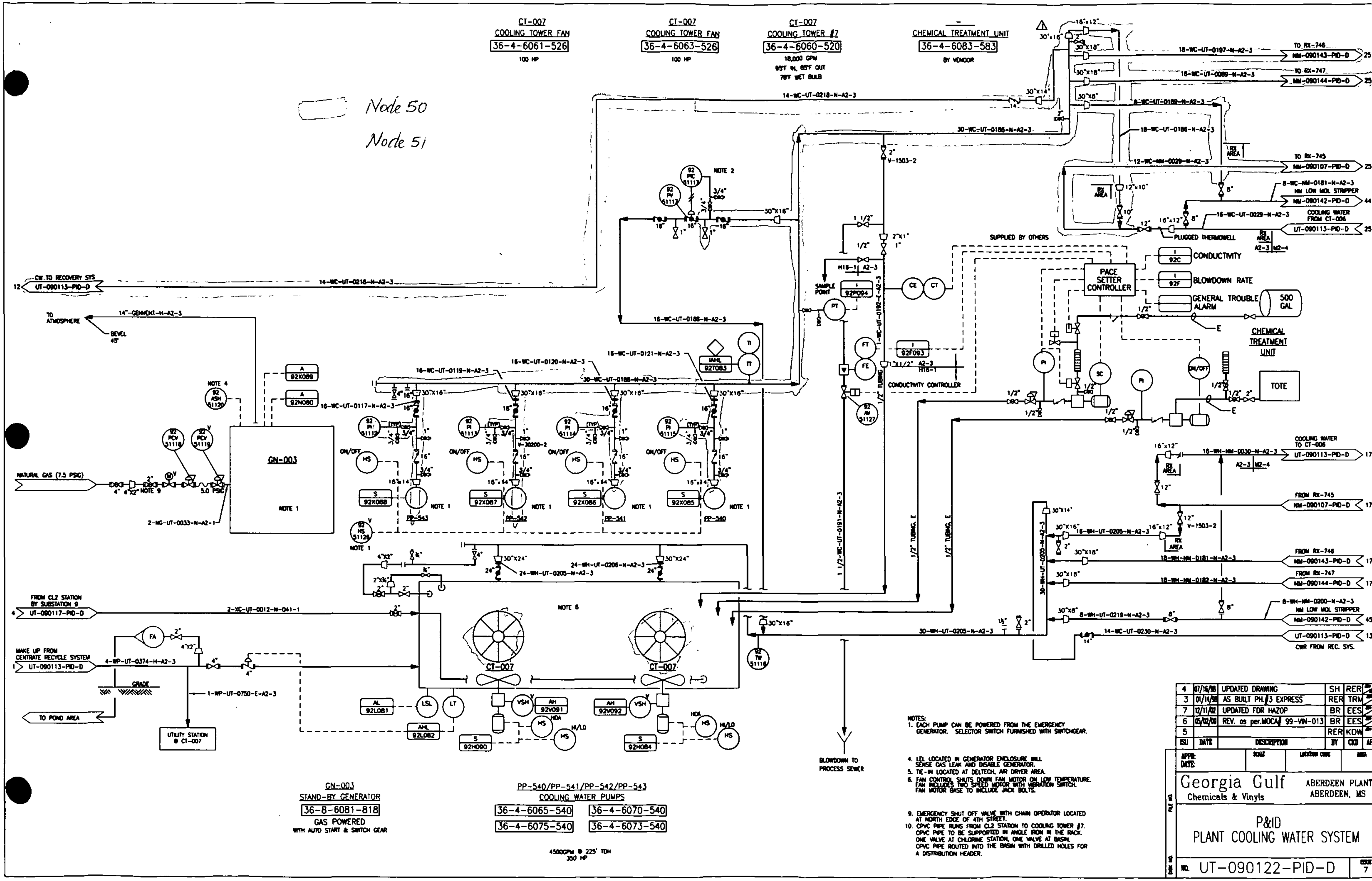

CT-006
EAST COOLING TOWER
PP-116
COOLING WATER PUMPS
4500 GPM @ 225' TDH
PP-906/PP-907/PP-908
COOLING WATER PUMPS
4500 GPM @ 225' TDH
CT-006
50006A
50006B
Node 32
Node 47
Node 48
Node 50
UPDATED DRAWING
UPDATED FOR HAZOP
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT COOLING WATER SYSTEM
SHEET 2 OF 4
UT-090113-PID-D
11

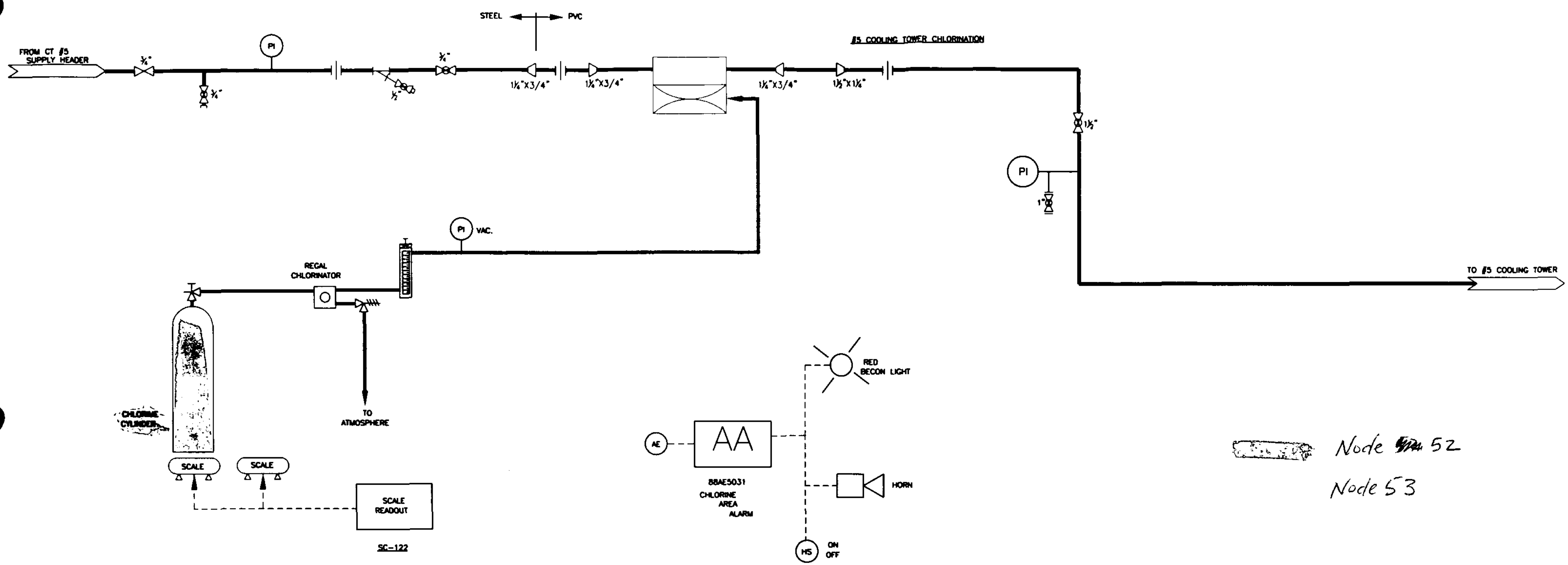

CT-002
NORTH COOLING TOWER
PP-247
EMERGENCY SUMP PUMP
600 GPM @ 225' HD
7 1/8" IMPELLER
PP-252/PP-253/PP977/PP978
COOLING WATER PUMPS
2000 GPM @ 223.2' HD
13 3/8" BOWL
9 7/8" x 10 5/8" IMP DIA
CI SUCTION BELL & BOWLS
BRZ IMP
PP-257/PP-258
COOLING WATER PUMPS
1500 GPM @ 225' HD
8 x 10 2 STAGE W/10 55/64" IMP
Node 20
Node 33
Node 49
50002B
50002A BASIN
EMERGENCY SUMP PUMP
CT-002
PP-977
PP-978
PP-252
PP-253
PP-247
PP-258
PP-257
PROCESS WATER
12 | 08/21/01 | REV. for MOCA# 00-UT-004 | BR | EES | JBH
15 | 12/11/02 | UPDATED FOR HAZOP | BR | EES | JBH
14 | 08/09/02 | REVISED FOR MOCA 99-WM-013 | BR | KOW | JBH
13 | 08/20/01 | REV. for MOCA# 01-UT-006 | BR | TLM | JBH
ISU | DATE | DESCRIPTION | BY | CKD | APD
APPD: JBH
DATE: 06/22/98
SCALE NONE
LOCATION CODE
AREA
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT COOLING WATER SYSTEM
SHEET 3 OF 4
NO. UT-090114-PID-D
ISSUE 15

ABD00031387




V10K CHLORINATOR
32 UT-090115-PID-D
2 UT-090113-PID-D
FROM CENTRATE
2-WP-UT-0760-H-A2-3
A2-3
Q41-1
2-WC-UT-0214-N-Q41-1
FC
84C783
VG
PS
AH
84P782
AL
84P781
M
PG
PI
2"X1.25"
1.25"X2"
2-XC-DY-0013-N-Q41-1
CENTRATE
DY-090119-PID-D 3
2-XC-UT-0012-N-Q41-1
#7 COOLING TOWER
UT-090122-PID-D 4
2-XC-UT-0215-N-Q41-1
#4 COOLING TOWER
UT-090112-PID-D 50
2-XC-UT-0216-N-Q41-1
#6 COOLING TOWER
UT-090113-PID-D 24
2-XC-UT-0217-N-Q41-1
#2 COOLING TOWER
UT-09114-PID-D 11
Node ~~35~~ 45
Node 35
COOLING TOWER
CHLORINATOR
CAPACITY: 500PPD
PRESS.:
TO ATMOSPHERE
2000 # CHLORINE CYCLINDER SPARE
2000 # CHLORINE CYCLINDER
SC-121
CHLORINE CLY. SCALE
CAPACITY: 8000#
AE
AI
81A085
CHLORINE AREA ALARM
SP 1
ELECTRIC DRIP LEG HEATER
3 10/10/02 UPDATED FOR HAZOP BR EES JBH
2 07/14/98 UPDATED DRAWING SH RER JBH
1 07/10/98 REVISED FOR MOCA #UT-002-97 SH RER JBH
0 8/23/94 DRAWN FOR MOCA UT-006-93 RER GRW JBH
ISU DATE DESCRIPTION BY CKD APD
APPD:
DATE:
SCALE NONE
LOCATION CODE
AREA
FILE NO.?
DISK NO.?
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
COOLING TOWER
AUTOMATIC CHLORINATION
NO. UT-090117-PID-D
ISSUE 3


CT-007
COOLING TOWER FAN
36-4-6061-526
100 HP
CT-007
COOLING TOWER FAN
36-4-6063-526
100 HP
CT-007
COOLING TOWER #7
36-4-6060-520
18,000 GPM
95°F IN, 85°F OUT
78°F WET BULB
CHEMICAL TREATMENT UNIT
36-4-6083-583
BY VENDOR
Node 50
Node 51
CW TO RECOVERY SYS
UT-090113-PID-D
TO ATMOSPHERE
NATURAL GAS (7.5 PSIG)
GN-003
FROM CL2 STATION BY SUBSTATION 9
UT-090117-PID-D
MAKE UP FROM CENTRATE RECYCLE SYSTEM
UT-090113-PID-D
TO POND AREA
UTILITY STATION @ CT-007
PACE SETTER CONTROLLER
CONDUCTIVITY
BLOWDOWN RATE
GENERAL TROUBLE ALARM
500 GAL
CHEMICAL TREATMENT UNIT
TOTE
SUPPLIED BY OTHERS
CONDUCTIVITY CONTROLLER
BLOWDOWN TO PROCESS SEWER
TO RX-746
NM-090143-PID-D
TO RX-747
NM-090144-PID-D
TO RX-745
NM-090107-PID-D
NM LOW MOL STRIPPER
NM-090142-PID-D
COOLING WATER FROM CT-006
UT-090113-PID-D
COOLING WATER TO CT-006
UT-090113-PID-D
FROM RX-745
NM-090107-PID-D
FROM RX-746
NM-090143-PID-D
FROM RX-747
NM-090144-PID-D
NM LOW MOL STRIPPER
NM-090142-PID-D
CWR FROM REC. SYS.
UT-090113-PID-D
GN-003
STAND-BY GENERATOR
36-8-6081-818
GAS POWERED
WITH AUTO START & SWITCH GEAR
PP-540/PP-541/PP-542/PP-543
COOLING WATER PUMPS
36-4-6065-540
36-4-6070-540
36-4-6075-540
36-4-6073-540
4500GPM @ 225' TDH
350 HP
NOTES:
1. EACH PUMP CAN BE POWERED FROM THE EMERGENCY GENERATOR. SELECTOR SWITCH FURNISHED WITH SWITCHGEAR.
4. LEL LOCATED IN GENERATOR ENCLOSURE WILL SENSE GAS LEAK AND DISABLE GENERATOR.
5. TIE-IN LOCATED AT DELTECH, AIR DRYER AREA.
6. FAN CONTROL SHUTS DOWN FAN MOTOR ON LOW TEMPERATURE. FAN INCLUDES TWO SPEED MOTOR WITH VIBRATION SWITCH. FAN MOTOR BASE TO INCLUDE JACK BOLTS.
9. EMERGENCY SHUT OFF VALVE WITH CHAIN OPERATOR LOCATED AT NORTH EDGE OF 4TH STREET.
10. CPVC PIPE RUNS FROM CL2 STATION TO COOLING TOWER #7. CPVC PIPE TO BE SUPPORTED IN ANGLE IRON IN THE RACK. ONE VALVE AT CHLORINE STATION, ONE VALVE AT BASIN. CPVC PIPE ROUTED INTO THE BASIN WITH DRILLED HOLES FOR A DISTRIBUTION HEADER.
4 07/16/98 UPDATED DRAWING SH RER
3 01/14/98 AS BUILT PH. #3 EXPRESS RER TRW
7 12/11/02 UPDATED FOR HAZOP BR EES
6 05/02/00 REV. as per MOC# 99-VIN-013 BR EES
5 RER KDW
ISU DATE DESCRIPTION BY CKD APD
Georgia Gulf
Chemicals & Vinyls
ABERDEEN PLANT
ABERDEEN, MS
P&ID
PLANT COOLING WATER SYSTEM
NO. UT-090122-PID-D
ISSUE 7



Node 52
Node 53

0	10/23/02	NEW P&ID FOR HAZOP	BR	EES	JBH
ISU	DATE	DESCRIPTION	BY	CKD	APD

APPD:
DATE:

SCALE NONE | LOCATION CODE | AREA

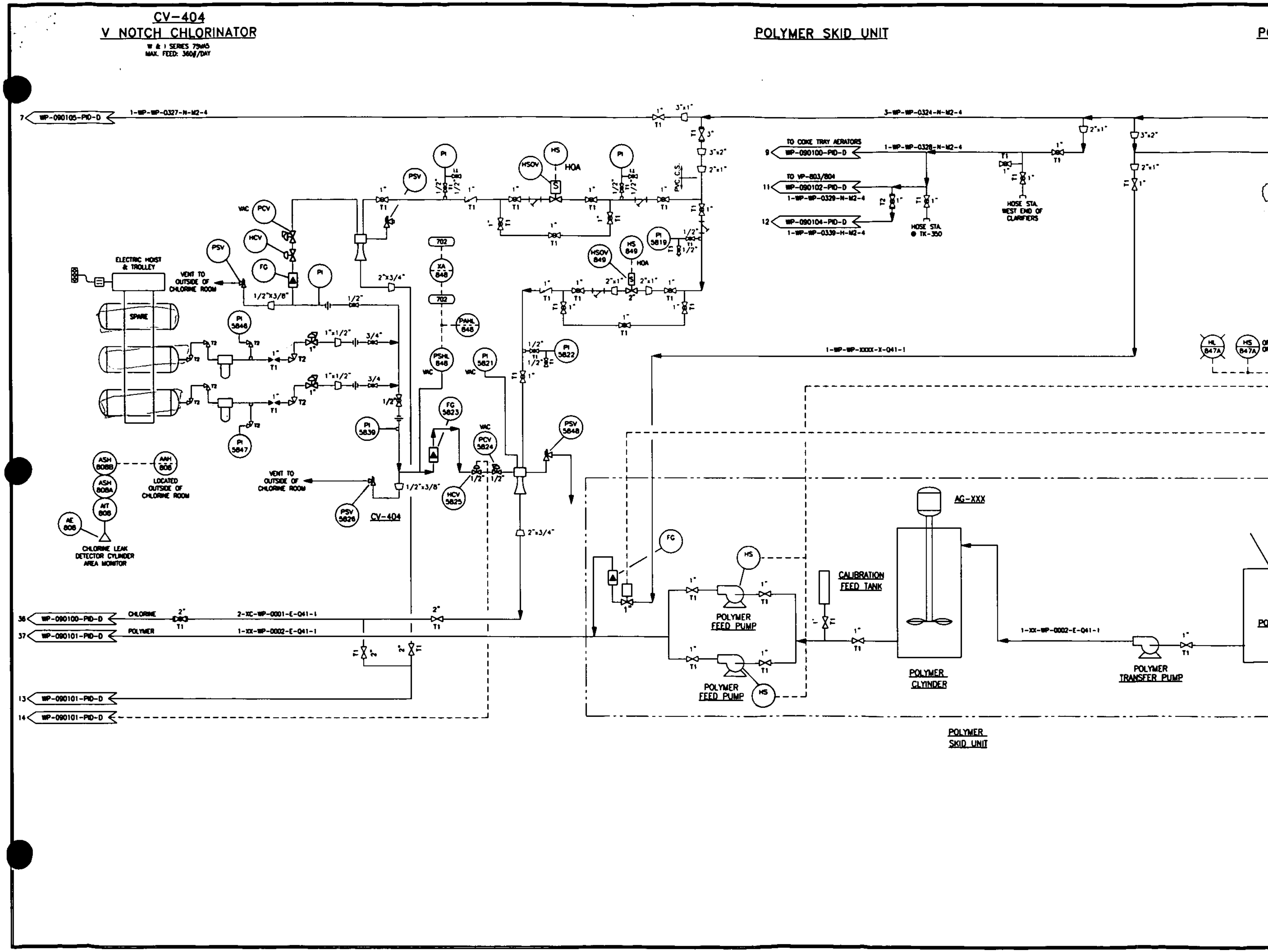
Georgia Gulf
Chemicals & Vinyls

ABERDEEN PLANT
ABERDEEN, MS

P&ID
#5 COOLING TOWER
CHLORINATION SYSTEM

NO. UT-090123-PID-D

ISSUE 0



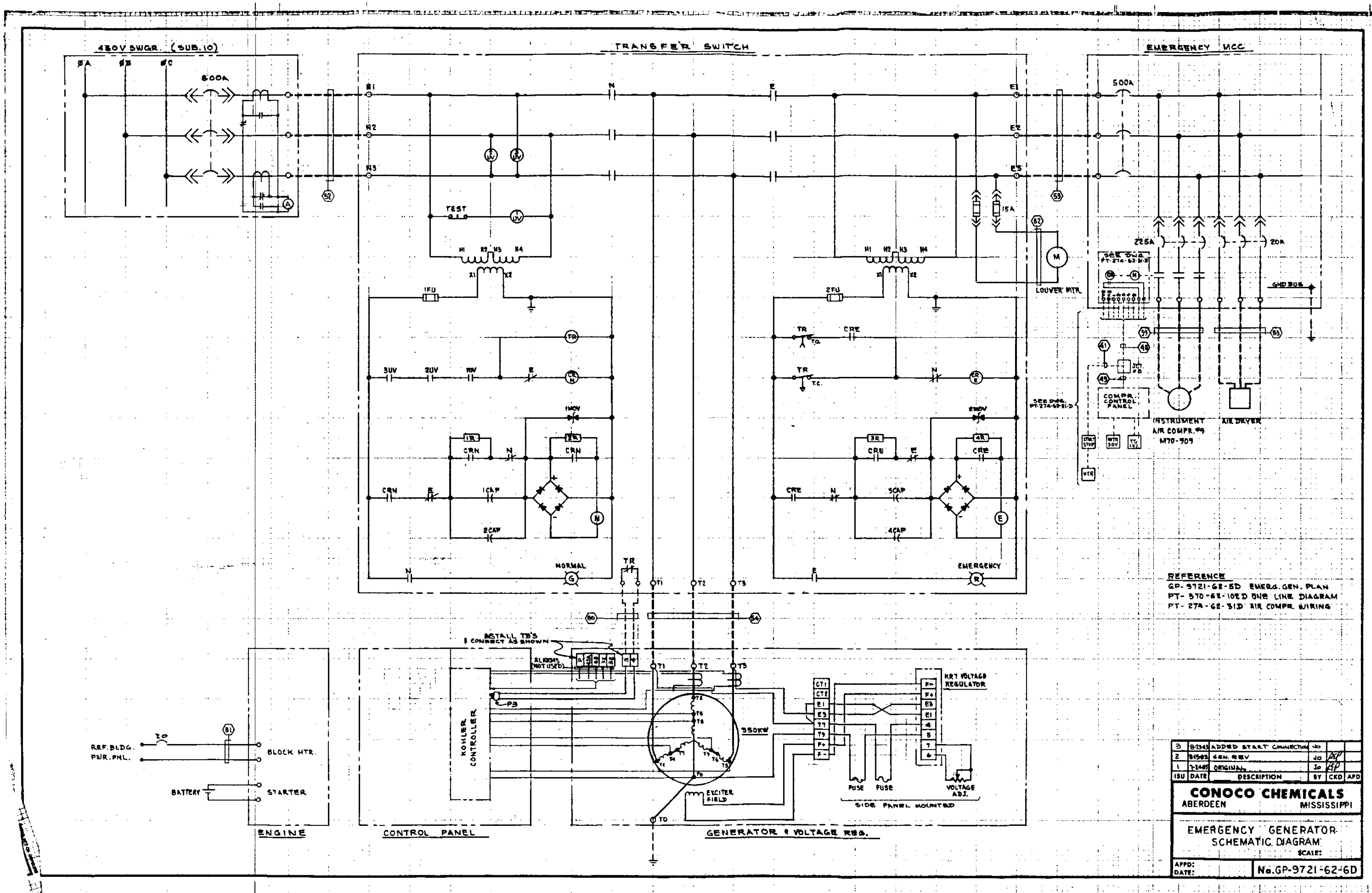
ISU	DATE	DESCRIPTION	BY	CKD	APD
4	09/28/02	UPDATED FOR HAZOP	BR	EES	JBH
3	1/25/96	REVISED FOR MOCA #UT-007-95	RER	VEM	JBH
2	1/25/96	REVISED FOR AFE: #G735	RER	GSN	JBH
1	6/2/94	DRAWING UP-DATED	RER	LHS	MGD
0	2/25/94	ISSUED TO CLIENT	PW		MGD

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

Georgia Gulf Chemicals & Vinyls
ABERDEEN PLANT ABERDEEN, MS

P&ID
ADDITIVE SYSTEM

NO. WP-090106-PID-D
ISSUE 4



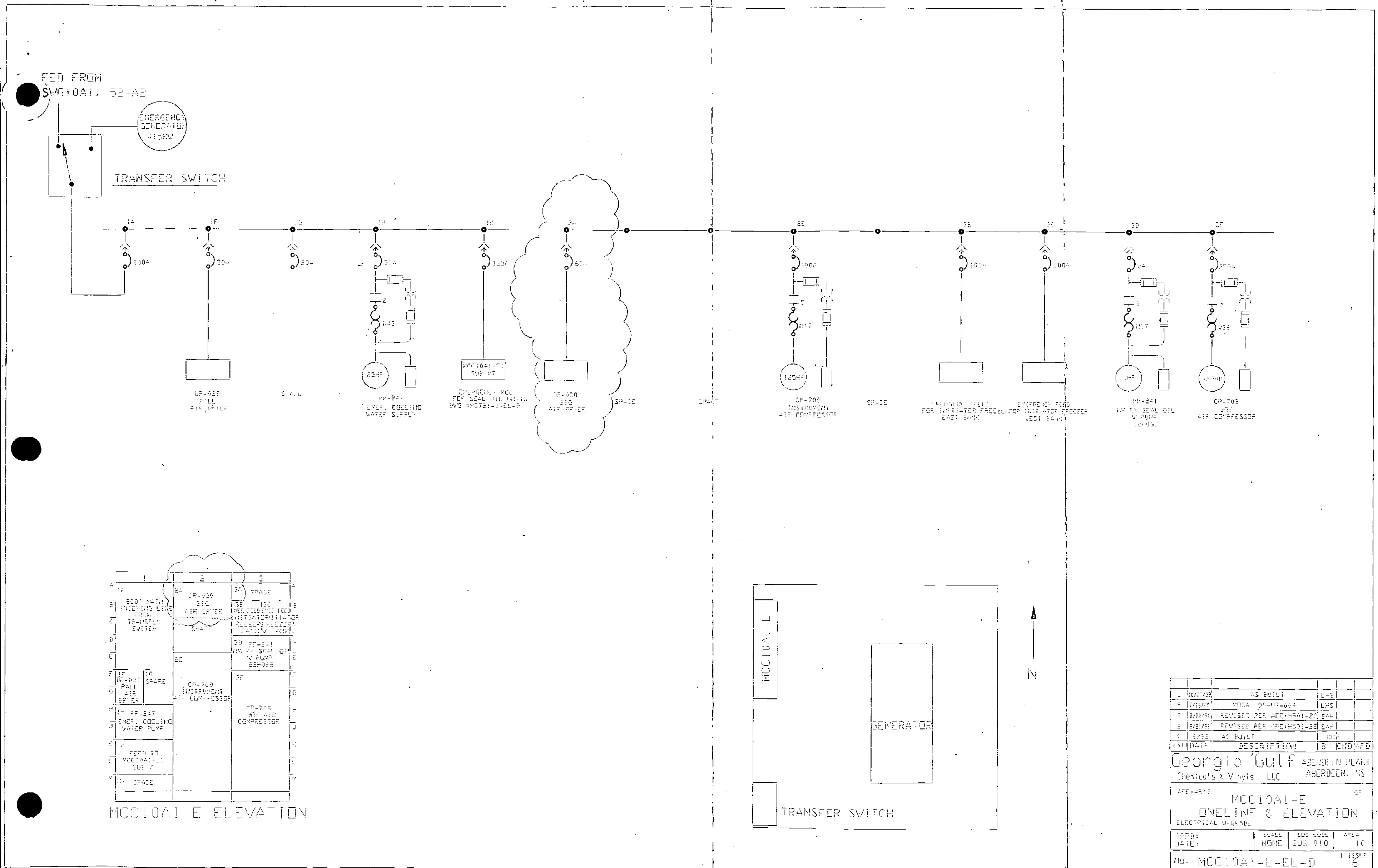
DRAWING NUMBER

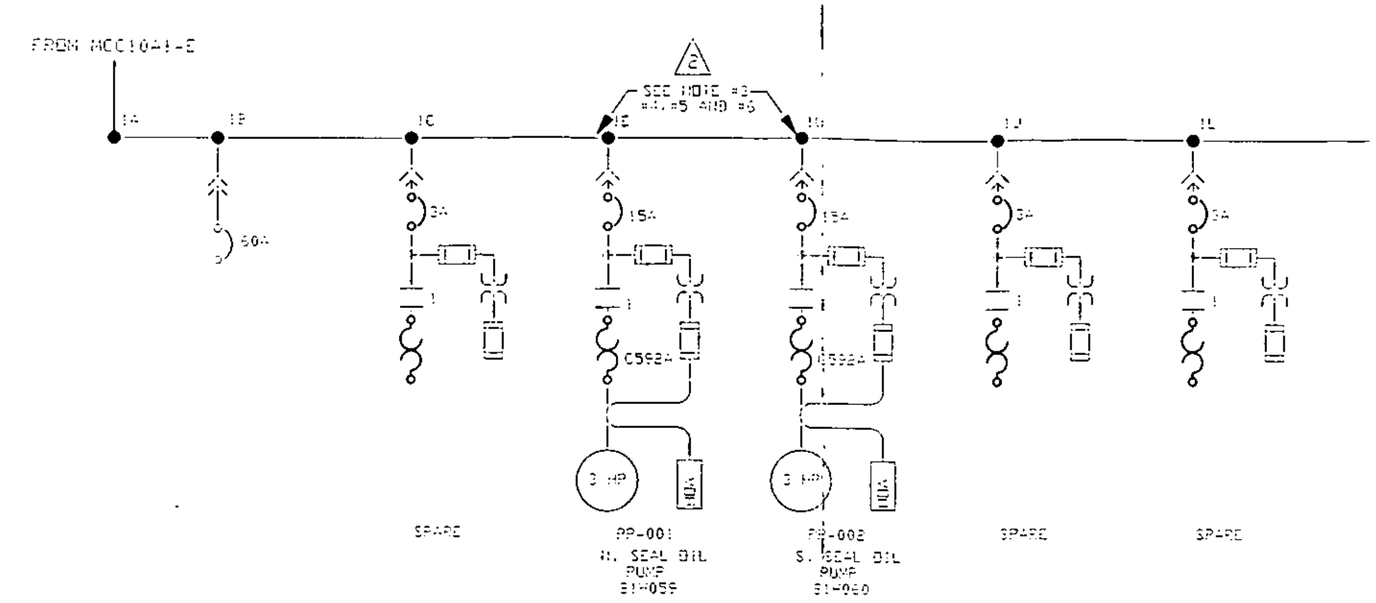
DRAWING NUMBER

DRAWING NUMBER AFE: 9721

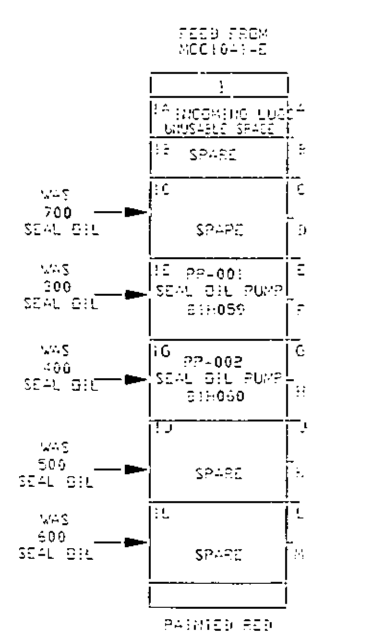
DRAWING NUMBER GP-9721-62-6-D

ABD00031393



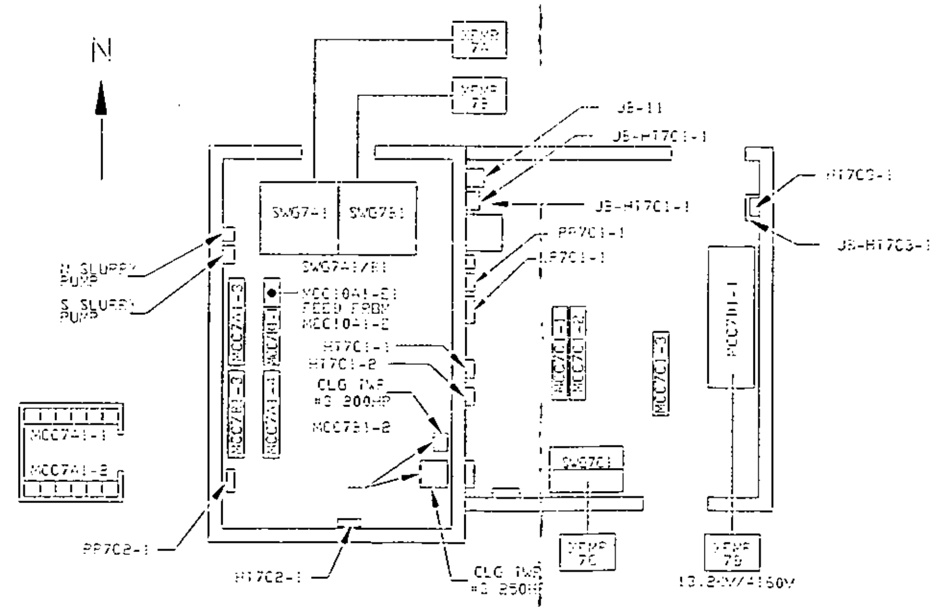


LOCATED IN SUB #7 AT MCC7E1-1



MCC10A1-E1

LOCATED IN SUB #7 AT MC7E1-1



PLAN VIEW

REFERENCE DWGS:

MCC7A1-1-EL-D MCC7A1-1 ONELINE AND ELEVATION
MCC10A1-E-EL-D MCC10A1-E ONELINE AND ELEVATION

NOTES:

1. EMERGENCY POWER FOR OLD MODULE SEAL OIL PUMPS
2. PAINTED RED FOR IDENTIFICATION
3. CHANGE BREAKER TO 15 AMP G.E. #TED134015WL
4. CHANGE OVERLOADS TO 4.8 AMP G.E. #C592A
5. TEMPORARILY FEED PP-001 FROM MCC7H1-1-2L WITH ENOUGH WIRE LENGTH TO BE RE-CONNECTED TO MCC10A1-E1
6. TEMPORARILY FEED PP-002 FROM MCC7A1-3-1D WITH ENOUGH WIRE LENGTH TO BE RE-CONNECTED TO MCC10A1-E1

NOV./1997
⇨ 3 SPECIAL NOTE:
THIS SUBSTATION IS AT MAXIMUM CAPACITY MAJOR REVISIONS ARE REQUIRED BEFORE MCC EXPANSION.

ISU	DATE	DESCRIPTION	BY	CKD	APD
3	11/97	PRELIMINARY CALCULATIONS	LHS/SAH		
2	3/24/94	CHANGE STARTERS AFE#C574	LHS		
1	3/20/91	ORIGINAL	SAH		

APPD: MLC DATE: 10/7/93 | SCALE N/A | LOCATION CODE | AREA 7

VISTA — VISTA CHEMICAL, ABERDEEN CHEMICAL PLANT, ABERDEEN, MS

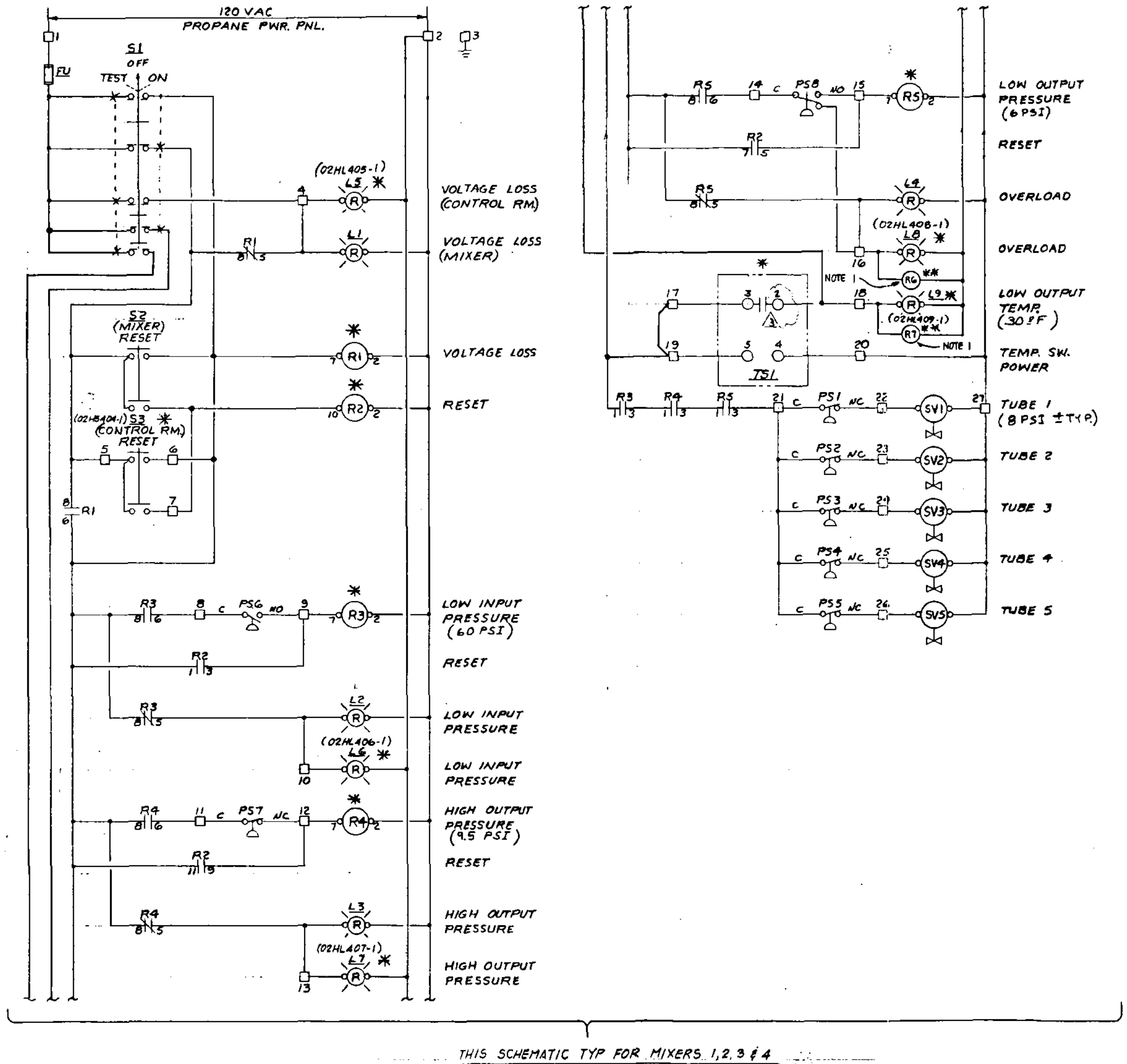
AFE#H501-22

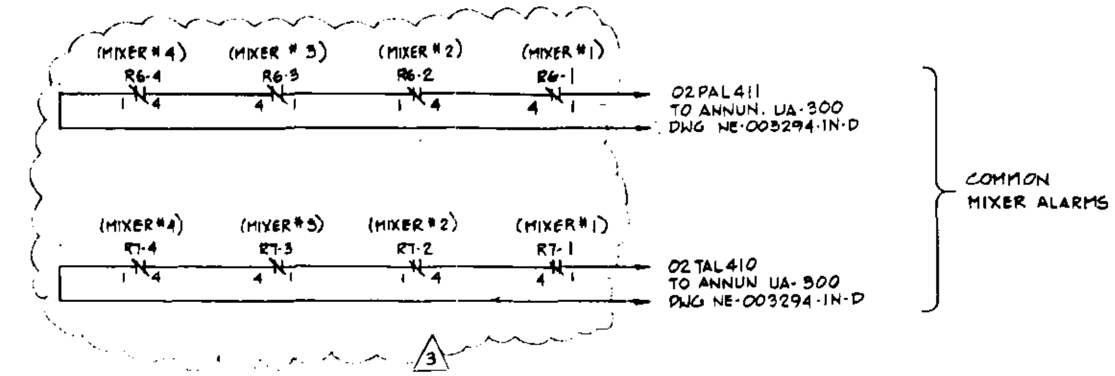
MCC10A1-E1 ONELINE AND ELEVATION

SEAL OIL PUMP EMERGENCY POWER

NO. MCC10A1-E1-EL-D ISSUE 2

FILE MCC10A1E1
DWG. NO MC-0110
GP





NOTES

1) RELAYS R6 & R7 WILL HAVE A SUFFIX OF -1, -2, -3 & -4 TO INDICATE WHICH MIXER THEY ARE ASSOCIATED WITH.

LEGEND

- * INDICATES DEVICE LOCATED IN MIXER CONTROL PANEL
- ** INDICATES DEVICE LOCATED IN MJB0208
- □ TERM. IN MIXER CONTROL PANEL

REFERENCE DWGS

- NE-D606-57-3-D —— MIXER CONTROL RACK WIRING DIAG
- NE-003264-IN-D —— CONTROL ROOM PLAN
- NE-003278-IN-D —— MARSHLING RACK MJB0208 WIRING DIAG
- NE-003286-IN-D —— BOILER CONTROL PANEL LAYOUT
- NE-003274-IN-D —— J-BOX CJB0206 WIRING DIAG.

SFE# PL06

ISU	DATE	DESCRIPTION	BY	CKD	APD
3	6-29-92	AS-BUILT PER SFE# H500	JME		
2	11-81-90	ADDED COMMON MIXER ALARMS AFE: 88-H500	RWG		
1	9/2/80	AS BUILT	AEP		
0	5/2/80	ORIGINAL	DRF		

VISTA Vista Polymers Inc.
Aberdeen, Mississippi

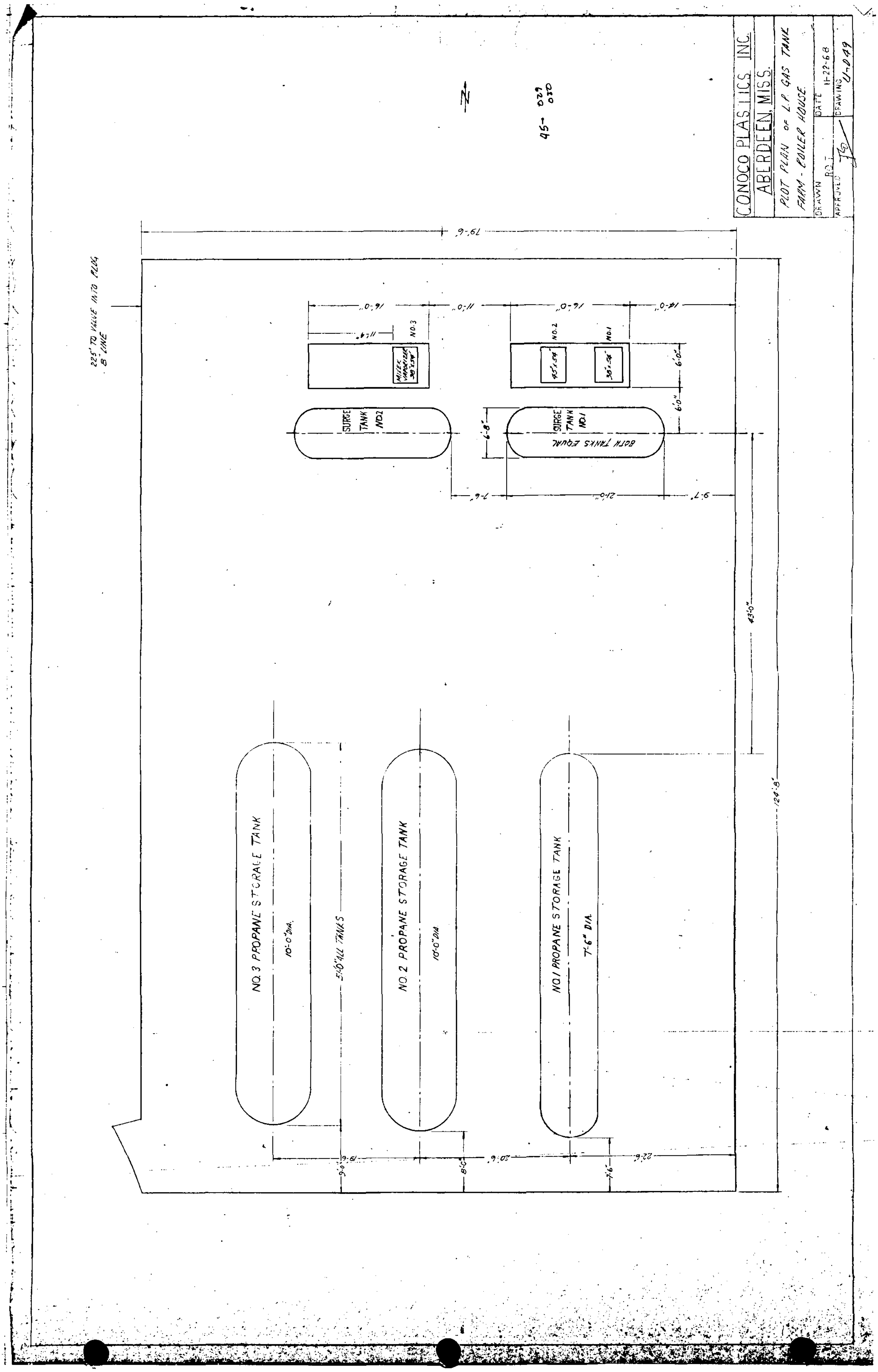
SECTION: NORTHEAST SUB. SECT. PROPANE

PROPANE TANK FARM
MIXER CONTROL RACK
CONTROL SCHEMATIC

SCALE: NONE

APPD:
DATE:

No. NE-D606-57-4-D


CONOCO PLASTICS INC.
ABERDEEN, MISS.
PLOT PLAN OF L.P. GAS TANK FARM - BOILER HOUSE.
DRAWN R.D.T.
DATE 11-22-68
APPROVED
DRAWING U-049
N
225' TO VALVE INTO PLTG 8" LINE
79'-6"
16'-0"
11'-0"
14'-0"
11'-4"
NO.3
NO.2
NO.1
MIXER VAPORIZER 36"x36"
45"x54"
30"x54"
6'-0"
SURGE TANK NO.2
SURGE TANK NO.1
BOTH TANKS EQUAL
6'-8"
7'-6"
21'-0"
9'-7"
43'-0"
124'-8"
NO.3 PROPANE STORAGE TANK
10'-0" DIA.
51'-0" ALL TANKS
NO.2 PROPANE STORAGE TANK
10'-0" DIA.
NO.1 PROPANE STORAGE TANK
7'-6" DIA.
19'-6"
20'-6"
22'-6"
9'-0"
8'-0"
7'-6"

APPENDIX B

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix B. Copies of Operating Procedures Referenced

FOR FINAL REVIEW/APPROVAL

CONDEA Vista Company - Aberdeen Plant

OPERATING PROCEDURES

PROCESS: **Old Module** **PROCEDURE TYPE:** **Emergency**

PROCESS AREA: **Vinyl Control Room Building**

PROCEDURE TITLE: **Operation of Emergency Generator for Vinyl Control Room**

APPROVED BY: ____________________ **DATE:**__________
Unit Manager Resin

I. PURPOSE

The purpose of this procedure is to describe the operation of the emergency generator supplying emergency power to vinyl control room.

II. REFERENCES

N/A

III. SAFETY AND HEALTH CONSIDERATIONS

General

N/A

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

E. Special or Unique Hazards

N/A

IV. DISCUSSION

The power distribution system for the vinyl control room consists of two separate feeds from substation 7 480 volt AC switchgear (only one of these will be in use at a time). These feeds are fed into the normal line terminals of the automatic transfer switch. The feed from the emergency generator is fed into the emergency line terminal. The load side terminals are then connected to the motor control center, MCC7AB1-1. This motor control center supplies the 480-volt AC power to all loads in the control room. Examples of these loads are UPS, emergency lighting, power transformers, air conditioning units, 24-volt DC battery chargers, pressurization blowers, and the plant telephone system.

V. OPERATING PROCEDURE

"NOTE"

The emergency generator is a 450-kilowatt generator powered by a 643 horsepower detroit diesel engine.

FOR FINAL REVIEW/APPROVAL

CONDEA Vista Company - Aberdeen Plant

OPERATING PROCEDURES

PROCESS: Old Module **PROCEDURE TYPE: Emergency**

PROCESS AREA: Vinyl Control Room Building

PROCEDURE TITLE: Operation of Emergency Generator for Vinyl Control Room

V. OPERATING PROCEDURE-Continued

"NOTE"

The automatic transfer switch is located on the west wall of the electrical equipment room (room 109). The electrical equipment room is located midway of the west side of the control room building.

1.0 Operation of Emergency Generator.

1.1 The emergency power system will be activated when power is interrupted on the lines coming in from Sub #7. When this occurs, the automatic transfer switch will switch from the normal line terminals to the emergency line terminals. This will place the emergency generator on the terminals that will be supplying power to MCC7AB1-1. This transfer will occur when the emergency generator's output frequency reaches 60 Hz (this typically takes about 10 - 15 seconds). During this time, the UPS will keep the 120 VAC loads from the DCS energized, and the 24 VDC battery system will keep the actuated valves and analog transmitters fully operational. Once the switchover occurs, the emergency generator will provide power to all loads that are attached to MCC7AB1-1. Now, the UPS and 24 VDC system will go back into the standby mode.

V. OPERATING PROCEDURE-Continued

1.2 Once the cause of the power failure has been determined and corrected, the automatic transfer switch should automatically switch back to its normal operating position. If it does not, depress the "switch back" button on the automatic transfer switch. At this time, the automatic transfer switch will switchback to the normal line terminals, thus allowing the feed from Sub #7 to power the loads in the vinyl control room.

******************************CAUTION**************************

The emergency generator has a starting mode switch labeled "run off auto". This switch must be in auto for generator to start during a power failure.

"NOTE"

The generator is tested weekly by electricians following the attached weekly test check, see attachment No. 1.

FOR FINAL REVIEW/APPROVAL

CONDEA Vista Company - Aberdeen Plant

OPERATING PROCEDURES

PROCESS: **Old Module** **PROCEDURE TYPE:** **Emergency**

PROCESS AREA: **Vinyl Control Room Building**

PROCEDURE TITLE: **Operation of Emergency Generator for Vinyl Control Room**

VI. OPERATING LIMITS

Critical Parameter	Loop Number	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action
Generator starting Mode switch	N/A	Switch must be in Auto.	Generator would not start in power failure. No emergency power	Insure switch is in automatic

VII. SAFETY SYSTEMS AND THEIR FUNCTIONS

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

VIII. REVISION HISTORY

Description of the Change	Revision
Updated procedure to reflect several changes	1
	05/01/99

CONDEA Vista Company - Aberdeen Plant

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

APPROVED BY: ______________________ **DATE:** __________

I. PURPOSE

The purpose of this procedure is to identify the equipment involved and describe the steps necessary to operate the Cooling Tower Standby Generator.

II. REFERENCES:

A. Aberdeen Safety and Health Manual
B. Drawing SW-003120-EL-D, Phase 3 One Line Diagram (Cooling Tower Standby Generator)

III. SAFETY & HEALTH CONSIDERATIONS

A. General

There is potential for exposure to natural gas when performing this procedure. Refer to the MSDS for specifications. VSP 5, Respiratory Protection policy, must be followed as established in the Safety and Health Manual.

There is potential for exposure to hazardous energy when performing this procedure. Extreme caution should be exercised at all times. VSP 32, Electrical Safe Work Practices policy, must be followed as established in the Safety and Health Manual.

B. Properties/Hazards Of Chemicals

Natural Gas - a transparent, colorless hydrocarbon vapor that is lighter than air, odorized to allow detection by smell. Flammable, asphixiant.

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

III. SAFETY & HEALTH CONSIDERATIONS (Continued)

C. Precautions To Prevent Exposure

CHEMICAL	PERSONAL PROTECTIVE EQUIPMENT	ENGINEERING CONTROLS	ADMINISTRATIVE CONTROLS
Natural Gas	N/A	Pressure safety valve	No sources of ignition or open flames allowed in plant without Hot Work Permit.

D. Control Measures To Be Taken If Exposed

See MSDS for specifications

E. Quality Control For Raw Materials And Control Of Hazardous Chemical Inventories

N/A

F. Special Or Unique Hazards

N/A

G. Safety Systems And Their Functions

Safety Systems	Function Performed
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.
Fixed Point Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Sends hydrocarbon sample analysis to the DCS.

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

IV. DISCUSSION

A. General Information

The Cooling Tower Emergency Generator is a natural gas engine-driven generator which provides standby electric power to operate one cooling water pump on #7 Cooling Tower in the event of a power failure.

When utility power to the MCC 17B1-1, 4160V Main Breaker 52-M1 fails, a 15 second timer starts and when it times out the breaker (52-M1) opens. When the breaker opens the generator start cycle begins. When the generator voltage reaches approximately 90 percent of rated voltage and the frequency is 60 Hertz, the Generator Breaker (52-G1) closes, supplying power the MCC. The cooling water pump that is selected by the selector switch on Generator Breaker (52-G1) panel starts automatically. The Main and Generator breakers are interlocked so they cannot be energized at the same time.

One cooling water pump is selected to operate by a selector switch. All other motors on MCC17B1-1 will not run while the generator is supplying power.

Although the standby generator starts automatically and its operating status is monitored by DCS, it must be shut down manually from the local control panel since there are no remote controls provided. The control panel, located outside, displays the following operating variables:

- Engine oil pressure
- Intake manifold pressure
- Engine cooling water temperature
- Engine RPM & Hours per Operating Cycle
- Intake manifold temperature

Note: The panel also has a pull to run & push to stop switch located on the east side of the generator

The control panel located inside # 17 MCC building north wall, displays the following:

- Manual Stop Auto
- RPM
- HRS run time
- Warning light
- Reset button

- **IV. DISCUSSION - Continued**

B. Location Codes

Cooling Tower Emergency Generator	GN-003

V. INSTRUCTIONS

A. Normal Automatic Startup

NOTE

Standby Generator Normal Operating Conditions are as follows:

1. **Substation 102, 15 KV Feeder Breaker to MCC17 4160Volt Transformer is CLOSED and utility power is present.**
2. **MCC 17 4160 V Main Breaker 52-M1 is CLOSED**. Switch in the **RED** position.
3. Generator Breaker 52-G1 is **OPEN**. Switch in the **RED** position
4. Generator Engine Control Switch is in **AUTO** position
5. **Cooling Water Pump selected for Auto Start is RUNNING.**
6. **Switch Positions 1=PP-540, 2=PP-541, 3=PP-542, 4=PP-543, 5=N/A**

1. On loss of utility power to 4160 main breaker 52-M1, GN-003, Standby Generator starts.
2. When standby generator voltage reaches approximately 90% of rated voltage, the following actions occur:
   a. Cooling water pump power bus is isolated from normal feeder.
   b. Cooling water pump power bus is connected to standby generator terminals.
   c. Control power to the following motor breakers is interrupted:
      - All three cooling water pumps except the one selected for emergency operation
      - Reactors 746 & 747 agitators
   d. The selected cooling water pump starts.

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

d. Verify that the ON/OFF switches located at the pumps for the pumps that are not running are switched to the OFF position

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

V. INSTRUCTIONS - Continued

B. Return to Normal Utility Power

NOTE

Normal utility power is restored manually at the standby generator control panel. Initial Conditions are as follows:

1. **The ON/OFF** switches located at the pumps for the pumps that are not running are in the **OFF** position.
2. **Engine control switch is in Auto position.**
3. **Sub 102, 15 KV Feeder Breaker 52-A1 is CLOSED.**
4. **Voltage must be present on incoming line at 4160V Main Breaker 52-M1.**
5. **4160V Main Breaker 52-M1 is OPEN.**
6. **Generator Breaker 52-G1 is CLOSED** with generator running.

1. Verify voltage is present on Incoming meter.

2. Manually open Generator Breaker 52-G1.

NOTE

After tripping the generator, the Start/Run signal is maintained, and the generator continues running.

3. After 5 second delay, manually close 4160 V Main Breaker 52-M1.

NOTE

Closing 4160V Main Breaker 52-M1 enables the Auto-Start control, and begins the generator cool down time of approximately 1 minute.

4. After the cooldown timer times out, the generator will shut down.

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

V. INSTRUCTIONS - Continued

C. Auto-Start Test Procedure

CAUTION

Performing this test will kill the #7 Cooling Tower & Reactor 746 & 747 agitator 4160V main bus until standby generator power is on line. Reactors 746 & 747, and the New Module Low Mole Stripper must be out of service during this test to avoid process upsets.

NOTE

Standby Generator Conditions for Auto Start testing are the same as for normal operation:

1.	**Sub 102, 15 KV Feeder Breaker 52-A1 is CLOSED**, and utility power is present.
2.	4160 V Main Breaker 52-M1 is **CLOSED.**
3.	4160 V Generator Breaker 52-G1 is **OPEN.**
4.	Generator Engine Control Switch is in AUTO.
5.	Cooling Water Pump selected for Auto Start is running.

1. Notify the Shift Supervisor of intent to test Cooling Tower Standby Generator Auto-Start.

2. Manually **OPEN** Sub 102 15 KV Feeder Breaker 52-A1.

   2.1 Loss of bus voltage for 15 seconds will trip Breaker 52-M1.
   2.2 After Breaker 52-M1 opens, the generator will crank and ramp to operating speed and voltage.
   2.3 Generator Breaker 52-G1 will close.
   2.4 Selected cooling water pump will start.

CAUTION

If any cooling water pump other than the one selected for emergency operation, or a reactor agitator starts, the control circuit has malfunctioned. If this occurs, the generator will trip on overload.

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

V. INSTRUCTIONS - Continued

D. Maintenance Test Procedure

NOTE

A weekly generator test is necessary to ensure generator startup capability. This procedure only tests the standby generator, and can be performed without affecting the cooling water pump or reactor agitator operation.

1. Inform Lead Operator of intent to perform maintenance test on GN-003, Cooling Tower Standby Generator.

2. Turn engine control switch to Manual position.

NOTE

Turning the engine control switch to Manual position should start the generator.

3. Test run generator for 45 minutes.

4. Perform weekly PM checks.

VII. OPERATING LIMITS

Critical Parameter	Loop Number	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Emergency

PROCESS AREA: New Module

PROCEDURE TITLE: Cooling Tower Standby Generator Operation

VIII. REVISION HISTORY

Description of the Change	Revision
Added step to switch off the pumps that are not running prior to return to utility power, and other minor revisions. Ref.: 99-NM-004 MOCA.	04/27/99

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 5
Utilities Operation Manual	08/09/00
Propane System General Information	UT-PR-001

APPROVED BY: ______________________________ Date: __________
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.

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 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.

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 t 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

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.

Revision History

Description of Change	Revision Date
Reviewed – no changes made	09/28/99
Company Name Change	08/09/00

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 7
Utilities Operation Manual	08/09/00
Start-Up & Operation of Propane System	UT-PR-002

APPROVED BY: ______________________________ **Date:** __________
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.

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.

1.1.5 Make sure isolation valves (CV2701, CV2702, and CV2705) are open.

1.1.6 Open the recirculation line valves and then slowly open the liquid valves on one large storage tanks (45-029 or 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 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.

IV. OPERATING PROCEDURE - Continued

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 standby.

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.

IV. <u>OPERATING PROCEDURE</u> - Continued

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 Enunciator 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 <u>Pump Start-Up</u>

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.

IV. OPERATING PROCEDURE - Continued

2.2 Pump Start-Up - continued

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	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.

VII. REVISION HISTORY -

Description of Change	Revision Date
Modified procedure to add isolation valve CV2705 to be open under Operating Procedure, 1.1.5.	10/10/97
Changed section IV. Operating Procedure 1.1.6	09/28/99
Company Name Change	08/09/00

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 5
Utilities Operation Manual	08/09/00
Propane System Shutdown	UT-PR-003

APPROVED BY: ______________________________ Date: __________
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 Motors	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.

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 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 # 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 of 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	Check Propane Transfer Pump operation.
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	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.

Revision History

Description of Change	Revision Date
Reviewed – no changes made	09/28/99
Company Name Change	08/09/00

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 4
Utilities Operation Manual	**08/09/00**
Propane Truck Unloading	**UT-PR-004**

APPROVED BY: ____Date: __________
Jimmy Autrey - Maintenance Manager

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

III. References - MSDS for Propane.
Liquefied Petroleum Gas Plant Operators Manual, LP Gas Industrial E
E 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.

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. If loading both west tanks, 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. Ensure that both west tanks are lined up to accept 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 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° 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.

Revision History

Description of Change	Revision Date
Changed section IV Operating Procedure 1.9	09/28/99
Company Name Change	08/09/00

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 4
Utilities Operation Manual	08/09/00
Propane System Emergency Procedures	UT-PR-006

APPROVED BY: ______________________________ Date: __________
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 Plan 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.

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 shutdown 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 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).

(72-

2.1.3 The propane bullet storage tanks are manually blocked in , while the plant is not on propane.

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 pisg) occurs.
General Monitors	1) Samples specific areas to analyze hydrocarbon concentration. 2) Activate the deluge system.

Revision History

Description of Change	Revision Date
Added 2.1.3	09/28/99
Company Name Change	08/09/00

Georgia Gulf Chemicals & Vinyls, LLC – Aberdeen Plant	Page 1 of 7
Utilities Operation Manual	05/29/02
Operation of the Instrument Air Compressors, CP-708 (North) and CP-709 (South).	UT-AS-001

APPROVED BY: ________________________________ Date: __________
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 -

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.

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 Airtek 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 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 unload 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.

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 Airtek air dryer at approximately 80°F.
- a. A moisture trap is located on the outlet of the air header on the aftercooler, before the Airtek 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

your body.

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

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

REVISION HISTORY

Description of Change	Revision Date
Company Name Change	08/02/00
Made changes per JAS	05/29/02

APPROVED BY: ______________________________ Date: __________
Jimmy Autrey - Maintenance Manager

I. Purpose -

The purpose of this procedure is to provide information on the operation and isolation of the Airtek Instrument air dryer, located south of the Instrument Air Compressors.

II. References -

Safety and Health Manual
*Energy Lock Out Procedure
*Confined Space Entry Procedure
*Safe Work Permit Procedure
Utility Procedures
System Drawing in This Procedure

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	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.

D. Special or Unique Hazards-Hot electric heating element, extremely hot surfaces.

IV. Discussion

The Airtek Instrument air dryer is used to dry the air on the discharge of the instrument instrument air compressors. Air from the instrument air compressor is routed to the plant for use in the control of air operated valves and other system controls.

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

Power lock switch on. The bed will automatically switch when the dewpoint rises above -40°. 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 is classified as a physical entry.

V. Operating /Isolation Procedures

1.0 Operation of the plant air Airtek Instrument air dryer.

1.1. Check that electrical power is available.

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

a. Breaker located at power panel MCC 10A1-E, breaker 1F.

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 dryer indicator panel.

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

1.2.1 Air discharges from the instrument air compressors and passes through an aftercooler.

1.2.2 From the aftercooler the air enters the bottom side of the surge tank.

a. The surge tank collects any debris and moisture that may be carried in the air.

b. Automatic Electric timed drain valves are installed to remove these contaminates from the surge tank.

1.2.3 Air leaves the surge tank, at the top east side and travels to the pre-filters.

1.2.4 These pre-filters are coulescers, they aid the dryer by removing some of the water vapor from the air.

1.2.5 Air enters the bottom ~~top~~ of the "in service" bed, flows through the desiccant, and out the ~~bottom~~ top of the bed.

1.2.6 Hot, dry air from the in service dryer bed flows through a particulate filler and enters an instrument air receiver.

1.2.7 Air leaves the receiver and passes to the instrument air header.

****
Extremely high temperatures exist in the compressor and dryer areas.
****

2.0 Regeneration Cycle

2.1 A 5% flow of hot air enters a heating chamber.

2.1.1 Inlet temperature, at the heating chamber, is between 250-300° F, from the compressor.

2.1.2 The discharge air temperature, from the heating chamber, will be controlled between 400-450° F by an electric heating element.

2.1.3 The heating element will maintain a 400°F temperature while the bed is in regeneration.

2.2 The heated air enters the top ~~bottom~~ of the dryer bed, travels downward ~~upward~~, out the bottom ~~top~~ of the dryer as wet air.

2.3 Regeneration times are controlled by a timer, except for the heating element operation.

3.0 In Service Operation.

3.1 All incoming air, to the dryer bed in service, will pass through a series of aftercoolers, surge tank, and a prefilter before entering the dryer bed.

3.2 The air flow to the in service bed is filtered at the prefilter, just east of the dryer beds.

3.2.1 An inline spare is provided to take the filter out of service for filter element replacement.

3.3 Air enters the top of the in service filter, flows through the hot, dry desiccant, and exits the bottom of the dryer.

3.4 The flow of dried air enters an afterfilter.

3.4.1 The afterfilter (particulate filter) removes any fines of desiccant that may have carried over in the air flow through the bed.

3.4.2 An inline spare is provided to take the filter out of service for filter element replacement.

3.4.3 A bypass is provided to take the dryer out of service if necessary for emergency.

4.0 Dryer Controls.

4.1 Dryer operations are controlled by a timer.

4.1.1 One bed will be in service, while the other bed is in regeneration.

4.2 Air flows through the beds are directed by bi-directional flow valves.

4.2.1 Air pressure is used to automatically operate and position valves.

a. Depending on the step in regeneration or if the bed is in service, will determine the direction of flow past the valve.

4.3 Temperature of the heated air flow to the regenerated bed is controlled by a heating element.

4.3.1 Heating element heats air to 400-450°F range.

a. Heating element is turned on at the start of the regeneration step, by a timer, and will cycle on and off to control the temperature between 400-450° F.

b. Heating element is turned off once the bed (regenerating) outlet temperature reaches 200° F.

4.4 The flow of air through the dryer bed is controlled by a hand operated valve with flowmeter located on the east side of the unit.

5.0 Isolation and Tag Out of the Instrument Air Dryer.

****

Bypass the dryer before isolating the dryer.
Disruption of instrument air flow must be avoided.

****

5.1 The dryer will have to be taken out of service for media changes or repairs. First stop will be to isolate the air dryer without disrupting the instrument air flow to the plant. The flow of air must be bypassed before isolating the dryer.

5.1.1 Open ball valve (N/S) after the surge tank.

a. Tagging is not needed, as mentioned in the next step. It is done as an option to prevent accidental closure of the normally closed valves. Valve will still need to be operated. Attach a lock and a "Do Not Operate" tag to the operator.

5.2.2 Close the inlet and outlet valves to the dryer.

a. Tagging is not needed, as mentioned in the next step. It is done as an option to prevent accidental closure of the normally closed valves. Valve will still need to be operated.

b. Attach a lock and a "Do Not Operate" tag to the operator.

****

All energy sources must be tagged and locked.

****

5.2.3 Open electrical breaker for the control power to the dryer.

a. Breaker located at the emergency generator substation, north of the plant air compressors. Power controls regeneration and heater element.
b. Breaker is a breaker 1F.
c. Attach a lock and a "Do Not Operate" tag to the opened breaker handle.

6.0 Isolation of the Surge Tank at the Dryer

****

All energy sources must be tagged and locked.

****

6.1 Perform all of the steps in Section 5.0 to bypass the air dryer. Additional tagging and isolation is needed to work on the surge tank.

6.1.1 Close the 6" block valve at the surge tank to the instrument air header.

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

6.1.2 Close the 6" block valve from the surge tank to the pre-filter

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

6.1.3 Open the 6" ball bypass valve if air is needed to the plant

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

6.1.4 Open the two 1/2" drain valves at the bottom of the surge tank.

a. Attach "Do Not Operate" tags to the valves.

7.0 Safety at the Dryers.

****

Extremely high temperatures exist in the dryer and compressor areas.
Ear protection is required at all times in the area.

****

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

7.1.1 Wear hearing protection at all times in the area.

7.2 Some surfaces have temperatures over 400° F.

7.2.1 Wear leather gloves whenever operating valves.

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

This page will be scanned.

VI. Operating Limits

Critical Parameter	Loop Number	Operating Limit	Consequence of Deviation	Prevention 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 Protection Leather Gloves

VII. Safety Systems and Their Functions

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

Revision History

Description of Change	Revision Date
Replaced procedure	10/5/99

FOR FINAL REVIEW/APPROVAL

CONDEA Vista 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: ____________________ Unit Manager Resin	**DATE:**__________

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.

A. Properties/Hazards of Chemicals

N/A

B. Precautions to Prevent Exposure

N/A

C. Control Measures to be Taken if Exposed

N/A

CONDEA Vista 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

III. SAFETY AND HEALTH CONSIDERATIONS-Continued

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

N/A

E. Special or Unique Hazards

N/A

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.

V. OPERATING PROCEDURE

"NOTE"

The deluge water 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.

V. OPERATING PROCEDURE-Continued

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).

"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 polyvic 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.

V. OPERATING PROCEDURE-Continued

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.

V. OPERATING PROCEDURE-Continued

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).

"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.

V. OPERATING PROCEDURE-Continued

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 reactor recovery page.

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

4.4 Select "OFF" and verify water flow drops.

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.

V. OPERATING PROCEDURE-Continued

"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.

"NOTE"

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

VI. OPERATING LIMITS

CONDEA Vista 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

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.

VII. SAFETY SYSTEMS AND THEIR FUNCTIONS

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

VIII. REVISION HISTORY

Description of the Change	Revision
Updated procedure to reflect changes.	1
	05/01/99

FOR FINAL REVIEW/APPROVAL

CONDEA Vista 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:**__________
Unit Manager Resin

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

B. Precautions to Prevent Exposure

N/A

C. Control Measures to be Taken if Exposed

N/A

FOR FINAL REVIEW/APPROVAL

CONDEA Vista 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

III. SAFETY AND HEALTH CONSIDERATIONS-Continued

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

N/A

E. Special or Unique Hazards

N/A

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.

V. OPERATING PROCEDURE

"NOTE"

The deluge water 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.

V. OPERATING PROCEDURE- Continued

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).

1.3 Start Emergency Generator for RX 746 and 747.

"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 the 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

CONDEA Vista 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- Continued

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).

3.1.4 Open bypass valve around Actuator 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.

FOR FINAL REVIEW/APPROVAL

CONDEA Vista 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- Continued

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).

"NOTE"

During the 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 will not drop in pressure or temperature.

PROCESS: **New Module** **PROCEDURE TYPE:** **Emergency**

PROCESS AREA: **New Module**

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

V. OPERATING PROCEDURE- Continued

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 reactor 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.

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.

V. OPERATING PROCEDURE- Continued

"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.

"NOTE"

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

VI. OPERATING LIMITS

CONDEA Vista 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**

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.

VII. SAFETY SYSTEMS AND THEIR FUNCTIONS

N/A

VIII. REVISION HISTORY

Description of the Change	Revision
Updated procedure to reflect several changes.	1
	05/01/99

APPROVED BY: ______________________________ **Date:** ______________
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, (3) a chlorine eductor, and (4) chlorine scales.

   The vacuum regulator has a capacity of 500 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~~ 5 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~~ 4 cooling towers, and centrate system.

   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 0.2 and 0.4 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
Revisions per Jon Cummins (Chlorine Feed)	02/12/98
Reviewed – no changes	09/29/99

APPROVED BY: ______________________________ **Date:** ______________
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. con-tainers.
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. con-tainers.
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 50 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.

****

W A R N I N G

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 0.2 and 0.4 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.

REVISION HISTORY

Description of the Change	Revision
Revisions per Jon Cummins	2/12/98
Reviewed – no changes	09/29/99

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

APPROVED BY: ____________________________ **Date:** _____________
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 chlori-nation 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. <u>OPERATING PROCEDURE</u> - Continued

3.0 <u>Leak in the Vacuum Regulator, Regulator Vent, or Supply Lines to Eductor</u>

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 <u>Leak at Container Valve, Fusible Plug, or Container</u>

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.

REVISION HISTORY

Description of Change	Revision Date
Changed format of revision history box	09/29/99

Approved: ______________________________Date:______________
Jimmy Autrey - Maintenance Manager

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 contstant 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 chlorine canister and some rubber gloves. Get some rags and aqua ammonia to check for leaks. Follow start-up procedures beginning with step 9 of <u>START-UP PREPARATION.</u>

****

****
CAUTION: Even though the system was free of leaks during the previous shutdown, one should be aware of the possibility of a leak occurring when starting the system back up. Do no skip any leak checking steps in any part of the start-up procedure.
****

V. Operating Procedure-

<u>START-UP PREPARATION</u>

!!

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 canister 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 canister, 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 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-~~ 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.	Boostwater pressure

VII. Safety Systems and Their Functions - N/A

REVISION HISTORY

Description of the Change	Revision
Committed to DMS	1 – 12/02/98
Company Name Change	07/20/00

VI. Description of Covered Processes

A. Propane System

Process description for propane system is detailed in the Georgia Gulf, Utilities Operations Manual, Procedure # UT-PR-001, "Propane System General Information", "Discussion" section, October 09, 2000. See Appendix B.

B. Instrument Air System

Instrument air is supplied by the West Joy (CP-912) and CP-708/709. CP-708 and CP-709 supply air at a rate of 526 ICFM and a pressure of 100 psig (each). The West Joy provides both plant and instrument air. The West Joy can supply 3500 SCFM @ 100 psig. The compressors have an interstage cooler that reduce the temperature of the first stage air (first and second stage for the West Joy). The air exits the compressor at a temperature around 250 °F. The hot air then flows through aftercooler EX-300 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-300. The air then flows through surge tank, DM-813. Air exiting DM-813 then flows to the Airtek instrument air dryer.

Before entering the Airtek, DR-030, the air is filtered. The air then enters one of two desiccant beds where the dew point is reduced to -40 °F or less. The instrument air is then filtered again and distributed throughout the plant for use as instrument air.

C. Emergency Cooling Water System

Process description for the Emergency Cooling Water System is detailed in the Georgia Gulf, Vinyl Operations Manual, procedures # Vinyl-OM-E008 & Vinyl-NM-E008, "Operation of Deluge Water to Emergency Cooling Water System", "Discussion" section, May 5, 1999. See Appendix B.

D. Cooling Tower Chlorination System

Process description for the Cooling Tower Chlorination System is detailed in the Georgia Gulf, Utilities Operations Manual, procedure #'s UT-CT-001 & UT-CT-002, "Operation of Chlorination System for CT-002, CT-004, and CT-006", Discussion section , 09/29/99 and "Operation of Chlorination System for CT-005","Discussion" section, 09/29/99. See Appendix B.

E. Water Plant Chlorination System

Process description for the Water Plant Chlorination System is detailed in the Georgia Gulf, Utilities Operations Manual, procedure # UT-WP-002, "Chlorine Feeder System Operation", "Discussion" section, July 20, 2000. See Appendix B.

F. Standby Generators

There are three standby generators installed at the plant.

GN-001 provides standby power to the Pall Air Dryer, the Airtek Air Dryer, CP-708 and CP-709, the catalyst freezers, the emergency cooling water pump, and the seal oil pumps for the New and Old Module. See drawings MCC10A1-E-EL-D, 10/28/02 and MCC10A1-E1-EL-D, 11/97. See Appendix A.

GN-004 provides standby power for MCC7AB1-1. This substation currently provides standby power to the Vinyl Control Room UPS, emergency lighting, power transformers, air conditioning units, 24-volt DC battery chargers, pressurization blowers, and the plant telephone system. See procedure Vinyl-OM-E007, May 01, 1999. See Appendix B.

GN-003 provides standby power for one on the cooling water pumps supplying cooling water from Cooling Tower #7 to Reactors 745, 746, and 747. See procedure Vinyl-NM-E013, April 27, 1999. 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 propane 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 the operating procedures make reference to.

B. Past Incidents Review

- Failure of piping components such as pressure gauges in cyclical pressure VCM/Propane service.

- Installation of a blinding skillet that is not correct for the size and/or pressure rating of the pipe flange.

- Operations not performed routinely.

C. Human Factors Review

- Utilities operator is detached from other operations personnel. 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 avoid a shutdown.

D. Facility Siting Review

- Occasional low flying crop dusters fly over the plant.

- Access road by Boilerhouse is close to buildings and is also close to chlorine containers located outside by the coke trays.

- PA system is hard to hear in boiler house.

- 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, chlorine leak, etc., 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 releasing their contents.

- Chlorine containers are stored inside a building that is connected to the Boiler control room. One of the inside doors to the chlorine cylinder room is left open at times.

- Combustible liquids are stored at times in the storage room next to the water plant chlorine cylinder room. The door between these two rooms is left open at times.

E. Site Specific Hazards Review

- No site specific hazards were identified.

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane Truck Unloading - Propane Vapor in Vapor lines, Propane Liquid in Liquid Lines. (Propane liquid transfer at approximately 225 gpm and 125 psid. Truck pump internal bypass set at 150 psi. - Dowdle Propane).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
1.1 High Pressure								
	1. Blocked unloading line during unloading	1. Fire/Explosion 2. Propane leak 3. Propane release	S/E S S/E	4 4 4	C B C	5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly before unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	48
	2. Blocked in liquid line on thermal expansion case	1. Fire/Explosion 2. Propane leak 3. Propane release	S/E S S/E	4 4 4	C B C	5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly after unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	2
	3. Fire	1. Downtime/lost production 2. Explosion 3. Personnel Evacuation 4. Propane leak 5. Propane release	EC S/E S S S/E	4 4 4 4 4	C C C B C	5 5 5 5 5	1. Fire Protection Equipment 2. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1
	4. High upstream pressure (from truck pump)	1. Fire/Explosion 2. Fire/Explosion - E 3. Personnel Evacuation 4. Propane leak 5. Propane release	S E S S S/E	3 4 4 4 4	C C C B C	4 5 5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly before unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	14
1.2 High Temperature								
	1. Fire	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Fire Protection Equipment 2. Fire Watch 3. Hot work permits 4. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1
	2. Hot work in close proximity	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Fire Protection Equipment 2. Fire Watch 3. Hot work permits 4. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane Truck Unloading - Propane Vapor in Vapor lines, Propane Liquid in Liquid Lines. (Propane liquid transfer at approximately 225 gpm and 125 psid. Truck pump internal bypass set at 150 psi. - Dowdle Propane).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
1.3 Low Temperature								
	1. Low Ambient Temperature	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Piping specification includes expected ambient low temperature	1
1.4 Low/No Flow								
	1. High downstream pressure	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Operating procedures for routing flows 2. Unique connectors for flexible lines 3. Valve position indicators	1
	2. Low upstream pressure - truck pump outlet pressure low - pump not running/worn out/ malfunction	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5		1
	3. Driver/Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Unique connectors for flexible lines 2. Valve position indicators 3. Operating procedures for routing flows	1
1.5 Reverse/Misdirected Flow								
	1. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane Release	EC S/E S/E	4 4 4	D D D	5 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading. 2. Operating procedures on line routings 3. Unique connectors for flexible lines 4. Valve position indicators 5. Fire protection equipment	1
	2. Check valve failure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane Release	EC S/E S/E	4 4 4	D D D	5 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading. 2. Operating procedures on line routings 3. Unique connectors for flexible lines 4. Valve position indicators 5. Fire protection equipment	1
	3. Truck unloading line rupture	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane Release	EC S E S/E	4 3 4 4	D C C C	5 4 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	14

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.1 High Pressure								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. Manual activation of deluge system 5. Pressure relief valve - isolation valve under relief valve is normally locked open 6. Sloping ground to prevent accumulation of flammables beneath vessel	15 16
	2. Overfilling of vessel	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 3	D D D	5 5 5	1. Accurate tank gauging before unloading 2. Deluge system 3. Fire monitors and hose stations 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system 7. Pressure relief valve - isolation valve under relief valve is normally locked open 8. Heat sensor activation of deluge system	4 5
	3. Missaligned valves - Propane pump suction connected to one storage tank and recirculating (pressure control) to another storage tank (not equalized).	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system 7. Pressure relief valve - isolation valve under relief valve is normally locked open	4 5
	4. Relief valve isolated (block valve under relief valve closed) under relieving condtions	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system	4 5

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.1 cont'd								
	4. cont'd						6. Manual activation of deluge system 7. Plant sign in/sign out for key to locks on valves under relief valves	
	5. Relief valve plugged under relieving conditions.	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system	4 5 7
3.2 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system 5. Manual activation of deluge system 6. Operating procedures 7. Pressure relief valve 8. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 9. Sloping ground beneath vessel to prevent flammables accumulating	6 15 16
3.3 High Level								
	1. Operator/truck driver overfill tank during filling	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Level gauge - dip tube (two tanks) bleed gauge with rotary dial (one tank). 2. Operating procedures	17
	2. Recirculation valves misaligned to pull from one tank and return to another	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Operating procedures	5 17 18
	3. Inaccurate tank gauging prior to unloading truck	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Level gauge - dip tube (two tanks) bleed gauge with rotary dial (one tank). 2. Operating procedures	17

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.4 Leak								
	1. Corrosion and/or erosion	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures	
	2. Flange, flange gasket, threaded fitting, and packing failure	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures 4. Procedures for torquing bolts	6
	3. Inadequate torquing of bolts	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures 4. Procedures for torquing bolts	6
	4. Relief valve or instrument failure to contain pressure	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. Isolation valves on pressure gauges and relief valve 3. LEL detection activation of deluge system & Alarm 4. Maintenance & inspection procedures 5. Procedures for torquing bolts	6
3.5 Rupture								
	1. Propane storage tank material failure due to fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system 5. Manual activation of deluge system 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 7. Sloping ground beneath vessel to prevent flammables accumulating	15 16
	2. Overpressure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system	7

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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 Georgia Gulf 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.

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, and 7 chlorination systems.
- Water Plant chlorination system.
- Standby Generators, GN-001, GN-003, GN-004

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

P&ID Number	Issue Date	Operating Procedure Number	Issue Date
BP-090100-PID-D	09/19/02	UT-PR-001	08/09/00
BP-090101-PID-D	12/11/02	UT-PR-002	08/09/00
BP-090102-PID-D	12/11/02	UT-PR-003	08/09/00
UT-090102-PID-D	02/25/94	UT-PR-004	08/09/00
UT-090108-PID-D	12/11/02	UT-PR-006	08/09/00
UT-090109-PID-D	12/11/02	VINYL-OM-E008	05/01/99
UT-090109A-PID-D	10/15/02	VINYL-NM-E008	05/01/99
UT-090111-PID-D	09/26/02	UT-AS-001	05/29/02
UT-090112-PID-D	12/11/02	UT-AS-009	07/26/00
UT-090113-PID-D	12/11/02	UT-WP-002	07/20/00
UT-090114-PID-D	12/11/02	UT-WP-003	08/09/00
UT-090115-PID-D	10/09/02	UT-WP-017	07/20/00
UT-090117-PID-D	10/10/02	UT-WP-018	07/20/00
UT-090122-PID-D	12/11/02	UT-CT-001	09/09/99
UT-090123-PID-D	10/23/02	UT-CT-002	09/29/99
WP-090106-PID-D	09/26/02	UT-CT-003	09/29/99
NE-D606-57-4-D	06/29/92	VINYL-OM-E007	05/01/99
GP-9721-62-6D	08/23/83	VINYL-NM-E013	04/27/99
MCC10A1-E-EL-D	10/28/02	VINYL-NM-N475	08/31/00
MCC101A-E1-EL-D	11/97		

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

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

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

IV. Team Members and Qualifications

Selection of the Hazop team is consistent with OSHA requirements and the requirements outlined in the Aberdeen Plant, PSM-004, " Process Hazard Analysis", section 4.4.2, Revision 5.

Name	Title	Expertise	Qualifications
Erik Smith	Facilitator	Engineering	Erik has 11 years experience in the Aberdeen Plant. Erik has had formal Hazop team leader training (see Appendix H).
Jimmy Brewer	Utility "A" Technician	Utility Operations	Jimmy has worked in the Aberdeen Plant for 32 years. Of these years he worked 22 years in the Yard and 10 years in Utility Operations.
David Nolen	Instrument Technician	Instrumentation/ Maintenance	David has worked in the Aberdeen Plant for 33 years. Of these years he spent 6 years in operations, 13 years general maintenance, and 14 years as an instrument technician.
Nathaniel Wilson	Chief Lead Operator	Vinyl Operations	Nathaniel has worked in the Aberdeen Plant for 30 years in Vinyl Operations.
Ed Mize	Maintenance "A" Mechanic	Maintenance	Ed has worked in the Aberdeen Plant for 36 years. Of these he spent 9 years in Plasticizer and 6 years in Electrical Maintenance and 21 years in Mechanical Maintenance.
Jeff Seaver	Reliability Engineer	Engineering & Operations	Jeff has worked in the Aberdeen Plant for 6 years. Of these he spent 3 years as a Project Engineer and 3 years as a Reliability Engineer. While a Reliability Engineer he served as a Temporary Utilities Supervisor for one year.
Jimmy Morgan	Maintenance "A" Mechanic	Maintenance	Jimmy has worked in the Aberdeen Plant for 29 years. Of these he spent 14 years in maintenance, 7 years in the Lab, and 8 years in Vinyl and Compound Operation.
David Roberts	Maintenance "A" Electrician	Maintenance	David has worked in the Aberdeen Plant for 32 years. Of these he spent 3 years in the Hose Department, 18 years in Mechanical Maintenance, and 11 years as Electrical Maintenance.

V. Team Orientation

A. Methodology

The methodology used to perform the Hazop study is outlined in the Georgia Gulf Chemicals & Vinyls – Aberdeen Plant, PSM-004, " Process Hazard Analysis", Revision 5, Section 4.

B. Risk Ranking Tables

Risk Ranking of identified process hazards was completed per the instructions and information provided in the Georgia Gulf Chemicals & Vinyls – Aberdeen Plant, PSM-004, " Process Hazard Analysis", Revision 5, Appendix D.

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.

Georgia Gulf Chemicals & Vinyls, 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	0
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	0
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	0
Displays	immediate, unambiguous	none or potentially misleading	0

Deviations	+	-	Observed Practice
Alarms	first-out; safety critical alarms	many simultaneous or false alarms	0
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	0

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	0
Format	graphical identification aids	Confusing/inconsistent; difficult to read	0
Aids	checklist or supervisory check	task sequence done by memory	0

"+" = 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.

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Scheduling	+	-	Observed Practice
Overtime		Extreme enough to affect performance	0
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	+ - for Propane
Intensity	regular tasks at normal pace	differing tasks in rapid succession	0

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	0
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	NO	DISCUSSION TOPIC
X		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.

REVIEWED YES	NO	DISCUSSION TOPIC
		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.)
		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, and rags.

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

REVIEWED YES	NO	DISCUSSION TOPIC
		Fire Protection
X		40. Access for fire fighting and other emergency services - trains, vehicle parking, and construction.
X		41. Ignition sources, continuous, intermittent, uncontrolled, hot surfaces.
X		42. Access to hydrants, monitors, and deluge valves.
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, and offices.

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

Instructions: This checklist represents item #36 on the Georgia Gulf Chemicals & Vinyls 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	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.

REVIEWED YES	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 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

F. Team Orientation Meeting Review Checklist

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

Session #	Date	Time (h)	Comments
1	10/28/102	8.0	Team Orientation, Human Factors, Facility Siting, Preliminary Hazards Review
2	10/29/102	8.0	Facility Siting, Human Factors, Prelimnary Hazards Review, P&ID and Operating Procedure Review
3	10/30/102	6.0	P&ID and Operating Procedure Review, Unit Tour
4	10/31/102	8.0	Team Orientation - New Member, P&ID and Operating Procedure Review
5	11/1/102	8.0	P&ID and Operating Procedure Review
6	11/4/102	8.0	P&ID and Operating Procedure Review
7	11/5/102	8.0	P&ID and Operating Procedure Review
8	11/6/102	4.0	P&ID and Operating Procedure Review
9	11/7/102	8.0	P&ID and Operating Procedure Review
10	11/8/102	8.0	Team Orientation - New Member, P&ID and Operating Procedure Review
11	12/16/102	8.0	P&ID and Operating Procedure Review
12	12/17/102	8.0	P&ID and Operating Procedure Review, Safety Audit Review, Moca Review, RecomendationsReview, Facility Siting Follow-up

ABD00031336

12/18/02 Utilities Area UTIL_02A.PHA

	1 - 10/28/102	2 - 10/29/102	3 - 10/30/102	4 - 10/31/102	5 - 11/1/102	6 - 11/4/102	7 - 11/5/102	8 - 11/6/102	9 - 11/7/102	10 - 11/8/102	11 - 12/16/102	12 - 12/17/102
BREWER, JIMMY												
MIZE, ED				-					-	-	-	-
MORGAN, JIMMY	-	-	-		-	-	-	-				
NOLEN, DAVID										-		
ROBERTS, DAVID											-	-
SEAVER, JEFF												
SMITH, ERIK												
WILSON, NATHANIEL												

17A-2

Approved ____Date:______________________
Jimmy Autrey, Maintenance Manager

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 pie, 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).

Don 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.

Chlorine an 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 0
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 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 liquefied 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 pisg).

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 Enter tare weight of container put on scales.

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 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.

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WARNING: If a chlorine leak develops at any time during normal handling when operators are protected only by a full face shield and chlorine canister, leave immediately and follow chlorine leak response procedure UT-WP-018.

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NOTE

Ensure that the drip leg heaters for both North and South vacuum regulator/check valves are plugged in and operating.

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3.4 Remove the chlorine container valve protection 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 an 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. Close again. 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 than 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. Standby container can not be hooked up before container in service is less than 500lbs.

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NOTE

The standby condition is indicated by the regulator's valve stem protruding up from the center of the open-close knob.

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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.

Re-

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 chlorine leak alarm is heard, leave immediately 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 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 SOLENOID 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 one 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 vale.
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.

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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.

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12.3 To calculate the chlorine feed rate in pounds per day (lb/day) for any well water flow rate use the following equation:

Chlorine Concentration (PPM)	X	Well Water Flow Rate (GPM)	÷	83.27	= Chlorine Feed Rate (lb/day)
____________________	**X**	__________	÷	**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 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.

REVISION HISTORY

Description of the Change	Revision
Committed to DMS	12/02/98
Change per Terry Noland – 1.4	12/02/98
Change per Terry Noland – 3.23	12/02/98
Changes per TLN (I. Purpose)	10/06/99
Company Name Change	08/09/00

Approved ______________________________ Date: ____________
Jimmy Autrey, Maintenance Manager

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 -

<u>RESPONSIBILITY - UTILITY OPERATOR</u>

1.0 CHLORINE LEAK - OPERATOR DETECTED

1.1 **NO VISIBLE VAPOR CLOUD -** Notify Vinyl operations personnel 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.

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1.3 You (person responsible) and one or more emergency respondents 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 guidelines 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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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 beginning 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

REVISION HISTORY

Description of the Change	**Revision**
Committed to DMS	02/01/99
Company Name Change	07/20/00

Approved ____Date:__________________
Jimmy Autrey, Maintenance Manager

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 larms, Chlorine Feeder Interlock Failures, Power Failures, Chlorine Feeder Failures, and ater Supply Solenoid Failures.

II. References - The Chlorine Manual: Chlorine Institute, Wallace & Tiernan Manuals, aterial Safety Data Sheet for Chlorine and Aqua Ammonia, Harcross Chemical training nformation sheet. Phone 601-9639-3177.

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 personnel of the leak (CALL 2200). Request assistance om person(s) equipped with SCBA(s). Obtain wind directions.

1.2 Turn off the well pumps.

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1.3 You (person responsible) and one or more emergency respondents 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 guidelines 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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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 indicate that there is an emergency chlorine leak situation.

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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 beginning 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 grater 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, fusible 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 transpiration.

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

REVISION HISTORY

Description of the Change	**Revision**
Committed to DMS	02/01/99
Company Name Change	07/20/00

ABERDEEN PLANT

OPERATING PROCEDURES

PROCESS: New Module **PROCEDURE TYPE:** Normal

PROCESS AREA: Distributive Control System

PROCEDURE TITLE: Cooling Tower Fan Control

APPROVED BY: ______________________________ **DATE:** __________
Unit Manager Resin

I. PURPOSE

The purpose of this procedure is to describe the cooling tower fan control for Cooling Towers CT-006A/B, CT-007.

II. REFERENCES:

UT-090113, Cooling Water System, Sheet 2 of 4
UT-093122, Cooling Water System

III. SAFETY & HEALTH CONSIDERATIONS

Safety Systems And Their Functions

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

IV. DISCUSSION

A. General Information

Cooling Tower fans are turned on and off by temperature control in the basins of the cooling tower. The fans will shut off at 50°F and turn back on at 60°F. The fans for CT-006B and CT-007B have a dual speed control and will turn on to low speed at 60°F and high speed at 65°F.

B. Location Codes

#6A Cooling Tower Fans(E&W)	CT-006A
#6B Cooling Tower Fan	CT-006B
#7A Cooling Tower Fan (E)	CT-007A
#7B Cooling Tower Fan (W)	CT-007B

V. INSTRUCTIONS

1. Control Scheme for CT-006A Fans:

1.1 DCS shuts fans off when basin temperature reaches 50°F. Temperature element (82T097), Fan switches (82H071, 82H072).

1.2 DCS turns fan on when basin temperature reaches 60°F.

2. Control Scheme for CT-006B/007A&B fans:

2.1 Senses cooling tower basin temperatures:

2.1.1 CT-006B Cooling Tower Temperature element (82T097)
2.1.2 CT-007A/B Cooling Tower Temperature element (92T094)

2.2 DCS turns fans to low speed when basin temperature drops to 60°F:

2.2.1 CT-006B Cooling Tower Fan switch (82H073)
2.2.2 CT-007A/B Cooling Tower Fan switch (92H090A)

2.3 DCS turns fans off when basin temperature drops to 50°F.

V. INSTRUCTIONS - Continued

2.3.1 CT-006B Cooling Tower Fan switch (82H073)
2.3.2 CT-007A/B Cooling Tower Fan switch (92H090B)

2.4 DCS turns fans to high speed when basin temperature increases to 65°F.

2.4.1 CT-006B Cooling Tower Fan switch (82H073)
2.4.2 CT-007A/B Cooling Tower Fan switch (92H090A)

"NOTE"

The Panel Operator has ability to run fans on and off manually, if necessary

**********CAUTION*********

When cooling tower fans are on high speed, they must be turned off and their speed allowed to decrease below the low operating speed before being placed on low speed.

VI. OPERATING LIMITS

Critical Parameter	Loop Number	Oper. Limit	Consequence of Deviation	Prevention or Corrective Action
Basin Temperature		Less than 60°F	Excess electric power consumption.	Fan switches place fans on low speed:
CT-006A	82T097			82H073
CT-007	92T094			92H090B
Basin Temperature		Less than 50°F	Freezing of Cooling Tower.	Fan switches turn fans off:
CT-006A	82T097			82H071, 82H072, and 82H073
CT-007	92T094			92H090A
Basin Temperature		Greater than 65°F	Insufficient cooling.	Starts/places fans on high speed.
CT-006A	82T097			82H071, 82H072, and 82H073
CT-007	92T094			92H090A/B

VII. REVISION HISTORY

Description of the Change	Revision
Cooling Tower 007 Installation.	01/06/98
Reviewed procedure.	08/31/00

APPENDIX C

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix C. Employee Participation Documentation

INTER OFFICE

Georgia Gulf

To: All Aberdeen Employees

From: Erik Smith

Date: October 23, 2002

Subject: **Employee Participation in the Utilities Area HAZOP Revalidation**

To comply with OSHA regulations, the Utility Area HAZOP (Hazard and Operability Study) will be revalidated. HAZOP is a method of evaluating a process to determine potential hazards. The Utility Area includes the Propane Tank Farm, the Instrument Air compressors and dryer, the Vinyl Emergency Generators, the Chlorine gas feed systems, and the Vinyl Cooling Towers. Employee participation in the Revalidation of the HAZOP is required.

The following employees are currently selected to be part of the Utility Area HAZOP team:

Jimmy Brewer
David Nolen
Ed Mize
Nathaniel Wilson
Jeff Seaver
Erik Smith

All Aberdeen Plant employees are requested to inform the team members of potential safety or environmental issues related to the Utility area that they may be aware of.

Meetings are schedule to be held in the plant's Training Conference Room. Meeting times are 7:00 a.m. - 3:30 p.m. daily beginning Monday, October 28, 2002.

Posting Date 10-24-02
Removal Date 11-08-02 after 3:30

APPENDIX D

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA 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	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
MSDS Toxicity	
Permissible Exposure Limits	
Physical Data	
Reactivity Data	
Corrosivity Data	
Thermal & Chemical stability Data	
Hazardous Effects of Inadvertent Mixing	
MSDS for Propane	Aberdeen/Safety/General Plant/MSDS/Vendor/Fuels (Gases or Liquids)
MSDS for Chlorine	Aberdeen/Safety/General Plant/MSDS/Vendor/Water Treatment Chemicals

II. Information On Technology of Process	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
PFD/Block Flow Diagrams	
Process Flow Diagram - Propane System	Aberdeen/Utilities/General Plant/Engineering Drawings/Flow Diagrams/General
Process Flow Diagram Cooling Tower Chlorination	"
Process Flow Diagram Water Plant Chlorination System	"
Process Flow Diagram - Cooling Tower #5 Chlorination System	"
Plant Air Systems	Utility Hazop File Aberdeen/Utilities/General Plant/Engineering Drawings/Flow Diagrams/General
Maximum Intended Inventory	
Maximum Plant Inventory of Highly Hazardous Chemicals, HHC, Rev. 7	Aberdeen/Vinyl/General Plant/Process/Unit Information/Maximum Intended Inventory
Process Chemistry	
No Information	

II. Information On Technology of Process	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
Safe Upper/Lower Limits For Critical Parameters	
See Operating Procedures (See List)	
Evaluation of Consequence of Deviation	
See Operating Procedures (See List)	

III. Information on Equipment In Process	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
Materials of Construction	
See Equipment Files (See List)	
P&ID's	**Aberdeen/---/---/Engineering Drawings/P&IDS/General**
BP-090100-PID-D, 09/19/02	Aberdeen/Utilities/Boiler House/Engineering Drawings/P&IDS/General
BP-090101-PID-D, 12/11/02	"
BP-090102-PID-D, 12/11/02	"
UT-090102-PID-D, 02/25/94	Aberdeen/Utilities/General Plant/Engineering Drawings/P&IDS/General
UT-090108-PID-D, 12/11/02	"
UT-090109-PID-D, 12/11/02	"
UT-090109A-PID-D, 10/15/02	"
UT-090111-PID-D, 09/26/02	"
UT-090112-PID-D, 12/11/02	"
UT-090113-PID-D, 12/11/02	"
UT-090114-PID-D, 12/11/02	"
UT-090115-PID-D, 10/09/02	"
UT-090117-PID-D, 10/10/02	Aberdeen/Utilities/General Plant/Engineering Drawings/P&IDS/General
UT-090122-PID-D, 12/11/02	"
UT-090123-PID-D, 10/23/02	"

Appendix D. HAZOP Pre-Work Material List

III. Information on Equipment In Process	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
WP-090106-PID-D, 09/26/02	Aberdeen/Utilities/Water Plant/Engineering Drawings/P&IDS/General
MCC10A1-E-EL-D, 10/28/02	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/One Line Diagrams
MCC10A1-E1-EL-D, 08/24/94	"
NE-D606-57-4-D, 06/29/92	Aberdeen/Utilities/Boiler House/Engineering Drawings/Instrumentation/Ladder Diagrams
GP-9721-62-6D, 08/23/83	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/Wiring Diagrams
Electrical Classification	
See Equipment Files (See List Below)	
Plant Area Electrical Classifications GP-003000-EL-D, Issue 5	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/Area Electrical Classification Plan
Relief System Design & Design Basis	**Aberdeen/--/--/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis)**
PSV-PV-029	Aberdeen/Utilities/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis)
PSV-PV-030	"
PSV-PV-031	"
PSV-PR-035	Not Found
PSV-PR-036	Not Found
PSV-PR-037	Not Found
PSV-PP-312	Aberdeen/Utilities/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis) **This basis may need to be reviewed for installed pump**
PSV-PP-868	Not Found
PSV-EX-811	Not Found
PSV-EX-811T	Not Found
PSV-EX-812	Not Found
PSV-EX-812T	Not Found
PSV-EX-813	Not Found
PSV-EX-813T	Not Found

Appendix D. HAZOP Pre-Work Material List

III. Information on Equipment In Process	
Item	**Location** **Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
PSV-PV-032	Aberdeen/Utilities/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis) **Relief Basis/Size of relief valve needs review**
PSV-PV-033	" **Relief Basis/Size of relief valve needs review**
PSV-PV-034	" **Relief Basis/Size of relief valve needs review**
PSV-DM-813	Not Found
PSV-CP-708	Not Found
PSV-CP-708A	Not Found
PSV-CP-709	Aberdeen/Utilities/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis)
PSV-CP-709A	Not Found
PSV-DM-838	Files (781250)
PSV-DR-030N	Not Found
PSV-DR-030S	Not Found
PSV-UT-0111	Not Found
PSV-DM-300	Aberdeen/Utilities/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis)
PSV-DM-810	Aberdeen/Vinyl/General Plant/(Safety/Environmental)/Relief Devices/(Specs/Calcs/Design Basis)
Ventilation System Design	
Boilers/Propane/Water Plant Control Room	Not Found
Boiler/Water Plant Lab Room	Not Found
Design Codes/Standards	
See Equipment Files (See List Below)	
Material & Energy Balances	
Not Applicable	

III. Information on Equipment In Process	
Item	**Location** **Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
Safety Systems	DMS/Procedures/PSM Compliance Manual/PSI
Safety Interlocks, shutdowns, measurements, control, and alarm systems	See Loop Drawings listed below
Gas Monitoring Systems	
NE-003254-IN-D,6/29/92	DMS/Files
NE-003282-IN-D, 8/31/93	DMS/Files
02A403	DMS/Files
GP-F016-77-1-D, 4/11/83	DMS/Files
Deluge and Firewater Systems	
DWG# 09-VL-0002-GA-D, 10/01/98	Utility Hazop File DMS/Files
Fire Water System Study, Webb, Murray & Associates, June 1998	PSM File Room
Process Design For Deluge System-Propane Tank Farm, Oct. 13, 1988	Utility Hazop File
NE-003095-PI-D, 4/25/89	Utility Hazop File DMS/Files
NE-003254-IN-D,6/29/92	DMS/Files
NE-D667-42-1-D, 6/2/89	Utility Hazop File
02X401	DMS/Files
Fire & Explosion suppression systems	See Deluge and Firewater Systems
Safety Showers	No Information Reviewed
Breathing Air Systems	No Information Reviewed
Public Address System	
Conversation with plant personnel regarding functionality.	
Standby Generators	
GN-001	See Equipment References Below
GN-003	See Equipment References Below
MCC17B1-1-EL-D, 4/30/02	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/One Line Diagrams

III. Information on Equipment In Process	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
SW-003133-EL-D, 08/26/97	Aberdeen/Vinyl/New Module/Engineering Drawings/Electrical/Wiring Diagrams
GN-004	See Equipment References Below
MCC-7AB1-1-EL-D,2/23/93	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/One Line Diagrams
SWG7AB1-EL-D, 6/98	"
Underground piping, utilities, and sewers	No Information Reviewed

IV. Other Information Used	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
Chemical Interaction Matrix	
Chemical Interaction Matrix for Chlorine	Utility HAZOP File Aberdeen/Utilities/General Plant/Process/Unit Information/Process Chemistry & Interaction Matrix
Previous Incidents (Reviewed)	
1. Catalyst Freezer Fire 3/18/98	Safety Dept. Files
2. VCM Release 4/6/98	"
3. TK 655 7/16/98	"
4. VCM Leak 1/5/99	"
5. Wastewater Line NM 1/11/99	"
6. 903 Compressor Breaker NM 1/26/99	"
7. Power Failure 2/3/99	"
8. Chris White 6/27/99	"
9. Process Water Loss 2/16/01	"
10. Compound Air Compressor Fire 2/16/01(Report 2/18/02)	"
11. Process Water Line 7/22/02	"
12. 720836 Instrument Air Failure, 5/11/94	Aberdeen/Utilities/General Plant/Rotating Equipment/Compressors/Maintenance Records
13. 1995 12/1 Near Miss Failure of Isolation Blind	Aberdeen/Safety/General Plant/(Safety/Health)/(Accident/Injury/Incident Repts)/Near Miss Incidents

IV. Other Information Used	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
14. 1996 4/16 RX 745 Agitator Electrical Problem	Aberdeen/Safety/General Plant/(Safety/Health)/(Accident/Injury/Incident Repts)/Incident Investigation Reports & Findings
15. 1996 6/28 Near Miss 744 Catalyst Pot	Aberdeen/Safety/General Plant/(Safety/Health)/(Accident/Injury/Incident Repts)/Near Miss Incidents
16. 1996 Vacuum Blower	Aberdeen/Compound/General Plant/(Safety/Health)/(Accident/Injury/Incident Repts)/Incident Investigation Reports & Findings
17. 1997 NM D 745 Dump Line	Aberdeen/Vinyl/New Module/(Safety/Health)/(Accident/Injury/Incident Repts)/Near Miss Incidents
18. Fire Old Module Recovery	Aberdeen/Vinyl/Old Module/(Safety/Health)/(Accident/Injury/Incident Repts)/Near Miss Incidents
MOCA's Reviewed	
WP-001-92	Aberdeen/Utilities/---/MOCA/---/---
UT-006-93	Aberdeen/Utilities/---/MOCA/---/---
UT-011-93	Aberdeen/Utilities/---/MOCA/---/---
UT-013-93	Aberdeen/Utilities/---/MOCA/---/---
WP-001-93	Aberdeen/Utilities/---/MOCA/---/---
OM-004-95	Aberdeen/---/Utilities/MOCA/---/---
UT-007-95	Aberdeen/Utilities/---/MOCA/---/---
UT-001-97	Aberdeen/Utilities/---/MOCA/---/---
UT-002-97	Aberdeen/Utilities/---/MOCA/---/---
99-UT-004	Aberdeen/Utilities/---/MOCA/---/---
99-UT-005	Aberdeen/Utilities/---/MOCA/---/---
00-UT-003	Aberdeen/Utilities/---/MOCA/---/---
00-UT-004	Aberdeen/Utilities/---/MOCA/---/---
00-UT-007	Aberdeen/Utilities/---/MOCA/---/---
00-UT-009	Aberdeen/Utilities/---/MOCA/---/---
Safety Audits Reviewed	
Process Safety Management Compliance Audit – 1995	PSM File Room & Aberdeen/PSM/General Plant/PSM Compliance/Audit/Compliance Audit Findings Report

IV. Other Information Used	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
Process Safety Management Compliance Audit – 1998	PSM File Room & Aberdeen/PSM/General Plant/PSM Compliance/Audit/Compliance Audit Findings Report
Process Safety Management Audit, May 7-11, 2001	PSM File Room
Facility Siting	
Facility Siting Process Hazard Analysis Report #42898, April 28, 1998	PSM File Room & Aberdeen/Vinyl/General Plant/PSM Compliance/Process Hazard Analysis/Facility Siting
Dow Fire & Explosion Indices, 09-VL-0001-GA-D	Utility Hazop File & Facility Siting Report #42898, April 28, 1998
Operating Procedures	
UT-PR-001, 08/09/00	Aberdeen/Utilities/General Plant/Procedures/Process Operation Procedures/Normal Operations
UT-PR-002, 08/09/00	"
UT-PR-003, 08/09/00	"
UT-PR-006, 08/09/00	"
UT-AS-001, 05/29/02	"
UT-AS-009, 07/26/00	"
VINYL-OM-E008, 05/01/99	Aberdeen/Vinyl/Old Module/Procedures/Process Operation Procedures/Emergency Operation or Shutdown
VINYL-NM-E008, 05/01/99	Aberdeen/Vinyl/New Module/Procedures/Process Operation Procedures/Emergency Operation or Shutdown
UT-CT-001, 09/29/99	Aberdeen/Utilities/General Plant/Procedures/Process Operation Procedures/Normal Operations
UT-CT-002, 09/29/99	"
UT-CT-003, 09/29/99	"
UT-WP-002, 07/20/00	Aberdeen/Utilities/Water Plant/Procedures/Process Operation Procedures/Normal Operations
UT-WP-003, 08/09/00	"
UT-WP-017, 07/20/00	"
UT-WP-018, 07/20/00	Aberdeen/Utilities/Water Plant/Procedures/Process Operation Procedures/Normal Operations

Appendix D. HAZOP Pre-Work Material List

IV. Other Information Used	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
VINYL-OM-E007, 05/01/99	Aberdeen/Vinyl/Old Module/Procedures/Process Operation Procedures/Emergency Operation or Shutdown
VINYL-NM-E013, 04/27/99	Aberdeen/Vinyl/New Module/Procedures/Process Operation Procedures/Emergency Operation or Shutdown
VINYL-NM-N475, 08/31/00	Aberdeen/Vinyl/New Module/Procedures/Process Operation Procedures/Normal Operations
Other Information	
450029 Plot Plan PV-029	Aberdeen/Utilities/General Plant/Vessels/Drums/Drawings
Chlorine Handbook, OxyChem, 1991	
Risk Management Program Guidance For Offsite Consequence Analysis, EPA 550-B-99-009, April 1999.	
Estimating the Area Affected by a Chlorine Release, Chlorine Institute, Pamphlet #74, June 1982	
Liquefied Petroleum Gases Handbook, 2nd Edition, 1989 edition of NFPA 58.	Engineering Book Shelf
Allgas Vaporizers	Utility Hazop File
Fisher Controls, Bulletin LP-21, July 1969	Utility Hazop File
Vessel Drawing for 45-031	Equipment Files
720912 Performance Curve	Aberdeen/Utilities/General Plant/Rotating Equipment/Compressors/Performance Curves
GP-9721-62-7-D, 10/2/84	Aberdeen/Utilities/General Plant/Engineering Drawings/Electrical/Wiring Diagrams
NE-D606-57-3-D, 11/26/90	Aberdeen/Utilities/Boiler House/Engineering Drawings/Instrumentation/Ladder Drawings
NE-D606-57-1-D, 5/20/87	Aberdeen/Utilities/Boiler House/Engineering Drawings/Instrumentation/(Elevations/Sections/Plans)
NE-D667-57-1-B, 10/23/87	Old Loop DWG File/ Utility Hazop File
NE-D667-57-2-B, 10/23/87	Old Loop DWG File/ Utility Hazop File
NE-D667-57-3-D, 7/16/91	Aberdeen/Utilities/Boiler House/Engineering Drawings/Instrumentation/Ladder Drawings
NE-D667-62-1-B, 10/29/87	Old Loop DWG File/ Utility Hazop File
NE-D667-62-2-B, 10/30/87	Old Loop DWG File/ Utility Hazop File
NE-D667-77-1-D, 01/08/90	Aberdeen/Utilities/General Plant/Engineering Drawings/Piping/(Piping Section/Details)
NE-003295-IN-D, 8/1/91	Aberdeen/Utilities/Water Plant/Engineering Drawings/Instrumentation/(Elevations/Sections/Plans)

IV. Other Information Used	
Item	**Location Site/Unit/Area/Category/Subcategory/Identifier (DMS)**
NE-003310-IN-D,12/12/91	Aberdeen/Utilities/Water Plant/Engineering Drawings/Instrumentation/(Elevations/Sections/Plans)
PP-312-EL-B, 11/23/02	Aberdeen/Utilities/Boiler House/Engineering Drawings/Electrical/Motor Diagrams
PP-868-EL-B, 11/23/02	"
PT-274-62-31-D, 8/15/83	Aberdeen/Vinyl/Utilities/Engineering Drawings/Electrical/Wiring Diagrams
Applicability PSM-001, Revision 11	Aberdeen/PSM/General Plant/Procedures/PSM Compliance Manual/Process Safety Information
Employee Participation PSM-002, Revision 5	Aberdeen/PSM/General Plant/Procedures/PSM Compliance Manual/Employee Participation
Process Safety Information PSM-003, Revision 8	Aberdeen/PSM/General Plant/Procedures/PSM Compliance Manual/Process Safety Information
Maximum Plant Inventories of Highly Hazardous Chemicals, HHC, Revision 7	Aberdeen/Vinyl/General Plant/Process/Unit Information/Maximum Intended Inventory

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
CV-2701		DMS, See DWG# NE-D667-57-3-D
CV-2702		DMS, See DWG# NE-D667-57-3-D
CV-2703	-------	DMS, DWG # CV-2703 NE-D667-57-1-B
CV-2704	-------	DMS, See DWG # CV-2703 NE-D667-57-1-B
CV-2705		DMS, See DWG# NE-D667-57-3-D
PIC-2706	-------	DMS, See DWG# PIC-2706 NE-D667-57-2-B
PP-312	720312	Some Information Available but Equipment File Not in DMS
PP-868	720868	Some Information Available but Equipment File Not in DMS
PSV-PV-029	780457	DMS/Files
PSV-PV-030	781465	DMS/Files
PSV-PV-031	780458	DMS/Files
PSV-PP-312	781117	DMS/Files
PSV-PP-868	781118	DMS/Files
PSV-PR-0035		Equipment Number/File Not Found
PSV-PR-0036		Equipment Number/File Not Found
PSV-PR-0037		Equipment Number/File Not Found
PV-029	450029	DMS/Files
PV-030	450030	DMS/Files

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
PV-031	450031	DMS/Files, Vessel Drawing Available, U1A Not Found
EX-811	551081	Name Plate Data Available, U1A Not Found
EX-812	551082	Name Plate Data Available, U1A Not Found
EX-813	551083	Name Plate Data Available, U1A Not Found
PSV-EX-811S		Equipment Number/File Not Found
PSV-EX-811T		Equipment Number/File Not Found
PSV-EX-812S		Equipment Number/File Not Found
PSV-EX-812T		Equipment Number/File Not Found
PSV-EX-813S		Equipment Number/File Not Found
PSV-EX-813T		Equipment Number/File Not Found
MI-032 #1	820007	DMS, Some Information Available but Equipment File Not Found
#2	820006	DMS, Some Information Available but Equipment File Not Found
#3	820008	DMS, Some Information Available but Equipment File Not Found
#4	820004	DMS, Some Information Available but Equipment File Not Found
PSV-PV-032	781286	DMS/Files
PSV-PV-033	781287	DMS/Files
PSV-PV-034	781288	DMS/Files
PV-032	45032	DMS/Files
PV-033	450033	DMS/Files
PV-034	450034	DMS/Files, Vessel DWG Found, U1A Not Found
02PAL410	-------	DMS, See DWG# NE-D606-57-4-D
02PAL411	-------	DMS, See DWG# NE-D606-57-4-D
EX-300	550300	Equipment File Not Found
DM-813	450813	DMS/Files
PSV-DM-813		Equipment Number/File Not Found
02P606	-------	DMS/Files
02UA629	-------	DMS/Files
02LA712	-------	DMS/Files
82P085	-------	DMS/Files
82P090	-------	DMS/Files
CP-708	720708	DMS/Files
CP-709	72909	DMS/Files
DM-838	45052	DMS/Files
FL-075	640061	DMS/Files

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
FL-076	640062	DMS/Files
FL-080	640063	DMS/Files
FL-081	640064	DMS/Files
PSV-CP-708	781445	DMS/Files
PSV-CP-708A		Equipment Number/File Not Found
PSV-CP-709	781446	DMS/Files
PSV-CP-709A	781442	Equipment File Not Found
PSV-DM-838	781250	DMS/Files
DR-030	560030	Some Information Available in I/E Shop, U1A Available, Equipment File Not Found in DMS
PSV-DR-030N	781489	Equipment File Not Found
PSV-DR-030S	781486	DMS/Files
DM-300	450302	DMS/Files
DM-810	452008	DMS/Files
PSV-DM-300	781036	DMS/Files
PSV-DM-810	781315	DMS/Files
PSV-UT-0111	781461	DMS/Files
81L049	-------	DMS/Files
81H066	-------	DMS/Files
81H067	-------	DMS/Files
81H068	-------	DMS/Files
81H073	-------	DMS/Files
81H074	-------	DMS/Files
81H075A	-------	DMS/Files
81H076A	-------	DMS/Files
81P079	-------	DMS/Files
81H086	-------	DMS/Files
81H087	-------	DMS/Files
81L088	-------	DMS/Files
81L089	-------	DMS/Files
81T092	-------	DMS/Files
81T097	-------	DMS/Files
92P075	-------	DMS/Files
PP-243	720282	DMS/Files
PP-281	720281	DMS/Files, Performance Curve Not Found

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
PP-955	720955	DMS/Files
82H060	-------	DMS/Files
82H061	-------	DMS/Files
82H062	-------	DMS/Files
82H063	-------	DMS/Files
82H071	-------	DMS/Files
82H072	-------	DMS/Files
82H073A	-------	DMS/Files
82L079	-------	DMS/Files
82H086	-------	DMS/Files
82H087	-------	DMS/Files
82L088	-------	DMS/Files
82L089	-------	DMS/Files
82T097	-------	DMS/Files
82T099	-------	DMS/Files
92P076	-------	DMS/Files
PP-906	720906	Equipment File Not Found
PP-907	720907	Equipment File Not Found
PP-908	721199	DMS/Files
PP-116	720146	Equipment File Not Found
81H056	-------	DMS/Files
81T058	-------	DMS/Files
81H061	-------	DMS/Files
81H062	-------	DMS/Files
81H063	-------	DMS/Files
81H064	-------	DMS/Files
81H065	-------	DMS/Files
81H070	-------	DMS/Files
81H071	-------	DMS/Files
81H072	-------	DMS/Files
81L079	-------	DMS/Files
81P079	-------	DMS/Files
81L090	-------	DMS/Files
81L091	-------	DMS/Files
81T092	-------	DMS/Files
81T096	-------	DMS/Files

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
PP-247	720247	DMS/Files
PP-252	720252	DMS/Files
PP-253	720253	DMS/Files
PP-257	720257	DMS/Files
PP-258	720258	DMS/Files
PP-977	722505	Equipment File Not Found
PP-978	722506	Equipment File Not Found
CV- 407	591063	Equipment File Not Found
81A085	-------	DMS/Files
SC-121	961005	Files
92N080	-------	DMS/Files
92L081	-------	DMS/Files
92L082	-------	DMS/Files
92T083	-------	DMS/Files
92H084	-------	DMS/Files
92X085	-------	DMS/Files
92X086	-------	DMS/Files
92X087	-------	DMS/Files
92X088	-------	DMS/Files
92X089	-------	DMS/Files
92H090	-------	DMS/Files
92V091	-------	DMS/Files
92V092	-------	DMS/Files
92P094	-------	DMS/Files
92ASH51120	-------	DMS/Files
99N257	-------	DMS/Files
GN-003	351002	DMS/Files
PP-540	721291	DMS/Files
PP-541	721292	DMS/Files
PP-542	721293	DMS/Files
PP-543	721294	DMS/Files
CV- 406	591062	Equipment File Not Found
88AE5031	-------	Information Not Found
SC-122	961000	Files

PSM Covered Equipment		
Location Code	**Equipment Number**	**Location**
		For Equipment Information in DMS Search by Loop Number, Equipment Number, or Drawing Number.
02A808	-------	DMS/Files
CV-404	591060	DMS/Files
CV- 405	591061	Equipment Number/File Not Found
PSHL-848	-------	DMS/Files
SC-015	961035	Equipment File Not Found
SC-016	961040	Equipment File Not Found
GN-001	351000	DMS/Files
GN-004	351003	Files
99N002	-------	DMS/Files

APPENDIX E

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix E. List of Updates and Revalidations

1. Initial PHA 1997
2. Revalidation PHA. 2002

APPENDIX F

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix F. Hazop Worksheets

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane Truck Unloading - Propane Vapor in Vapor lines, Propane Liquid in Liquid Lines. (Propane liquid transfer at approximately 225 gpm and 125 psid. Truck pump internal bypass set at 150 psi. - Dowdle Propane).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
1.1 High Pressure								
	1. Blocked unloading line during unloading	1. Fire/Explosion 2. Propane leak 3. Propane release	S/E S S/E	4 4 4	C B C	5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly before unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	48
	2. Blocked in liquid line on thermal expansion case	1. Fire/Explosion 2. Propane leak 3. Propane release	S/E S S/E	4 4 4	C B C	5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly after unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	2
	3. Fire	1. Downtime/lost production 2. Explosion 3. Personnel Evacuation 4. Propane leak 5. Propane release	EC S/E S S S/E	4 4 4 4 4	C C C B C	5 5 5 5 5	1. Fire Protection Equipment 2. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1
	4. High upstream pressure (from truck pump)	1. Fire/Explosion 2. Fire/Explosion - E 3. Personnel Evacuation 4. Propane leak 5. Propane release	S E S S S/E	3 4 4 4 4	C C C B C	4 5 5 5 5	1. Fire Protection Equipment 2. Following correct operating procedure. Making sure valves are lined up properly before unloading. 3. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	14
1.2 High Temperature								
	1. Fire	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Fire Protection Equipment 2. Fire Watch 3. Hot work permits 4. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1
	2. Hot work in close proximity	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Fire Protection Equipment 2. Fire Watch 3. Hot work permits 4. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	1

Node: 1. Propane storage tank, PV-029, PV-030, and PV-031, liquid and vapor fill lines.	
Type: Line	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane Truck Unloading - Propane Vapor in Vapor lines, Propane Liquid in Liquid Lines. (Propane liquid transfer at approximately 225 gpm and 125 psid. Truck pump internal bypass set at 150 psi. - Dowdle Propane).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
1.3 Low Temperature								
	1. Low Ambient Temperature	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Piping specification includes expected ambient low temperature	1
1.4 Low/No Flow								
	1. High downstream pressure	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Operating procedures for routing flows 2. Unique connectors for flexible lines 3. Valve position indicators	1
	2. Low upstream pressure - truck pump outlet pressure low - pump not running/worn out/ malfunction	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5		1
	3. Driver/Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Environmental - No Consequence	EC E	4 4	D D	5 5	1. Unique connectors for flexible lines 2. Valve position indicators 3. Operating procedures for routing flows	1
1.5 Reverse/Misdirected Flow								
	1. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane Release	EC S/E S/E	4 4 4	D D D	5 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading. 2. Operating procedures on line routings 3. Unique connectors for flexible lines 4. Valve position indicators 5. Fire protection equipment	1
	2. Check valve failure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane Release	EC S/E S/E	4 4 4	D D D	5 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading. 2. Operating procedures on line routings 3. Unique connectors for flexible lines 4. Valve position indicators 5. Fire protection equipment	1
	3. Truck unloading line rupture	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane Release	EC S E S/E	4 3 4 4	D C C C	5 4 5 5	1. No Hot Work in Contractor Area, Propane Tank Farm, and Boiler Area while unloading.	14

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawings: BP-090100-PID-D, 09/19/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane liquid flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
2.1 High Pressure								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	EC S EC S S/E	4 3 4 4 4	D D D C C	5 5 5 5 5	1. Heat sensor activation of deluge system 2. Manual activation of deluge system 3. LEL detection activation of deluge system 4. Remote operation of transfer line actuated block valves and transfer pumps 5. Pressure relief valve on pump discharge (upstream of the first block valve after the transfer pump)	3 4
	2. Pump driver overspeeding-incorrect sheave	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	EC S E S S/E	4 3 4 4 4	D D D C C	5 5 5 5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system 3. Manual activation of deluge system 4. Remote operation actuated block valves 5. Pressure relief valve on pump discharge (upstream of the first block valve after the transfer pump)	3 4
	3. Pressure control valve malfunction or block valves closed while pump is running	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	EC S E S S/E	4 3 4 4 4	D D D C C	5 5 5 5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system 3. Manual activation of deluge system 4. Pressure relief valve on pump discharge (upstream of the first block valve after the transfer pump) 5. Remote operation of transfer line actuated block valves and transfer pumps	3 4 27
	4. Valve closed on pump discharge when pump is running	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	EC S E S S/E	4 3 4 4 4	D D D C C	5 5 5 5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system 3. Manual activation of deluge system 4. Pressure relief valve on pump discharge (upstream of block valve) 5. Remote operation actuated block valves	3 4
	5. Relief Valve failure or block valves closed downstream of	1. Downtime/Lost Production	EC	4	D	5	1. Heat sensor activation of deluge system	3 4

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawings: BP-090100-PID-D, 09/19/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane liquid flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
2.1 cont'd								
	5. cont'd relief valve under relieving conditions	2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	S E S S/E	3 4 4 4	D D C C	5 5 5 5	2. LEL detection activation of deluge system 3. Manual activation of deluge system 4. Remote operation actuated block valves	
	6. Blocked in thermal expansion	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Personnel Evacuation 5. Propane release	EC S E S S/E	4 3 4 4 4	D D D C C	5 5 5 5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system 3. Manual activation of deluge system 4. Pressure relief valve on pump discharge (upstream of block valve)	2 3 4
2.2 Cavitation								
	1. Inlet filter/strainer plugs	1. Damage to pump 2. Downtime/loss of production 3. Low or no flow	S/E EC S/E	4 4 4	D D D	5 5 5		1
	2. Low level in propane storage tank supplying pump	1. Damage to pump 2. Downtime/loss of production 3. Low or no flow	S/E EC S/E	4 4 4	D D D	5 5 5	1. Operator checking storage tank level	1
	3. Misaligned/closed valve	1. Damage to pump 2. Downtime/loss of production 3. Low or no flow	S/E EC S/E	4 4 4	D D D	5 5 5	1. Following correct operating procedure. Making sure valves are lined up properly	1
2.3 Leak								
	1. Corrosion/erosion	1. Fire/Explosion 2. Propane leak/release	S/E S/E	4 4	D B	5 5	1. Heat sensor activation of deluge system 2. Inspection & maintenance program to detect corrosion/ erosion & replace affected components 3. LEL detection activation of deluge system & Alarm 4. Manual activation of deluge system 5. Remote shutdown of pump 6. Remotely operable isolation valves one on pump suction, two on discharge.	4
	2. High pressure	1. Fire/Explosion 2. Propane leak/release	S/E S/E	4 4	D B	5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system & Alarm 3. Manual activation of deluge system	4

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawings: BP-090100-PID-D, 09/19/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane liquid flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
2.3 cont'd								
	2. cont'd						4. Remote shutdown of pump 5. Remotely operable isolation valves one on pump suction, two on discharge.	
	3. Improper maintenance	1. Fire/Explosion 2. Propane leak/release	S/E S/E	4 4	D B	5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system & Alarm 3. Manual activation of deluge system 4. Remote shutdown of pump 5. Remotely operable isolation valves one on pump suction, two on discharge.	4
	4. Seal/packing failure	1. Fire/Explosion 2. Propane leak/release	S/E S/E	4 4	D B	5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system & Alarm 3. Manual activation of deluge system 4. Remote shutdown of pump 5. Remotely operable isolation valves one on pump suction, two on discharge.	4
	5. Blown gasket	1. Fire/Explosion 2. Propane leak/release	S/E S/E	4 4	D B	5 5	1. Heat sensor activation of deluge system 2. LEL detection activation of deluge system & Alarm 3. Manual activation of deluge system 4. Remote shutdown of pump 5. Remotely operable isolation valves one on pump suction, two on discharge.	4
2.4 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Fire Protection Equipment 2. Fire Watch 3. Heat sensor activation of deluge system 4. Hot work permits	1
	2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Fire Protection Equipment 2. Fire Watch 3. Heat sensor activation of deluge system 4. Hot work permits	1
	3. Pump malfunction	1. Downtime/Lost Production 2. Fire/Explosion	EC S/E	4 3	D D	5 5	1. Fire Protection Equipment 2. Fire Watch	1

Node: 2. Propane transfer pumps, PP-312 and PP-868, and transfer line.	
Type: Centrifugal Pump + Line	Drawings: BP-090100-PID-D, 09/19/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane liquid flow at 125 psig, 6700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
2.4 cont'd								
	3. cont'd	3. Propane release	S/E	4	D	5	3. Heat sensor activation of deluge system 4. Hot work permits	
2.5 Low Pressure								
	1. Line Rupture/Leak	1. Downtime/Loss of production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. LEL detection activation of deluge system & Alarm 2. Manual activation of deluge system 3. Remote shutdown of pump 4. Remotely operable isolation valves one on pump suction, two on discharge.	4
	2. Operator fails to align correct lines/valves	1. Downtime/Loss of production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Pressure indication	4
	3. Transfer pump output pressure low	1. Downtime/Loss of production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Pressure indication 2. Spare pump on standby	4
	4. Low level in propane storage tank	1. Downtime/Loss of production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E					1. Bypass around control valve 2. Pressure indication 3. Spare pump on standby	4
	5. Incorrect sheave installed on pump/motor	1. Downtime/Loss of production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release 5. Propane release - E					1. Bypass around control valve 2. Pressure indication 3. Spare pump on standby	4

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.1 High Pressure								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. Manual activation of deluge system 5. Pressure relief valve - isolation valve under relief valve is normally locked open 6. Sloping ground to prevent accumulation of flammables beneath vessel	15 16
	2. Overfilling of vessel	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 3	D D D	5 5 5	1. Accurate tank gauging before unloading 2. Deluge system 3. Fire monitors and hose stations 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system 7. Pressure relief valve - isolation valve under relief valve is normally locked open 8. Heat sensor activation of deluge system	4 5
	3. Missaligned valves - Propane pump suction connected to one storage tank and recirculating (pressure control) to another storage tank (not equalized).	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system 7. Pressure relief valve - isolation valve under relief valve is normally locked open	4 5
	4. Relief valve isolated (block valve under relief valve closed) under relieving condtions	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system	4 5

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.1 cont'd								
	4. cont'd						6. Manual activation of deluge system 7. Plant sign in/sign out for key to locks on valves under relief valves	
	5. Relief valve plugged under relieving conditions.	1. Downtime/Lost Production 2. Propane release 3. Fire/Explosion	EC S/E S/E	4 3 3	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. High pressure indication - local pressure gauge 5. LEL detection activation of deluge system 6. Manual activation of deluge system	4 5 7
3.2 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system 5. Manual activation of deluge system 6. Operating procedures 7. Pressure relief valve 8. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 9. Sloping ground beneath vessel to prevent flammables accumulating	6 15 16
3.3 High Level								
	1. Operator/truck driver overfill tank during filling	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Level gauge - dip tube (two tanks) bleed gauge with rotary dial (one tank). 2. Operating procedures	17
	2. Recirculation valves misaligned to pull from one tank and return to another	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Operating procedures	5 17 18
	3. Inaccurate tank gauging prior to unloading truck	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Level gauge - dip tube (two tanks) bleed gauge with rotary dial (one tank). 2. Operating procedures	17

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.4 Leak								
	1. Corrosion and/or erosion	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures	
	2. Flange, flange gasket, threaded fitting, and packing failure	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures 4. Procedures for torquing bolts	6
	3. Inadequate torquing of bolts	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. LEL detection activation of deluge system & Alarm 3. Maintenance & inspection procedures 4. Procedures for torquing bolts	6
	4. Relief valve or instrument failure to contain pressure	1. Fire/Explosion 2. Propane release	S/E S/E	3 4	D D	5 5	1. Deluge 2. Isolation valves on pressure gauges and relief valve 3. LEL detection activation of deluge system & Alarm 4. Maintenance & inspection procedures 5. Procedures for torquing bolts	6
3.5 Rupture								
	1. Propane storage tank material failure due to fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Fire/Explosion - E 4. Propane release	EC S E S/E	4 2 3 4	D D D D	5 4 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system 5. Manual activation of deluge system 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 7. Sloping ground beneath vessel to prevent flammables accumulating	15 16
	2. Overpressure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Fire monitors and hose stations 3. Heat sensor activation of deluge system 4. LEL detection activation of deluge system	7

Node: 3. Propane storage tanks, PV-029, PV-030, and PV-031.	
Type: Vessel	Drawing: BP-090100-PID-D, 09/19/02
Design Conditions/Parameters: Propane storage to 250 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
3.5 cont'd								
	2. cont'd						5. Manual activation of deluge system 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 7. Sloping ground beneath vessel to prevent flammables accumulating 8. Pressure relief valve 9. Pressure relief valve - isolation valve under relief valve is normally locked open	
	3. Relief valve plugged under relieving condition	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	7
	4. Relief valve isolated under relieving condition	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 3. Pressure relief valve - isolation valve under relief valve is normally locked open	7

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
4.1 High Pressure								
	1. Blocked in liquid line with thermal expansion (from vaporizer or solar radiation)	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Operating procedure 2. Pressure control valve (PCV 2706) 3. Relief valve on vaporizer - sizing basis unknown 4. Relief valve on propane transfer pump 5. Fire Protection equipment	3 19
	2. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Relief valve on vaporizer - sizing basis unknown 2. Relief valve on propane transfer pump 3. Deluge system 4. Fire monitors and hose stations 5. Heat sensor activation of deluge system 6. Manual activation of deluge system 7. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 8. Sloping ground beneath vessel to prevent flammables accumulating	3 19
	3. High upstream pressure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Pressure control valve (PCV 2706) 2. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 3. Fire Protection equipment	3
	4. Pressure control valve (PCV 2706) failure to maintain pressure at set point	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Relief valve on vaporizer - sizing basis unknown 2. Relief valve on propane transfer pump 3. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 4. Fire Protection equipment	3 19
4.2 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection Equipment 2. Hot work permits 3. Deluge system 4. Fire monitors and hose stations 5. Heat sensor activation of deluge system	1

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
4.2 cont'd								
	1. cont'd						6. Manual activation of deluge system 7. Sloping ground beneath vessel to prevent flammables accumulating	
	2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection Equipment 2. Hot work permits 3. Deluge system 4. Fire monitors and hose stations 5. Heat sensor activation of deluge system 6. Manual activation of deluge system 7. Sloping ground beneath vessel to prevent flammables accumulating 8. Fire Watch	1
4.3 High Flow								
	1. High upstream pressure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Liquid exiting vaporizer	EC S/E S/E S	4 4 4 4	D D D C	5 5 5 5	1. Fire Protection equipment 2. Operating procedure 3. Pressure control valve (PCV 2706) 4. Level control solenoid valve on vaporizer shuts when level in the vaporizer is high 5. Annual PM on Propane System 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	1
	2. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection equipment 2. Operating procedure 3. Pressure control valve (PCV 2706) 4. Level control solenoid valve on vaporizer shuts when level in the vaporizer is high 5. Annual PM on Propane System 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	1
	3. Pressure control valve (PCV 2706) fails to maintain pressure at or below set point	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection equipment 2. Operating procedure includes control valve set point 3. Level control solenoid valve on vaporizer shuts when level	1

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
4.3 cont'd								
	3. cont'd						3. cont'd in the vaporizer is high 4. Annual PM on Propane System 5. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	
	4. Line leak	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection equipment 2. Annual PM on Propane System 3. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	1
	5. Both pumps running	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection equipment 2. Operating procedure indicates that only one pump is to be run at a time 3. Pressure control valve (PCV 2706) 4. Level control solenoid valve on vaporizer shuts when level in the vaporizer is high 5. Annual PM on Propane System 6. Remote shutdown of three actuated propane transfer valves and pump transfer pump.	1
	6. High pressure in storage tanks	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire Protection equipment 2. Level control solenoid valve on vaporizer shuts when level in the vaporizer is high 3. Annual PM on Propane System 4. Remote shutdown of three actuated propane transfer valves and pump transfer pump. 5. Operating procedure indicates that only one pump is to be run at a time	20
4.4 Low/No Flow								
	1. High downstream pressure	1. Downtime/Lost Production	EC	4	D	5		1
	2. Low upstream pressure	1. Downtime/Lost Production	EC	4	D	5	1. Pressure controller (PCV 2706) and pressure indication	1

Node: 4. Propane transfer line to and from vaporizers.	
Type: Line	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane flow at 125 psig to 6,700 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
4.4 cont'd								
	3. Operator fails to align correct lines/valves	1. Downtime/Lost Production	EC	4	D	5	1. Operating procedures for routing flows 2. Valve position indicators	1
	4. Plugged strainer/filter	1. Downtime/Lost Production	EC	4	D	5		1
	5. Pump failure	1. Downtime/Lost Production	EC	4	D	5	1. Spare pump on standby	1
	6. Pressure control valve failure to maintain pressure at set point	1. Downtime/Lost Production	EC	4	D	5		1
4.5 Leak								
	1. Corrosion	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	D D	5 5	1. Annual PM on Propane System 2. Maintenance & inspection procedures 3. Water monitors & deluge system 4. Flammable gas detection & alarm	1
	2. Gasket or packing or valve seal failure	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	D D	5 5	1. Annual PM on Propane System 2. Maintenance & inspection procedures 3. Water monitors & deluge system 4. Flammable gas detection & alarm	1
	3. Inadequate torquing of bolts	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	D D	5 5	1. Annual PM on Propane System 2. Maintenance & inspection procedures 3. Water monitors & deluge system 4. Flammable gas detection & alarm 5. Maintenance procedures for torquing bolts	1
	4. Line overstressed	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	D D	5 5	1. Maintenance & inspection procedures 2. Water monitors & deluge system 3. Flammable gas detection & alarm	1

Node: 5. Steam supply to vaporizers.	
Type: Line	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Steam supply at 150 psig then reduced to 25 psig. Flow to 1500 lb/hr.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
5.1 High Pressure								
	1. Blocked discharge	1. Blow gasket 2. Blow gasket - E 3. Lift relief valve	S E S/E	4 4 4	C D C	5 5 5	1. Pressure relief valve on steam outlet line	21
	2. High upstream pressure	1. Blow gasket 2. Blow gasket - E 3. Lift relief valve 4. Lift relief valve - E	S E S E	4 4 4 4	C D C D	5 5 5 5	1. Pressure relief valve on steam outlet line 2. Steam pressure regulator on line to vaporizer	21
	3. Regulator malfunction	1. Blow gasket 2. Blow gasket - E 3. Lift relief valve 4. Lift relief valve - E	S E S E	4 4 4 4	C D C D	5 5 5 5	1. Pressure relief valve on steam outlet line	21
	4. Regulator bypass open	1. Blow gasket 2. Blow gasket - E 3. Lift relief valve 4. Lift relief valve - E	S E S E	4 4 4 4	C D C D	5 5 5 5	1. Pressure relief valve on steam outlet line	21
5.2 Low/No Flow								
	1. High downstream pressure	1. Downtime/Lost Production 2. Liquid exiting vaporizer	EC S	4 4	B B	5 5	1. Level control solenoid valve on vaporizer shuts when propane level in the vaporizer is high 2. Relief valve on the steam outlet from vaporizer	1
	2. Low upstream pressure	1. Downtime/Lost Production 2. Liquid exiting vaporizer	EC S	4 4	B B	5 5	1. Level control solenoid valve on vaporizer shuts when propane level in the vaporizer is high	1
	3. Operator fails to align correct lines/valves	1. Downtime/Lost Production 2. Liquid exiting vaporizer	EC S	4 4	B B	5 5	1. Level control solenoid valve on vaporizer shuts when propane level in the vaporizer is high 2. Operating procedure for routing flows	1
	4. Plugged strainer/filter/trap	1. Downtime/Lost Production 2. Liquid exiting vaporizer	EC S	4 4	B B	5 5	1. Level control solenoid valve on vaporizer shuts when propane level in the vaporizer is high 2. Relief valve on the steam outlet from vaporizer 3. Bypass valve around trap/ strainer	1
	5. Line rupture	1. Downtime/Lost Production 2. Liquid exiting vaporizer	EC S	4 4	B B	5 5	1. Level control solenoid valve on vaporizer shuts when propane level in the vaporizer is high	1

Node: 6. Propane vaporizers, EX-811, EX-812, and EX-813.	
Type: Heat Exchanger	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Capacity: Vaporize 100,000 scfh propane each.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
6.1 High Pressure								
	1. Blocked-in condition (Propane) thermal expansion	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane leak/release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & prevention 2. Pressure relief valve on propane side of vaporizer 3. Pressure indication on vaporizer 4. Operating Procedure proper valve alignment	1
	2. Tube rupture	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane leak/release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & prevention 2. Pressure relief valve on outlet steam line 3. Pressure indication on vaporizer 4. Operating Procedure proper valve alignment	22
	3. Discharge line closed	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane leak/release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & prevention 2. Pressure relief valve on propane side of vaporizer 3. Pressure indication on vaporizer 4. Operating Procedure proper valve alignment	1
	4. Relief valve malfunction	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane leak/release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & prevention 2. Pressure indication on vaporizer	1
6.2 Low Temperature								
	1. Low steam flow	1. Downtime/Lost Production 2. Liquid exiting vaporizer 3. Liquid exiting vaporizer - E	EC S E	4 4 4	B B D	5 5 5	1. Operating procedures 2. Steam regulator 3. Strainers	1
6.3 Tube Leak								
	1. Corrosion	1. Downtime/Lost Production 2. Fire/Explosion 3. Liquid exiting vaporizer 4. Propane release	EC S/E S S/E	4 4 4 4	D C D D	5 5 5 5	1. Inspection/PM program 2. Fire detection & protection	1
	2. Overpressure	1. Downtime/Lost Production 2. Fire/Explosion 3. Liquid exiting vaporizer 4. Propane release	EC S/E S S/E	4 4 4 4	D C D D	5 5 5 5	1. Fire detection & protection 2. Relief Valve on vaporizer steam outlet line	1
6.4 Shell Leak								
	1. Corrosion	1. Downtime/Lost Production 2. Fire/Explosion 3. Liquid exiting vaporizer 4. Propane release	EC S/E S/E S/E	4 4 4 4	D D D C	5 5 5 5	1. Inspection/PM procedures 2. Fire detection & protection	1
	2. Overpressure	1. Downtime/Lost Production	EC	4	D	5	1. Fire detection & protection	1

Node: 6. Propane vaporizers, EX-811, EX-812, and EX-813.	
Type: Heat Exchanger	Drawings: BP-090101-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Capacity: Vaporize 100,000 scfh propane each.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
6.4 cont'd								
	2. cont'd	2. Fire/Explosion	S/E	4	D	5	2. Pressure relief valve located on vaporizer shell	
		3. Liquid exiting vaporizer	S/E	4	C	5		
		4. Propane release	S/E	4	D	5		

Node: 7. Propane transfer lines thru propane/air mixers, MI-032, mixers 1,2,3,and 4.	
Type: Line	Drawings: BP-090102-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: Propane flow: 5500 scfh, Air flow: 4500 scfh. Per individual mixer.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
7.1 High Pressure								
	1. Blocked discharge	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm 2. Fire detection & prevention	1
	2. Regulator malfunction	1. Downtime/Lost Production 2. Fire/Explosion 3. Incorrect air propane mixture 4. Propane release	EC S/E S S/E	4 4 4 4	D D D D	5 5 5 5	1. Relief valve on surge tank 2. Fire detection & prevention 3. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	1
	3. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & prevention 2. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm 3. Hot work permits 4. Fire Watch	1
7.2 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Fire detection & Protection Equipment 2. Hot work permits 3. Fire Watch	1
	2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Hot work permits 2. Fire detection & Protection Equipment 3. Fire Watch	1

Node: 8. Air supply line to propane/air mixer.	
Type: Line	Drawings: BP-090102-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00
Design Conditions/Parameters: 4500 scfh to each individual mixer.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
8.1 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Hot work permits 2. Fire detection & Protection Equipment 3. Fire Watch	1
	2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Hot work permits 2. Fire detection & Protection Equipment 3. Fire Watch	1
8.2 Low/No Flow								
	1. Plugged strainer/filter	1. Downtime/Lost Production 2. Environmental - No consequence 3. Incorrect air/propane mixture	EC E S	4 4 4	C D C	5 5 5		23
	2. No propane flow	1. Downtime/Lost Production 2. Environmental - No consequence 3. Incorrect air/propane mixture	EC E S	4 4 4	C D C	5 5 5	1. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	1
	3. Check valve malfunction	1. Downtime/Lost Production 2. Incorrect air/propane mixture 3. Propane Release 4. Fire/Explosion	EC S S/E S/E	4 4 4 4	C C D D	5 5 5 5	1. Annual PM on Propane System 2. Fire detection & prevention	1
	4. Line plugged	1. Downtime/Lost Production 2. Environmental - No consequence 3. Incorrect air/propane mixture	EC E S	4 4 4	C D C	5 5 5		1
8.3 Reverse/Misdirected Flow								
	1. Discharge of mixer plugged	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Annual PM on Propane System 2. Fire detection and protection system	1
	2. Eductor malfunction	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Incorrect Air/Propane Mixture	EC S/E S/E S	4 4 4 4	D D D D	5 5 5 5	1. Annual PM on Propane System 2. Fire detection and protection system	1
	3. Check Valve Failure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Incorrect Air/Propane Mixture	EC S/E S/E S	4 4 4 4	D D D D	5 5 5 5	1. Annual PM on Propane System 2. Fire detection and protection system	1

Node: 9. Propane surge tanks, PV-032, PV-033, and PV-034.	
Type: Vessel	Drawings: BP-090102-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00, NE-D606-57-4-D, 06/29/92
Design Conditions/Parameters: Propane/Air mixture to 9.5 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
9.1 High Pressure								
	1. Blocked in condition with liquid present	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Pressure relief valve on surge tank 3. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	24 49
	2. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Fire Watch 3. Hot work permits 4. Pressure relief valve on surge tank 5. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	1
	3. Overfilling of vessel	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Pressure relief valve on surge tank 3. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	1
	4. Plugging of pressure relief valve under relieving condition	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Deluge system 2. Pressure regulator 3. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm 4. Routine PM on Pressure Relief Valves.	1
9.2 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 3 4	D D D	5 5 5	1. Fire detection & Protection Equipment 2. Fire Watch 3. Hot work permits	25
	2. Hot work in area	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	E S/E S/E	4 3 4	D D D	5 5 5	1. Fire detection & Protection Equipment 2. Fire Watch 3. Hot work permits	25
9.3 High Level								
	1. Mixer solenoid valve fails open	1. Downstream equipment damage 2. Downtime/Lost Production 3. Fire/Explosion	S/E EC S/E	3 4 3	D D D	5 5 5	1. Operating procedures 2. Pressure relief valve on surge tank 3. Fire detection and protection equipment	1

Node: 9. Propane surge tanks, PV-032, PV-033, and PV-034.	
Type: Vessel	Drawings: BP-090102-PID-D, 12/11/02, (OP) UT-PR-001, 08/09/00, NE-D606-57-4-D, 06/29/92
Design Conditions/Parameters: Propane/Air mixture to 9.5 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
9.3 cont'd								
	1. cont'd	4. Overpressure system	S	4	C	5	4. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	
		5. Propane release	S/E	4	D	5	5. Low Temperature Alarm (probe located at surge tank inlet)	
	2. Liquid exiting vaporizers	1. Downstream equipment damage	S/E	3	D	5	1. Operating procedures	1
		2. Downtime/Lost Production	EC	4	D	5	2. Pressure relief valve on surge tank	
		3. Fire/Explosion	S/E	3	D	5	3. Fire detection and protection equipment	
		4. Overpressure system	S	4	C	5	4. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	
		5. Propane release	S/E	4	D	5	5. Low Temperature Alarm (probe located at surge tank inlet)	
	3. Vent valve on surge tank and vent valve on unloading line left open or leaking while unloading truck into storage tank.	1. Downstream equipment damage	S/E	3	D	5	1. Pressure relief valve on surge tank	9
		2. Downtime/Lost Production	EC	4	D	5		
		3. Fire/Explosion	S/E	3	D	5		
		4. Overpressure system	S	4	C	5		
		5. Propane release	S/E	4	D	5		
9.4 Rupture								
	1. Material fatigue due to fire	1. Downtime/Lost Production	EC	4	D	5	1. Fire detection and protection equipment	1
		2. Fire/Explosion	S/E	3	D	5	2. Pressure relief valve on surge tank	
		3. Propane release	S/E	4	D	5		
	2. Overpressure	1. Downtime/Lost Production	EC	4	D	5	1. Fire detection and protection equipment	1
		2. Fire/Explosion	S/E	3	D	5	2. Pressure relief valve on surge tank	
		3. Propane release	S/E	4	D	5		

Node: 10. Propane supply line to plant.	
Type: Line	Drawings: BP-090102-PID-D, 12/11/02, UT-090102-PID-D, 2/25/94, (OP) UT-PR-001, 08/09/00, (OP) UT-PR-002, 08/09/00, NE-D606-57-4-D, 06/29/92
Design Conditions/Parameters: Propane/Air mixture at 6 to 9.5 psig and varying flows.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
10.1 High Temperature								
	1. Fire	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Hot work permits 2. Fire detection & Protection Equipment 3. Fire Watch 4. Some of piping is underground	1
	2. Hot work in close proximity	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release	EC S/E S/E	4 4 4	D D D	5 5 5	1. Hot work permits 2. Fire detection & Protection Equipment 3. Fire Watch 4. Some of piping is underground	1
10.2 Leak								
	1. Corrosion	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Propane release - E	EC S/E S E	4 4 4 4	D D C D	5 5 5 5	1. Isolation valves	1
	2. Gasket or packing or valve seal failure	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Propane release - E	EC S/E S E	4 4 4 4	D D C D	5 5 5 5	1. Isolation valves 2. Maintenance procedures for torquing bolts	1
	3. Inadequate torquing of bolts	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Propane release - E	EC S/E S E	4 4 4 4	D D C D	5 5 5 5	1. Isolation valves 2. Maintenance procedures for torquing bolts	1
	4. Line overstressed from vehicle traffic on ground over pipe.	1. Downtime/Lost Production 2. Fire/Explosion 3. Propane release 4. Propane release - E	EC S/E S E	4 4 4 4	D D C D	5 5 5 5	1. Isolation valves	26

Node: 11. Propane storage/surge tank vent line.	
Type: Line	Drawings: BP-090100-PID-D, 09/19/02, BP-090102-PID-D, 12/11/02, (OP) UT-PR-004, 08/09/00
Design Conditions/Parameters: Vent low pressure propane vapor to flare stack for burning before release to the atmosphere	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
11.1 Low/No Flow								
	1. Operator fails to align correct lines/valves	1. Can't burn off propane storage/surge tanks	S/E	4	D	5	1. Storage and Surge tank pressure indication	1
		2. Can't depressurize truck unloading lines prior to disconnecting	S/E	4	D	5		
	2. Line plugged	1. Can't burn off propane storage/surge tanks	S/E	4	D	5	1. Storage and Surge tank pressure indication	1
		2. Can't depressurize truck unloading lines prior to disconnecting	S/E	4	D	5		
	3. Valve closed	1. Can't burn off propane storage/surge tanks	S/E	4	D	5	1. Storage and Surge tank pressure indication	1
		2. Can't depressurize truck unloading lines prior to disconnecting	S/E	4	D	5		
11.2 Leak								
	1. Corrosion	1. Fire/Explosion	S/E	4	D	5	1. Isolation valves	1
		2. Propane release	S	4	C	5	2. Fire detection and protection equipment	
		3. Propane release - E	E	4	D	5		
	2. Gasket or packing or valve seal failure	1. Fire/Explosion	S/E	4	D	5	1. Isolation valves	1
		2. Propane release	S	4	C	5	2. Fire detection and protection equipment	
		3. Propane release - E	E	4	D	5		
	3. Inadequate torquing of bolts	1. Fire/Explosion	S/E	4	D	5	1. Isolation valves	1
		2. Propane release	S/E	4	D	5	2. Maintenance procedures for torquing bolts	
							3. Fire detection and protection equipment	
	4. Line overstressed	1. Fire/Explosion	S/E	4	D	5	1. Isolation valves	1
		2. Propane release	S/E	4	D	5	2. Fire detection and protection equipment	
11.3 Reverse/Misdirected Flow								
	1. Operator fails to align correct lines/valves	1. Downtime/Lost Production	EC	4	D	5	1. Fire detection and protection equipment	9
		2. Fire/Explosion	S/E	3	D	5	2. Pressure relief valve on surge tank	
		3. Propane release	S/E	4	D	5	3. Pressure switch (located on the inlet/outlet of the mixer cabinet) activated shutdown and alarm	
		4. Unload truck into surge tank or out flare	S	3	D	5		

Node: 12. Put propane system into standby.	
Type: Procedural Step	Drawing: (OP) UT-PR-002, 08/09/00
Design Conditions/Parameters: Steps 1.1.1 thru 1.1.10 & 1.2.1 thru 1.2.6	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
12.1 No execution of step								
	1. Insufficient knowledge	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks	1
	2. Operator omits step	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Mixer Temperature and Pressure Alarms 2. Safety interlocks - Pump start/ run, Mixer pressure interlocks 3. Training/qualification of personnel 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	1
	3. Poor labeling	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	10
	4. Procedure deficient or missing	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705) 5. Regular review of propane operating procedures	1
12.2 Other than specified action								
	1. Insufficient knowledge	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks	1
	2. Operator omits step	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Mixer Temperature and Pressure Alarms 2. Safety interlocks - Pump start/ run, Mixer pressure interlocks 3. Training/qualification of personnel	1

Node: 12. Put propane system into standby.	
Type: Procedural Step	Drawing: (OP) UT-PR-002, 08/09/00
Design Conditions/Parameters: Steps 1.1.1 thru 1.1.10 & 1.2.1 thru 1.2.6	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
12.2 cont'd								
	2. cont'd						4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	
	3. Poor labeling	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	10
	4. Procedure deficient or missing	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705) 5. Regular review of propane operating procedures	1

Node: 13. Start-up of propane system.	
Type: Procedural Step	Drawing: (OP) UT-PR-002, 08/09/00
Design Conditions/Parameters: Steps 2.0; 2.1.1-2.1.6; 2.2; 2.2.1-2.2.4; 2.3.1-2.3.4	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
13.1 Other than specified action								
	1. Communication failure between operators	1. Lost production/downtime 2. Overpressure system 3. Put liquid to surge tanks	EC S/E S/E	4 4 4	C C C	5 5 5	1. Use of portable phones/two way radios 2. Safety interlocks - Pump start/ run, Mixer pressure interlocks	1
	2. Operating procedure does not reflect latest changes to propane system	1. Lost production/downtime 2. Overpressure system 3. Put liquid to surge tanks	EC S/E S/E	4 4 4	C C C	5 5 5	1. Safety interlocks - Pump start/ run, Mixer pressure interlocks 2. Training/qualification of personnel 3. Mixer Temperature and Pressure Alarms	1
	3. Poor labeling	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	10
	4. Operator omits step	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Mixer Temperature and Pressure Alarms 2. Safety interlocks - Pump start/ run, Mixer pressure interlocks 3. Training/qualification of personnel 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	1

Node: 14. Shutdown of propane system.	
Type: Procedural Step	Drawing: (OP) UT-PR-003, 08/09/00
Design Conditions/Parameters: Steps 1.0; 1.1.1-1.1.10; 1.2.1-1.2.4	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
14.1 Other than specified action								
	1. Insufficient knowledge	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks	1
	2. Operator omits step	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Mixer Temperature and Pressure Alarms 2. Safety interlocks - Pump start/ run, Mixer pressure interlocks 3. Training/qualification of personnel 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	1
	3. Poor labeling	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705)	10
	4. Procedure deficient or missing	1. Overpressure system 2. Put liquid to surge tanks 3. Downtime/Lost Production	S/E S/E EC	4 4 4	C C C	5 5 5	1. Training/qualification of personnel 2. Mixer Temperature and Pressure Alarms 3. Safety interlocks - Pump start/ run, Mixer pressure interlocks 4. Indication of block valve position (CV 2701, CV 2702, CV 2705) 5. Regular review of propane operating procedures	1

Node: 15. Emergency response to a propane system fire or vapor release.	
Type: Procedural Step	Drawing: (OP) UT-PR-006, 08/09/00
Design Conditions/Parameters: Step 1.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
15.1 Other than specified action								
	1. Confusion in emergency situation	1. Fire/Explosion 2. Propane release	S/E S/E	3 3	D D	5 5	1. Specific guidance in procedures 2. Training/qualification of personnel	28
	2. Operator not trained properly	1. Fire/Explosion 2. Propane release	S/E S/E	3 3	D D	5 5	1. Specific guidance in procedures 2. Training/qualification of personnel	28

Node: 16. Response to propane system power failure.	
Type: Procedural Step	Drawing: (OP) UT-PR-006, 08/09/00
Design Conditions/Parameters: Step 2.1, 2.1.1 thru 2.1.3 and 2.2, 2.2.1 thru 2.2.3	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
16.1 Other than specified action								
	1. Confusion in emergency situation	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Specific guidance in procedures 2. Training/qualification of personnel	29
	2. Operator not trained properly	1. Fire/Explosion 2. Propane release	S/E S/E	4 4	C C	5 5	1. Specific guidance in procedures 2. Training/qualification of personnel	29

Node: 17. Instrument air compressors, CP-708 and CP-709, and discharge line to aftercoolers.	
Type: Centrifugal Compressor + Line	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02
Design Conditions/Parameters: Compressor capacity: 526 ICFM at 100 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
17.1 Low/No Flow								
	1. Compressor shutdown - interlocks (High cooling water temperature, High outlet air temperature, Low oil pressure, Low water pressure)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 3	B C	5 4	1. Low instrument Air pressure alarm 2. Low sump level Alarm #2 cooling Tower 3. PM on #2 Cooling Tower Pumps and Tower 4. Routine cleaning of Y-strainer 5. Daily operator check of oil level 6. Oil pressure switch (shutdown switch) 7. Routinely change oil in compressors	11 30 31 32
	2. Closed valve	1. Loss of Instrument Air	S/E	4	D	5	1. Low instrument Air pressure alarm	1
	3. Compressor fail to run (motor, internals, no power)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 3	B C	5 4	1. Low instrument Air pressure alarm 2. Daily operator check of oil level 3. Oil pressure switch (shutdown switch) 4. Routinely change oil in compressors 5. PM emergency generator	31 32
	4. Inlet air filter plugged	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B D	5 5	1. PM inlet air filter regularly 2. Low instrument Air pressure alarm	1
17.2 Low Pressure								
	1. Low air flow from compressors	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low instrument Air pressure alarm 2. PM inlet air filter regularly	1
	2. Leak	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	3. Compressor internals failure (valves, innercooler, etc.)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low instrument Air pressure alarm 2. Daily operator check of oil level 3. Oil pressure switch (shutdown switch) 4. PM inlet air filter regularly 5. Routine cleaning of Y-strainer 6. Routinely change oil in compressors	1

Node: 18. Cooling water supply and return lines to instrument air compressors, CP-708 and CP-709. Water is to the compressor's internal aftercooler which is part of the compressor itself.	
Type: Line	Drawing: UT-090109-PID-D, 12/11/02
Design Conditions/Parameters: Cooling water flow of 9 gpm @ 68 F each (Randy Bird, Power & Equipment Co., 11/27/02). (This is approximately equivalent to 20 gpm @ 85 F). Outlet water temperature between 100-120 F (Joy Operators Manual).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
18.1 Low/No Flow								
	1. Low cooling water supply pressure	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Three sources of cooling water to CP-708 &CP-709 2. Check valve to separate emergency cooling water supply from normal cooling tower 2 supply. 3. Operating procedure for routing flows.	33
	2. Operator fails to align correct lines/valves	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Low water pressure compressor shutdown switch 3. High temperature compressor shutdown switch	1
	3. Plugged strainer/filter	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Routine cleaning of Y-strainer	1
	4. Pump failure including emergency cooling water pump	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Three sources of cooling water to CP-708 &CP-709 3. Check valve to separate emergency cooling water supply from normal cooling tower 2 supply. 4. Low water pressure compressor shutdown switch 5. High temperature compressor shutdown switch	1
	5. Water line freeze up	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Leave water circulating 3. Run all compressors when the ambient temperature falls below 28 F	1
18.2 High Temperature								
	1. Cooling Tower fan not running	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Cooling fan run indication and alarm 2. Cooling Tower Sump Temperature indication and alarm	1
	2. High ambient temperature	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Cooling Tower Sump Temperature indication and alarm 2. Ambient temperature indication	1

Node: 19. Instrument air aftercooler EX-300, and discharge line through knockout tank, DM-813, and Airtek inlet filter. Knockout tank is not included in node.	
Type: Heat Exchanger + Line	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02, UT-090109A-PID-D, 10/15/02
Design Conditions/Parameters: Air flow to 2960 SCFM @ 250 F inlet/2560 SCFM @ 350 F inlet with 10 F approach to cooling water, pressure 150 psig. MAWP EX-300 150 psig @ 200 F/350 F (Shell/Tube);MAWP DM-813 156 psig/FV @ 450 F; MAWP FL-075/076 150 psig @ 200 F.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
19.1 High Temperature								
	1. High compressor discharge air temperature	1. Water in the air	S/E	4	D	5	1. High temperature compressor shutdown 2. Coelescing inlet air filter for Airtek 3. Inlet air temperature indication	1
	2. Loss of cooling water to Aftercooler	1. Water in the air	S/E	4	D	5	1. Outlet Air temperature indication	1
19.2 Low Pressure								
	1. Low/No flow	1. Loss of instrument air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	2. Line leak	1. Loss of instrument air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
19.3 Tube Leak								
	1. Corrosion	1. Water in air	S/E	4	D	5	1. Trap on Aftercooler 2. Knock-out Drum 3. Coelescing air inlet filters for Airtek	34

Node: 20. Cooling water supply lines to and from aftercooler EX-300.	
Type: Heat Exchanger + Line	Drawings: UT-090115-PID-D, 10/09/02, UT-090108-PID-D, 12/11/02, UT-090114-PID-D, 12/11/02
Design Conditions/Parameters: Cooling water of 100 gpm @ 85 F (Estimate based on 2560 SCFM @ 350 F inlet, 100 F outlet).	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
20.1 Low/No Flow								
	1. Low upstream pressure	1. Hot, wet air	S/E	4	D	5	1. Water temperature indicator	1
	2. Operator fails to align correct lines/valves	1. Hot, wet air	S/E	4	D	5	1. Water temperature indicator	1
	3. Pump failure	1. Hot, wet air	S/E	4	D	5	1. Water pressure indicator 2. Water temperature indicator	1
	4. Line leak	1. Hot, wet air	S/E	4	D	5	1. Water pressure indicator 2. Water temperature indicator	1
	5. Cooling water control valve failure	1. Hot, wet air	S/E	4	D	5	1. Water temperature indicator 2. Water pressure indicator	1

Node: 21. Knockout tank, DM-813.	
Type: Vessel	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02
Design Conditions/Parameters: Air flow to 2960 SCFM @ 100 F, pressure to 150 psig. MAWP: 156/FV psig at 450 F. Remove water from air. 120 gallon capacity.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
21.1 High Level								
	1. Water carryover from aftercooler or compressor	1. Downstream instrument malfunction	S/E	4	B	5	1. Operating procedures	1
		2. Water in air system	S/E	4	B	5	2. Automatic actuated drain valve for knock-out tank	
	2. Malfunction of automatic drain valve	1. Downstream instrument malfunction	S/E	4	B	5		1
		2. Water in air system	S/E	4	B	5		
21.2 High Pressure								
	1. Operator fails to align correct lines/valves	1. Loss of air supply	S/E	4	B	5	1. Pressure relief valve	1
		2. Overpressure vessel	S/E	4	D	5		
	2. Relief Valve Plugged under relieving condition	1. Loss of air supply	S/E	4	C	5	1. Pressure relief valve	1
		2. Overpressure vessel	S	4	C	5	2. Pressure vessel inspection program	
		3. Overpressure vessel	E	4	D	5	3. Relief valve PM	

Node: 22. Airtek Air Dryer Package, DR-030.	
Type: Air Dryer	Drawing: UT-090109A-PID-D, 10/15/02
Design Conditions/Parameters: Air flow to 2200 SCFM @ 80 psig & 100 F. Outlet dewpoint -40 F. Pressure to 150 psig. MAWP DR-030 150 psig @ 575 F.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
22.1 High Flow								
	1. Line leak on discharge	1. Downstream instrument malfunction	S/E	4	B	5	1. Dew point indication 2. Air flow recorder downstream of the Air Dryer	1
		2. High dew point	S/E	4	B	5		
22.2 High Pressure								
	1. Valve blocked on discharge/ check valve malfunction	1. Lift relief valve	S/E	4	B	5	1. Relief Valve PM program	1
	2. No air usage	1. Lift relief valve	S/E	4	D	5	1. Relief Valve PM program	1
22.3 High Temperature								
	1. Airtek Instrument/heater malfunction	1. Airtek shutdown on high temperature - moisture in air	S/E	4	B	5	1. Dew point indication 2. Temperature indication	35
	2. Air cooler EX-300 fails to cool air	1. Downstream instrument malfunction due to wet air	S/E	4	B	5	1. Dew point indication 2. Temperature indication	1

Node: 23. Airtek discharge line to process. Includes Airtek outlet filters.	
Type: Line + Vessel	Drawings: UT-090109-PID-D, 12/11/02, UT-090109A-PID-D, 10/15/02
Design Conditions/Parameters: Air flow to 2200 SCFM @ 80 psig & 100 F. Outlet dewpoint -40 F. Pressure to 150 psig. MAWP FL-080/081 150 psig @ 200 F.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
23.1 Low/No Flow								
	1. Low upstream pressure	1. Loss of instrument air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	2. Operator fails to align correct lines/valves	1. Loss of instrument air	S/E	4	B	5	1. Operating procedures for routing flows 2. Low instrument Air pressure alarm	1
	3. Plugged outlet filters	1. Loss of instrument air	S/E	4	B	5	1. Spare strainer/filter 2. Low instrument Air pressure alarm 3. Daily operator check of filters	1
23.2 Contamination								
	1. Failure of upstream separation equipment (dessicant/water)	1. Loss of instrument air supply 2. Downstream instrument failure	S/E S/E	4 4	B B	5 5	1. Airtek outlet filters 2. Knock out drums DM-813 (Airtek inlet) and DM-838 (Airtek outlet)	36
	2. Rust in process lines	1. Downstream instrument failure	S/E	4	B	5	1. In-line filters	36
23.3 Leak								
	1. Corrosion	1. Loss of air supply	S/E	4	B	5	1. Corrosion allowance 2. Low instrument air indication and alarm 82PI090/82PA085	1
	2. Drain or vent valve open/ malfunction	1. Loss of air supply	S/E	4	B	5	1. Daily operator inspection	1
	3. Gasket, packing, or valve seal failure	1. Loss of air supply	S/E	4	B	5	1. Daily operator inspection 2. Spare filter (FL-080 or FL-081) 3. Maintenance procedures for torquing bolts	

Node: 24. Instrument air surge tank, DM-838.	
Type: Vessel	Drawing: UT-090109-PID-D, 12/11/02
Design Conditions/Parameters: Air pressure to 150 psig. Inlet dew point -40 F. MAWP: 150 psig at 566 F.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
24.1 High Level								
	1. Moisture in the inlet air	1. Downstream instrument malfunction due to water in air	S/E	4	B	5	1. Drain valve	1
		2. Loss of air supply	S/E	4	D	5		
	2. Plugged drain valve	1. Downstream instrument malfunction due to water in air	S/E	4	B	5	1. Daily operator check	1
		2. Loss of air supply	S/E	4	D	5		
24.2 High Pressure								
	1. Operator fails to align correct lines/valves	1. Loss of instrument air	S/E	4	B	5	1. Pressure relief valve	1
		2. Overpressure vessel	S/E	4	D	5	2. Relief valve PM	
	2. Relief Valve Plugged under relieving condition	1. Overpressure vessel	S/E	4	B	5	1. Pressure vessel inspection program 2. Relief valve PM	1

Node: 25. Instrument air supply line to plant.	
Type: Line	Drawing: UT-090111-PID-D, 09/26/02
Design Conditions/Parameters: Air flows to 2200 SCFM at 80 psig and dew point -40 F. Air pressure to 100 psig.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
25.1 Low/No Flow								
	1. Low upstream pressure	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	2. Operator fails to align correct lines/valves	1. Loss of Instrument Air	S/E	4	B	5		1
25.2 Contamination								
	1. Failure of upstream separation equipment (dessicant/water)	1. Loss of instrument air supply to some equipment	S/E	4	B	5	1. Airtek outlet filter	36
	2. Rust in process lines	1. Loss of instrument air supply to some equipment	S/E	4	B	5	1. Airtek outlet filter	36
25.3 Leak								
	1. Corrosion	1. Loss of Instrument Air	S/E	4	B	5	1. Adequate corrosion allowance 2. Low instrument Air pressure alarm	1
	2. Drain or vent or sample valve leak	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm	1
	3. Gasket, packing, or valve seal failure	1. Loss of Instrument Air	S/E	4	B	5	1. Maintenance procedures for torquing bolts 2. Low instrument Air pressure alarm	1
	4. Inadequate torquing of bolts	1. Loss of Instrument Air	S/E	4	B	5	1. Maintenance procedures for torquing bolts 2. Low instrument Air pressure alarm	1
	5. Line overstressed	1. Loss of Instrument Air	S/E	4	B	5	1. Line adequately supported and guided	1

Node: 26. Instrument air surge drum, DM-300.	
Type: Vessel	Drawing: UT-090111-PID-D, 09/26/02
Design Conditions/Parameters: Air pressure to 100 psig. MAWP: 150 psig @ ambient temperature	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
26.1 High Level								
	1. Moisture in the inlet air	1. Downstream instrument malfunction due to water in air	S/E	4	B	5	1. Drain valve	37
		2. Loss of air supply to some equipment	S/E	4	B	5		
	2. Plugged drain valve	1. Downstream instrument malfunction due to water in air	S/E	4	B	5		37
		2. Loss of air supply to some equipment	S/E	4	B	5		
26.2 High Pressure								
	1. Operator fails to align correct lines/valves	1. Loss of instrument air to some equipment	S/E	4	B	5	1. Pressure relief valve 2. Relief valve PM	1
		2. Overpressure vessel	S/E	4	B	5		
	2. Relief Valve Plugged under relieving condition	1. Overpressure vessel	S/E	4	B	5	1. Pressure vessel inspection program 2. Relief valve PM	1

Node: 27. Start-up of instrument air compressors, CP-708 and CP-709.	
Type: Procedural Step	Drawing: (OP) UT-AS-001, 05/29/02
Design Conditions/Parameters: Steps 1.1-1.6	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
27.1 Other than specified action								
	1. Confusing piping configurations	1. Damage to compressor	S/E	4	B	5	1. Specific guidance in procedures	1
		2. Failure to get compressor running	S/E	4	B	5	2. Training & qualification of personnel	
		3. No instrument air supply	S/E	4	B	5	3. Tagging of valves closed for maintenance - helps identify valves to be opened.	
							4. Low instrument Air pressure alarm	
							5. Compressor protection shutdown switches (low Oil pressure, low Cooling water pressure, high water temperature, and high air temperature)	
	2. Inadequate lighting	1. Damage to compressor	S/E	4	B	5	1. Training & qualification of personnel	38
		2. Failure to get compressor running	S/E	4	B	5	2. Low instrument Air pressure alarm	
		3. No instrument air supply	S/E	4	B	5	3. Compressor protection shutdown switches (low Oil pressure, low Cooling water pressure, high water temperature, and high air temperature)	
	3. Communication failure between operators	1. Damage to compressor	S/E	4	B	5	1. Specific guidance in procedures	1
		2. Failure to get compressor running	S/E	4	B	5	2. Training & qualification of personnel	
		3. No instrument air supply	S/E	4	B	5	3. Tagging of valves closed for maintenance - helps identify valves to be opened.	
							4. Low instrument Air pressure alarm	
							5. Compressor protection shutdown switches (low Oil pressure, low Cooling water pressure, high water temperature, and high air temperature)	

Node: 28. Shut down of instrument air compressors, CP-708 and CP-709.	
Type: Procedural Step	Drawing: (OP) UT-AS-001, 05/29/02
Design Conditions/Parameters: Steps 4.1, 4.2	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
28.1 Other than specified action								
	1. Confused piping configurations	1. Damage to compressor 2. No instrument air supply	S/E S/E	4 4	B B	5 5	1. Compressor protection shutdown switches (low Oil pressure, low Cooling water pressure, high water temperature, and high air temperature) 2. Low instrument Air pressure alarm 3. Specific guidance in procedures 4. Tagging of valves closed for maintenance - helps identify valves to be opened. 5. Training & qualification of personnel	1
	2. Inadequate lighting	1. Damage to compressor 2. No instrument air supply	S/E S/E	4 4	B B	5 5	1. Compressor protection shutdown switches (low Oil pressure, low Cooling water pressure, high water temperature, and high air temperature) 2. Low instrument Air pressure alarm 3. Specific guidance in procedures 4. Tagging of valves closed for maintenance - helps identify valves to be opened. 5. Training & qualification of personnel	38
	3. Shut wrong compressor down	1. No instrument air supply	S/E	4	B	5	1. Low instrument Air pressure alarm 2. Specific guidance in procedures 3. Training & qualification of personnel	1

Node: 29. Isolation and Tag Out/Lock Out of Airtek Air Dryer.	
Type: Procedural Step	Drawing: (OP) UT-AS-009, 07/26/00
Design Conditions/Parameters: Step 5	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
29.1 Other than specified action								
	1. Insufficient knowledge	1. Possible personal injury	S	4	B	5	1. Specific guidance in procedures	1
		2. Possible plant loss of instrument air supply	S/E	4	B	5	2. Training/qualification of personnel	
		3. Possible personal injury	E	4	D	5	3. Low instrument Air pressure alarm	
	2. Operator omits step	1. Possible plant loss of instrument air supply	S/E	4	B	5	1. Specific guidance in procedures	1
		2. Possible personal injury	S	4	B	5	2. Training/qualification of personnel	
		3. Possible personal injury	E	4	D	5	3. Low instrument Air pressure alarm	
	3. Poor labeling	1. Possible personal injury	S	4	B	5	1. Specific guidance in procedures	1
		2. Possible plant loss of instrument air supply	S/E	4	B	5	2. Training/qualification of personnel	
		3. Possible personal injury	E	4	D	5	3. Low instrument Air pressure alarm	

Node: 30. Start-up/Returning the Airtek Air Dryer back to service.	
Type: Procedural Step	Drawing: (OP) UT-AS-009, 07/26/00
Design Conditions/Parameters: Step1.1 and 1.2	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
30.1 Other than specified action								
	1. Insufficient communication between operators	1. Possible personal injury	S	4	B	5	1. Process paramter indication - dew point temperature, air pressure, air temperature, air flow rate	1
		2. Possible personal injury	E	4	D	5	2. Specific guidance in procedures	
		3. Possible plant loss of instrument air supply	S/E	4	B	5	3. Training/qualification of personnel	
		4. Downstream instrument malfunction due to water in air	S/E	4	B	5	4. Lockout/Tagout procedure	
	2. Insufficient knowledge	1. Possible personal injury	S	4	B	5	1. Process paramter indication - dew point temperature, air pressure, air temperature, air flow rate	1
		2. Possible personal injury	E	4	D	5	2. Specific guidance in procedures	
		3. Possible plant loss of instrument air supply	S/E	4	B	5	3. Training/qualification of personnel	
		4. Downstream instrument malfunction due to water in air	S/E	4	B	5	4. Lockout/Tagout procedure	
	3. Operator omits step	1. Possible personal injury	S	4	B	5	1. Process paramter indication - dew point temperature, air pressure, air temperature, air flow rate	1
		2. Possible personal injury	E	4	D	5	2. Specific guidance in procedures	
		3. Possible plant loss of instrument air supply	S/E	4	B	5	3. Training/qualification of personnel	
		4. Downstream instrument malfunction due to water in air	S/E	4	B	5	4. Lockout/Tagout procedure	
	4. Poor labeling	1. Possible personal injury	S	4	B	5	1. Process paramter indication - dew point temperature, air pressure, air temperature, air flow rate	1
		2. Possible personal injury	E	4	D	5	2. Specific guidance in procedures	
		3. Possible plant loss of instrument air supply	S/E	4	B	5	3. Training/qualification of personnel	
		4. Downstream instrument malfunction due to water in air	S/E	4	B	5	4. Lockout/Tagout procedure	

Node: 31. Cooling Tower #4 fans, 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, 12/11/02
Design Conditions/Parameters: Flow rates up to 10500 gpm @ 100 psig Pressure to 175 psig can be achieved at lower flow rates including dead head condition.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
31.1 Cavitation								
	1. Low sump level	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Cooling tower sump low level alarm 2. Emergency cooling water 3. Automatic sump level control	1
	2. Plugged inlet pump screen/ sump screen	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. PM of cooling towers every two years	1
31.2 Low/No Flow								
	1. Sump empty/sump screens plugged	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm	1
	2. Cooling water pressure control valve or controller fails CV opens	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	3. Operator fails to align correct lines/valves	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication 4. Operating procedures/training	1
	4. Pump failure	1. No cooling water supply	S/E	4	B	5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	5. Line leak/rupture	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm 4. High temperature alarms on reactor 5. Reactor cooling water flow indication	1
31.3 High Temperature								
	1. Fan not running	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1
	2. High ambient temperature	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1

Node: 31. Cooling Tower #4 fans, 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, 12/11/02
Design Conditions/Parameters: Flow rates up to 10500 gpm @ 100 psig Pressure to 175 psig can be achieved at lower flow rates including dead head condition.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
31.3 cont'd								
	3. Poor distribution of water over cooling tower	1. Reactor temperture control problems	S/E	4	B	5	1. Routine operator checks	1
31.4 Low Temperature								
	1. Low ambient temperature	1. Cooling tower structural damage	EC	4	C	5	1. Automatic cooling tower fan control 2. Cooling tower sump temperature indication 3. Routine operator checks	1

Node: 32. Cooling Tower #6 fans, cooling water pumps, PP-906, PP-907, PP-908, and PP-116, and supply lines to New Module Reactors.	
Type: Centrifugal Pump + Line	Drawing: UT-090113-PID-D, 12/11/02
Design Conditions/Parameters: Flows to 18,000 gpm @ 100 psig. Pressures to 125 psig at lower flow rates.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
32.1 Cavitation								
	1. Low sump level	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Cooling tower sump low level alarm 2. Emergency cooling water 3. Automatic sump level control	1
	2. Plugged inlet pump screen/ sump screen	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. PM of cooling towers every two years	1
32.2 Low/No Flow								
	1. Cooling water pressure control valve or controller fails CV opens	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	2. Line leak/rupture	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm 4. High temperature alarms on reactor 5. Reactor cooling water flow indication	1
	3. Operator fails to align correct lines/valves	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication 4. Operating procedures/training	1
	4. Pump failure	1. No cooling water supply	S/E	4	B	5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	5. Sump empty/sump screens plugged	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm	1
32.3 High Temperature								
	1. Fan not running	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1
	2. High ambient temperature	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1
	3. Poor distribution of water over cooling tower	1. Reactor temperture control problems	S/E	4	B	5	1. Routine operator checks	1

Node: 32. Cooling Tower #6 fans, cooling water pumps, PP-906, PP-907, PP-908, and PP-116, and supply lines to New Module Reactors.	
Type: Centrifugal Pump + Line	Drawing: UT-090113-PID-D, 12/11/02
Design Conditions/Parameters: Flows to 18,000 gpm @ 100 psig. Pressures to 125 psig at lower flow rates.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
32.4 Low Temperature								
	1. Low ambient temperature	1. Cooling tower structural damage	EC	4	C	5	1. Automatic cooling tower fan control 2. Cooling tower sump temperature indication 3. Routine operator checks	1

Node: 33. Cooling Tower #2 fans, cooling water pumps, PP-252, PP-253, PP-977, PP-978, PP-257, and PP-258 and supply line to air compressors, Old Module Recovery, ERS, Dryers, OM Strippers and can supply OM Reactor cooling water.	
Type: Centrifugal Pump + Line	Drawing: UT-090114-PID-D, 12/11/02
Design Conditions/Parameters: Flows to 11,000 gpm @ 100 psig. Pressures up to 125 psig at lower flow rates.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
33.1 Cavitation								
	1. Low sump level	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Cooling tower sump low level alarm 2. Emergency cooling water 3. Automatic sump level control	1
	2. Plugged inlet pump screen/ sump screen	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. PM of cooling towers every two years	1
33.2 Low/No Flow								
	1. Cooling water pressure control valve or controller fails CV opens	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	2. Line leak/rupture	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm 4. High temperature alarms on reactor 5. Reactor cooling water flow indication	1
	3. Operator fails to align correct lines/valves	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication 4. Operating procedures/training	1
	4. Pump failure	1. No cooling water supply	S/E	4	B	5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	5. Sump empty/sump screens plugged	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm	1
33.3 High Temperature								
	1. Fan not running	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1
	2. High ambient temperature	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1

Node: 33. Cooling Tower #2 fans, cooling water pumps, PP-252, PP-253, PP-977, PP-978, PP-257, and PP-258 and supply line to air compressors, Old Module Recovery, ERS, Dryers, OM Strippers and can supply OM Reactor cooling water.	
Type: Centrifugal Pump + Line	Drawing: UT-090114-PID-D, 12/11/02
Design Conditions/Parameters: Flows to 11,000 gpm @ 100 psig. Pressures up to 125 psig at lower flow rates.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
33.3 cont'd								
	3. Poor distribution of water over cooling tower	1. Reactor temperture control problems	S/E	4	B	5	1. Routine operator checks	1
33.4 Low Temperature								
	1. Low ambient temperature	1. Cooling tower structural damage	EC	4	C	5	1. Automatic cooling tower fan control 2. Cooling tower sump temperature indication 3. Routine operator checks	1

Node: 34. Operation of Deluge Water to Emergency Cooling Water System.	
Type: Procedural Step	Drawings: (OP) VINYL-NM-E008, 05/01/99, (OP) VINYL-OM-E008, 05/01/99
Design Conditions/Parameters: Steps 1 thru 5	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
34.1 Other than specified action								
	1. Communication failure between operators	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system 2. Automatic Emergency kill system 3. Manual emergency kill system 4. High pressure alarms on reactor 5. High temperature alarms on reactor 6. Emergency operating procedures/training/ qualification 7. Gaitronics system - alternative communication system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5		
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5		
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	E	4	D	5		
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S	3	D	5		
		6. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	E	3	D	5		
	2. Confusion in emergency situation	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system 2. Manual emergency kill system 3. High pressure alarms on reactor 4. High temperature alarms on reactor 5. Emergency operating procedures/training/ qualification 6. Gaitronics system - alternative communication system 7. Automatic Emergency kill system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5		
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5		
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5		
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5		
	3. Insufficient training	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system 2. Automatic Emergency kill system 3. Manual emergency kill system 4. High pressure alarms on reactor 5. High temperature alarms on reactor 6. Emergency operating procedures/training/ qualification 7. Gaitronics system - alternative communication system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5		
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5		
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5		
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5		
	4. Operator omits step	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system 2. Automatic Emergency kill system 3. Manual emergency kill system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5		

Node: 34. Operation of Deluge Water to Emergency Cooling Water System.	
Type: Procedural Step	Drawings: (OP) VINYL-NM-E008, 05/01/99, (OP) VINYL-OM-E008, 05/01/99
Design Conditions/Parameters: Steps 1 thru 5	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
34.1 cont'd								
	4. cont'd	3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. High pressure alarms on reactor	
							5. High temperature alarms on reactor	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	6. Emergency operating procedures/training/ qualification	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	7. Gaitronics system - alternative communication system	

Node: 35. Chlorine supply line from chlorine container to ejector. Cooling Towers #'s 2, 4, and 6.	
Type: Line	Drawing: UT-090117-PID-D, 10/10/02
Design Conditions/Parameters: Up to 500 lb/day of chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
35.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to towers	S/E S/E	4 4	D D	5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to towers 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to cooling towers	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication 4. Drip leg heater 5. Operating Procedures/ Training for cylinder valve alignment 6. Chlorine area monitor and alarm 81A085 7. Buddy system when hooking and unhooking chlorine cylinders 8. Personal Protective Equipment	42 43
	4. Liquid Chlorine in the line	1. Tubing rupture/leak 2. Tubing rupture/leak-E 3. Overfeed chlorine to cooling towers	S E S/E	3 4 4	C C C	4 5 5	1. Chlorine regulator located on cylinder 2. Drip leg heater 3. Operating Procedures/ Training for cylinder valve alignment 4. Chlorine area monitor and alarm 81A085 5. Buddy system when hooking and unhooking chlorine cylinders 6. Personal Protective Equipment	41 42
35.2 Low/No Flow								
	1. Ruptured/cracked line	1. Loss of chlorine to towers	S/E	4	C	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	2. Blocked discharge	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	3. High upstream pressure	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	4. Chlorine cylinder is empty	1. Loss of chlorine to towers	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication	1

Node: 35. Chlorine supply line from chlorine container to ejector. Cooling Towers #'s 2, 4, and 6.	
Type: Line	Drawing: UT-090117-PID-D, 10/10/02
Design Conditions/Parameters: Up to 500 lb/day of chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
35.2 cont'd								
	4. cont'd						3. Regular cooling tower checks 4. Chlorine cylinder scale 5. Spare chlorine cylinder	
	5. Plugged regulator inlet filter	1. Loss of chlorine to towers	S/E	4	B	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
35.3 Leak								
	1. Corrosion	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Personal Protective Equipment	42 43
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use 6. Personal Protective Equipment	42 43

Node: 36. Chlorine supply line from chlorine container to ejector. Water Plant Chlorination System.	
Type: Line	Drawing: WP-090106-PID-D, 09/26/02
Design Conditions/Parameters: 360 PPD at ambient chlorine vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
36.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to water plant	S/E S/E	4 4	D D	5 5	1. Regular water plant checks 2. Daily visual checks 3. Eductor Vacuum indication	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to water plant 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to water plant	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular water plant checks 2. Daily visual checks 3. Eductor Vacuum indication 4. Drip leg heater 5. Operating Procedures/ Training for cylinder valve alignment 6. Chlorine area monitor and alarm AAH808 7. Buddy system when hooking and unhooking chlorine cylinders 8. Personal Protective Equipment	43 45 46
	4. Liquid Chlorine in the line	1. Tubing rupture/leak 2. Tubing rupture/leak-E 3. Overfeed chlorine to water plant	S E S/E	3 4 4	C C C	4 5 5	1. Drip leg heater 2. Operating Procedures/ Training for cylinder valve alignment 3. Chlorine area monitor and alarm AAH808 4. Buddy system when hooking and unhooking chlorine cylinders 5. Personal Protective Equipment	41 45 46
36.2 Low/No Flow								
	1. Blocked discharge	1. Loss of chlorine to water plant	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1
	2. Chlorine cylinder is empty	1. Loss of chlorine to water plant	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks 4. Chlorine cylinder scale 5. Spare chlorine cylinder	1
	3. High upstream pressure	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1
	4. Plugged regulator inlet filter	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks	1

Node: 36. Chlorine supply line from chlorine container to ejector. Water Plant Chlorination System.	
Type: Line	Drawing: WP-090106-PID-D, 09/26/02
Design Conditions/Parameters: 360 PPD at ambient chlorine vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
36.2 cont'd								
	4. cont'd						4. Spare chlorine cylinder with regulator	
	5. Ruptured/cracked line	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular water plant checks 4. Isolation valves	1
36.3 Leak								
	1. Corrosion	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808	43 45 46
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use	43 45 46
	3. High pressure tubing crack/ rupture	1. Loss of chlorine to water plant 2. Chlorine release	S/E S/E	4 4	B B	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm AAH808 3. Leak check cylinder connection with amonia every time cylinder is changed 4. Spare chlorine cylinder 5. Personal Protective Equipment	45 46

Node: 37. Chlorine one ton container. Water Plant in Room	
Type: Vessel	Drawing: WP-090106-PID-D, 09/26/02
Design Conditions/Parameters: Chlorine at ambient vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
37.1 Leak								
	1. Corrosion	1. Chlorine release	S/E	3	D	5	1. Inside building	45
		2. Loss of chlorine to water plant	S/E	4	D	5	2. Buddy system when hooking and unhooking chlorine cylinders	46 47
							3. Chlorine area monitor and alarm AAH808	
							4. Personal Protective Equipment	
	2. Gasket or packing or valve seal failure	1. Chlorine release	S/E	4	C	5	1. Buddy system when hooking and unhooking chlorine cylinders	45 46 47
		2. Loss of chlorine to water plant	S/E	4	D	5	2. Chlorine area monitor and alarm AAH808	
							3. Personal Protective Equipment	
							4. Check packing on cylinder valves before use	
							5. Leak check cylinder connection with amonia every time cylinder is changed	
							6. Use new washer every time cylinder is changed	
	3. Fusible Plug blowout	1. Chlorine release	S/E	3	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	45 46 47
		2. Loss of chlorine to water plant	S/E	4	D	5	2. Chlorine area monitor and alarm AAH808	
							3. Personal Protective Equipment	
							4. Chlorine "B" kit located at water plant	
							5. Emergency Response Procedures/Training	

Node: 38. Start-up of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99
Design Conditions/Parameters: UT-CT-001 Steps 1.0 & 2.0; UT-CT-002 Steps 1.0 & 2.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
38.1 Other than specified action								
	1. Inadequate operator training	1. Chlorine leak/release	S/E	4	B	5	1. Chlorine leak detection device 81AA085	41
		2. Equipment shutdown	S/E	4	B	5	2. Personal protection equipment	42
		3. Personal exposure	S	4	C	5	3. Specific guidance in procedures	43
							4. Training & qualification of personnel	50
							5. More than one Chlorine "B" kit in plant for emergency use.	
							6. Chlorine regulator located on cylinder which requires vacuum for flow.	
	2. Operator doesn't adhere to procedure	1. Chlorine leak/release	S/E	4	B	5	1. Chlorine leak detection device 81AA085	41
		2. Equipment shutdown	S/E	4	B	5	2. Personal protection equipment	42
		3. Personal exposure	S	4	C	5	3. Specific guidance in procedures	43
							4. Training & qualification of personnel	50
							5. More than one Chlorine "B" kit in plant for emergency use.	
							6. Chlorine regulator located on cylinder which requires vacuum for flow.	

Node: 39. Shut down of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-CT-001, 09/29/99, (OP) UT-CT-002, 09/29/99
Design Conditions/Parameters: UT-CT-001 Steps 3.0 & 4.0; UT-CT-002 Steps 3.0 & 4.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
39.1 Other than specified action								
	1. Inadequate operator training	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 81AA085 2. Chlorine regulator located on cylinder which requires vacuum for flow. 3. More than one Chlorine "B" kit in plant for emergency use. 4. Personal protection equipment 5. Specific guidance in procedures 6. Training & qualification of personnel	41 42 43 50
	2. Operator doesn't adhere to procedure	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 81AA085 2. Chlorine regulator located on cylinder which requires vacuum for flow. 3. More than one Chlorine "B" kit in plant for emergency use. 4. Personal protection equipment 5. Specific guidance in procedures 6. Training & qualification of personnel	41 42 43 50

Node: 40. Emergency response to a chlorine leak of Cooling Tower Chlorination System.	
Type: Procedural Step	Drawing: (OP) UT-CT-003, 09/29/99
Design Conditions/Parameters: Steps 1.0 - 4.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
40.1 Other than specified action								
	1. Inadequate personal training	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	13 47
		2. Personal evacuation	S/E	3	C	4		
		3. Personal exposure	S/E	3	C	4		
	2. Emergency response material not available	1. Interuption of plant operations	EC	3	C	4	1. Annual inventory of ERT Team "B" kit	12
		2. Personal evacuation	S/E	3	C	4		
		3. Personal exposure	S/E	3	C	4		

Node: 41. Start-up of Water Plant Chlorination System	
Type: Procedural Step	Drawings: (OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00
Design Conditions/Parameters: UT-WP-002, Start-up Steps 1-22; UT-WP-003, Steps 2.0, 2.1-2.8, 3.1-3.24, 4.1-4.3	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
41.1 Other than specified action								
	1. Inadequate operator training	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 02A808 2. Personal protection equipment 3. Specific guidance in procedures 4. Training & qualification of personnel 5. More than one Chlorine "B" kit in plant for emergency use. 6. Chlorine regulator located on cylinder which requires vacuum for flow - Back-up chlorination system only. 7. Chlorine room ventilation fan	41 45 46 50
	2. Operator doesn't adhere to procedure	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 02A808 2. Personal protection equipment 3. Specific guidance in procedures 4. Training & qualification of personnel 5. More than one Chlorine "B" kit in plant for emergency use. 6. Chlorine regulator located on cylinder which requires vacuum for flow - Back-up chlorination system only. 7. Chlorine room ventilation fan	41 45 46 50

Node: 42. Shut down of Water Plant Chlorination System	
Type: Procedural Step	Drawings: (OP) UT-WP-002, 07/20/00, (OP) UT-WP-003, 08/09/00
Design Conditions/Parameters: UT-WP-002, SHUTDOWN Procedure Steps 1-5; UT-WP-003 Steps 13.1-13.16	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
42.1 Other than specified action								
	1. Inadequate operator training	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 02A808 2. Chlorine regulator located on cylinder which requires vacuum for flow - Back-up chlorination system only. 3. Chlorine room ventilation fan 4. More than one Chlorine "B" kit in plant for emergency use. 5. Personal protection equipment 6. Specific guidance in procedures 7. Training & qualification of personnel	41 45 46 50
	2. Operator doesn't adhere to procedure	1. Chlorine leak/release 2. Equipment shutdown 3. Personal exposure	S/E S/E S	4 4 4	B B C	5 5 5	1. Chlorine leak detection device 02A808 2. Chlorine regulator located on cylinder which requires vacuum for flow - Back-up chlorination system only. 3. Chlorine room ventilation fan 4. More than one Chlorine "B" kit in plant for emergency use. 5. Personal protection equipment 6. Specific guidance in procedures 7. Training & qualification of personnel	41 45 46 50

Node: 43. Emergency response to a chlorine leak of Water Plant Chlorination System.	
Type: Procedural Step	Drawings: (OP) UT-WP-017, 07/20/00, (OP) UT-WP-018, 07/20/00
Design Conditions/Parameters: UT-WP-017 Steps 1-4; UT-WP-018 Steps 1.1-1.22, 2.0	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
43.1 Other than specified action								
	1. Inadequate personal training	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	13
		2. Personal evacuation	S/E	3	C	4		47
		3. Personal exposure	S/E	3	C	4		
	2. Emergency response material not available	1. Interuption of plant operations	EC	3	C	4	1. Annual training of ERT Team Members	12
		2. Personal evacuation	S/E	3	C	4	2. Annual inventory of ERT Team "B" kit	
		3. Personal exposure	S/E	3	C	4		

Node: 44. DM-810 Instrument Air surge tank at VCM tank farm	
Type: Vessel	Drawing: UT-090111-PID-D, 09/26/02
Design Conditions/Parameters: Pressure to 100 psig. Dew point -40 F. MAWP 100 psig @ 175 F	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
44.1 High Level								
	1. Moisture in the inlet air	1. Downstream instrument malfunction due to water in air	S/E	4	B	5	1. Drain valve	37
		2. Loss of air supply to some equipment	S/E	4	B	5		
	2. Plugged drain valve	1. Downstream instrument malfunction due to water in air	S/E	4	B	5		37
		2. Loss of air supply to some equipment	S/E	4	B	5		
44.2 High Pressure								
	1. Operator fails to align correct lines/valves	1. Loss of instrument air to some equipment	S/E	4	B	5	1. Pressure relief valve 2. Relief valve PM	1
		2. Overpressure vessel	S/E	4	B	5		
	2. Relief Valve Plugged under relieving condition	1. Overpressure vessel	S/E	4	B	5	1. Pressure vessel inspection program 2. Relief valve PM	1

Node: 45. Chlorine Ton Cylinder for Cooling Towers Vinyl Area	
Type: Tank	Drawing: UT-090117-PID-D, 10/10/02
Design Conditions/Parameters: Chlorine at ambient vapor pressure and temperature.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
45.1 Leak								
	1. Corrosion	1. Chlorine release	S/E	3	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	42
		2. Loss of chlorine to #2, #4, #6, and #7 Cooling Towers as well as Centrate	S/E	4	D	5	2. Chlorine area monitor and alarm 81A085	47
							3. Personal Protective Equipment	
	2. Gasket or packing or valve seal failure	1. Chlorine release	S/E	4	C	5	1. Buddy system when hooking and unhooking chlorine cylinders	42
		2. Loss of chlorine to #2, #4, #6, and #7 Cooling Towers as well as Centrate	S/E	4	D	5	2. Chlorine area monitor and alarm 81A085	47
							3. Personal Protective Equipment	
							4. Check packing on cylinder valves before use	
							5. Leak check cylinder connection with amonia every time cylinder is changed	
							6. Use new washer every time cylinder is changed	
	3. Fusible Plug blowout	1. Chlorine release	S/E	3	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	42
		2. Loss of chlorine to #2, #4, #6, and #7 Cooling Towers as well as Centrate	S/E	4	D	5	2. Chlorine area monitor and alarm 81A085	47
							3. Personal Protective Equipment	
							4. Chlorine "B" kit located at water plant	
							5. Emergency Response Procedures/Training	

Node: 46. Emergency cooling to #4 cooling tower supply line	
Type: Line	Drawings: UT-090112-PID-D, 12/11/02, (OP) VINYL-OM-E008, 05/01/99
Design Conditions/Parameters: 1500 to 1800 gpm of firewater from deluge system to cooling water supply header	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
46.1 Low/No Flow								
	1. Actuated valve 81H086 does not open	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Manual emergency kill system	
							3. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	5. Gaitronics system - alternative communication system	
							6. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	7. High temperature alarms on reactor	
	2. Bypass valve won't open and 81H086 is closed	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Manual emergency kill system	
							3. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	5. Gaitronics system - alternative communication system	
							6. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	7. High temperature alarms on reactor	
	3. Low firewater pressure/flow	1. Loss of cooling - Reactor overheat	S/E	4	C	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	C	5	2. Manual emergency kill system	
							3. Emergency operating procedures/training/ qualification	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. Gaitronics system - alternative communication system	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	5. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	6. High temperature alarms on reactor	

Node: 47. Emergency cooling water to #6 cooling tower water supply	
Type: Line	Drawings: UT-090113-PID-D, 12/11/02, (OP) VINYL-NM-E008, 05/01/99
Design Conditions/Parameters: 1500 to 1800 gpm of firewater from deluge system to cooling water supply header	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
47.1 Low/No Flow								
	1. Actuated valve 82H086 does not open	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Manual emergency kill system	
							3. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	5. Gaitronics system - alternative communication system	
							6. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	7. High temperature alarms on reactor	
	2. Bypass valve won't open and 82H086 is closed	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Manual emergency kill system	
							3. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	4. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	5. Gaitronics system - alternative communication system	
							6. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	7. High temperature alarms on reactor	
	3. Low firewater pressure/flow	1. Loss of cooling - Reactor overheat	S/E	4	C	5	1. Automatic Emergency kill system	39
		2. Loss of cooling - Reactor overpressure	S/E	4	C	5	2. Manual emergency kill system	
							3. Emergency operating procedures/training/ qualification	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5		
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
							5. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	6. High temperature alarms on reactor	

Node: 48. Cooling water line from #6 Cooling Tower Supply to Air compressors.	
Type: Line	Drawings: UT-090113-PID-D, 12/11/02, UT-090115-PID-D, 10/09/02
Design Conditions/Parameters: 140 gpm of cooling water @ 85 F	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
48.1 Low/No Flow								
	1. Low cooling water supply pressure	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Three sources of cooling water to CP-708 &CP-709 2. Check valve to separate emergency cooling water supply from normal cooling tower 2 supply. 3. Operating procedure for routing flows.	33
	2. Operator fails to align correct lines/valves	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Low water pressure compressor shutdown switch 3. High temperature compressor shutdown switch	1
	3. Water line freeze up	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Leave water circulating 3. Run all compressors when the ambient temperature falls below 28 F	1
48.2 High Temperature								
	1. Cooling Tower fan not running	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Cooling fan run indication and alarm 2. Cooling Tower Sump Temperature indication and alarm	1
	2. High ambient temperature	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Cooling Tower Sump Temperature indication and alarm 2. Ambient temperature indication	1

Node: 49. Emergency Cooling Pump and line for #2 Cooling Tower emergency cooling water supply to CP-708 & CP-709	
Type: Centrifugal Pump + Line	Drawings: UT-090114-PID-D, 12/11/02, UT-090115-PID-D, 10/09/02
Design Conditions/Parameters: 600 gpm @ 100 psig	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
49.1 Low/No Flow								
	1. Operator fails to align correct lines/valves	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Low water pressure compressor shutdown switch 3. High temperature compressor shutdown switch	1
	2. Pump failure (mechanical/ electrical)	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Three sources of cooling water to CP-708 &CP-709 3. Check valve to separate emergency cooling water supply from normal cooling tower 2 supply. 4. Low water pressure compressor shutdown switch 5. High temperature compressor shutdown switch	1
	3. Water line freeze up	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Leave water circulating	1
	4. Leak/rupture	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Operating procedures for routing flows 2. Low water pressure compressor shutdown switch 3. High temperature compressor shutdown switch 4. Three sources of cooling water to CP-708 &CP-709	1
	5. Low sump level	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low water pressure compressor shutdown switch 2. High temperature compressor shutdown switch 3. Three sources of cooling water to CP-708 &CP-709 4. Cooling tower sump low level alarm	1
	6. Pump suction screen plugged	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low water pressure compressor shutdown switch 2. High temperature compressor shutdown switch 3. Three sources of cooling water to CP-708 &CP-709	1
	7. Check valve failure	1. Compressor shutdown 2. Loss of Instrument Air	S/E S/E	4 4	B B	5 5	1. Low water pressure compressor shutdown switch 2. High temperature compressor shutdown switch 3. Three sources of cooling water to CP-708 &CP-709	1

Node: 49. Emergency Cooling Pump and line for #2 Cooling Tower emergency cooling water supply to CP-708 & CP-709	
Type: Centrifugal Pump + Line	Drawings: UT-090114-PID-D, 12/11/02, UT-090115-PID-D, 10/09/02
Design Conditions/Parameters: 600 gpm @ 100 psig	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
49.1 cont'd								
	7. cont'd						4. Isolation valve downstream of check valve	

Node: 50. Cooling Tower #7 Pumps PP-540, PP-541, PP-542, PP-543, and line to supply cooling water to the large reactors in the New Module. Tower also supplies water to the LM stripper and NM recovery system. Can provide water to other NM reactors and HM stripper.	
Type: Centrifugal Pump + Line	Drawing: UT-090122-PID-D, 12/11/02
Design Conditions/Parameters: Flow rate up to 18,000 gpm @ 100 psig. Pressures to 125 psig at lower flows.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
50.1 Cavitation								
	1. Low sump level	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Cooling tower sump low level alarm 2. Emergency cooling water 3. Automatic sump level control	1
	2. Plugged inlet pump screen/ sump screen	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. PM of cooling towers every two years	1
50.2 Low/No Flow								
	1. Cooling water pressure control valve or controller fails CV opens	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication	1
	2. Line leak/rupture	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm 4. High temperature alarms on reactor 5. Reactor cooling water flow indication	1
	3. Operator fails to align correct lines/valves	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. High temperature alarms on reactor 3. Reactor cooling water flow indication 4. Operating procedures/training	1
	4. Pump failure (mechanical/ electrical)	1. No cooling water supply	S/E	4	B	5	1. High temperature alarms on reactor 2. Reactor cooling water flow indication 3. Emergency Power from GN-003	1
	5. Sump empty/sump screens plugged	1. Equipment damage 2. No cooling water supply	S/E S/E	4 4	B B	5 5	1. Emergency cooling water 2. Automatic sump level control 3. Cooling tower sump low level alarm	1
50.3 High Temperature								
	1. Fan not running	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms 2. Fan run indication	1
	2. High ambient temperature	1. Reactor temperture control problems	S/E	4	B	5	1. Reactor high temperature alarms	1

Node: 50. Cooling Tower #7 Pumps PP-540, PP-541, PP-542, PP-543, and line to supply cooling water to the large reactors in the New Module. Tower also supplies water to the LM stripper and NM recovery system. Can provide water to other NM reactors and HM stripper.

Type: Centrifugal Pump + Line	Drawing: UT-090122-PID-D, 12/11/02

Design Conditions/Parameters: Flow rate up to 18,000 gpm @ 100 psig. Pressures to 125 psig at lower flows.

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
50.3 cont'd								
	2. cont'd						2. Fan run indication	
	3. Poor distribution of water over cooling tower	1. Reactor temperture control problems	S/E	4	B	5	1. Routine operator checks	1
50.4 Low Temperature								
	1. Low ambient temperature	1. Cooling tower structural damage	EC	4	C	5	1. Automatic cooling tower fan control 2. Cooling tower sump temperature indication 3. Routine operator checks	1

Node: 51. Emergency Generator GN-003 supplies power to one cooling tower pump for #7 Cooling Tower.	
Type: Generator	Drawing: UT-090122-PID-D, 12/11/02
Design Conditions/Parameters: Automatic Start-up in case of power failure.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
51.1 Other than Start-up/Shutdown								
	1. Pump not in Auto	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	1
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High pressure alarms on reactor	
							6. High temperature alarms on reactor	
							7. Manual emergency kill system	
							8. Cooling Pump run indication	
							9. Reactor cooling water flow indication	
							10. Annual PM of Generator	
	2. Batteries/Starter Malfunction	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	1
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High pressure alarms on reactor	
							6. High temperature alarms on reactor	
							7. Manual emergency kill system	
							8. Weekly start check of generator	
							9. Generator trouble alarm	
	3. Generator in Stop position (Local hand switch)	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	1
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High pressure alarms on reactor	
							6. High temperature alarms on reactor	
							7. Manual emergency kill system	
							8. Cooling Pump run indication	
							9. Reactor cooling water flow indication	
	4. No fuel	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	1

Node: 51. Emergency Generator GN-003 supplies power to one cooling tower pump for #7 Cooling Tower.	
Type: Generator	Drawing: UT-090122-PID-D, 12/11/02
Design Conditions/Parameters: Automatic Start-up in case of power failure.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
51.1 cont'd								
	4. cont'd	2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High pressure alarms on reactor	
							6. High temperature alarms on reactor	
							7. Manual emergency kill system	
							8. Cooling Pump run indication	
							9. Reactor cooling water flow indication	
							10. Gas supply line is tagged to stay open	
	5. Generator not in auto	1. Loss of cooling - Reactor overheat	S/E	4	B	5	1. Automatic Emergency kill system	1
		2. Loss of cooling - Reactor overpressure	S/E	4	B	5	2. Deluge system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Emergency operating procedures/training/ qualification	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. Gaitronics system - alternative communication system	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High pressure alarms on reactor	
							6. High temperature alarms on reactor	
							7. Manual emergency kill system	
							8. Cooling Pump run indication	
							9. Reactor cooling water flow indication	

Node: 52. 150 Lb Chlorine Cylinder for Compound #5 Cooling Tower	
Type: Tank	Drawing: UT-090123-PID-D, 10/23/02
Design Conditions/Parameters: Chlorine at ambient temperatures and pressures.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
52.1 Leak								
	1. Corrosion	1. Chlorine release	S	3	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	44
		2. Chlorine release-E	E	4	D	5	2. Chlorine area monitor and alarm 88AE5031	47
		3. Loss of chlorine to #5 Cooling Tower	S/E	4	D	5	3. Personal Protective Equipment	
	2. Gasket or packing or valve seal failure	1. Chlorine release	S/E	4	C	5	1. Buddy system when hooking and unhooking chlorine cylinders	44
		2. Loss of chlorine to #5 Cooling Tower	S/E	4	D	5	2. Personal Protective Equipment	47
							3. Check packing on cylinder valves before use	
							4. Leak check cylinder connection with amonia every time cylinder is changed	
							5. Use new washer every time cylinder is changed	
							6. Chlorine area monitor and alarm 88AE5031	
	3. Fusible Plug blowout	1. Chlorine release	S/E	3	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	44
		2. Loss of chlorine to #5 Cooling Tower	S/E	4	D	5	2. Personal Protective Equipment	47
							3. Chlorine "A" kit located nearby	
							4. Emergency Response Procedures/Training	
							5. Chlorine area monitor and alarm 88AE5031	

Node: 53. Regulator and line that supplies chlorine gas to chlorine ejector for Compound Cooling Tower #5	
Type: Line	Drawing: UT-090123-PID-D, 10/23/02
Design Conditions/Parameters: Up to 10 lb/day of chlorine gas at ambient vapor pressure before the regulator and at 0 psig or below after the regulator to the ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
53.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction 2. Loss of chlorine to towers	S/E S/E	4 4	D D	5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication	43
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to towers 2. Tubing rupture/leak 3. Tubing rupture/leak-E 4. Overfeed chlorine to cooling towers	S/E S E S/E	4 3 4 4	D C C C	5 4 5 5	1. Regular cooling tower checks 2. Daily visual checks 3. Eductor Vacuum indication 4. Drip leg heater 5. Operating Procedures/ Training for cylinder valve alignment 6. Chlorine area monitor and alarm 81A085 7. Buddy system when hooking and unhooking chlorine cylinders	42 43 44
	4. Liquid Chlorine in the line	1. Tubing rupture/leak 2. Tubing rupture/leak-E 3. Overfeed chlorine to cooling towers	S E S/E	3 4 4	C C C	4 5 5	1. Chlorine regulator located on cylinder 2. Drip leg heater 3. Operating Procedures/ Training for cylinder valve alignment 4. Chlorine area monitor and alarm 81A085 5. Buddy system when hooking and unhooking chlorine cylinders	41 42 44
53.2 Low/No Flow								
	1. Ruptured/cracked line	1. Loss of chlorine to towers	S/E	4	C	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	2. Blocked discharge	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	3. High upstream pressure	1. Loss of chlorine to towers	S/E	4	D	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks	1
	4. Chlorine cylinder is empty	1. Loss of chlorine to towers	S/E	4	A	5	1. Daily visual checks 2. Eductor Vacuum indication 3. Regular cooling tower checks 4. Chlorine cylinder scale	1
	5. Plugged regulator inlet filter	1. Loss of chlorine to towers	S/E	4	B	5	1. Daily visual checks	1

Node: 53. Regulator and line that supplies chlorine gas to chlorine ejector for Compound Cooling Tower #5	
Type: Line	Drawing: UT-090123-PID-D, 10/23/02
Design Conditions/Parameters: Up to 10 lb/day of chlorine gas at ambient vapor pressure before the regulator and at 0 psig or below after the regulator to the ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
53.2 cont'd								
	5. cont'd						2. Eductor Vacuum indication 3. Regular cooling tower checks	
53.3 Leak								
	1. Corrosion	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	D C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085	42 43
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to towers 2. Chlorine release	S/E S/E	4 4	B C	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Chlorine area monitor and alarm 81A085 3. Use new washer every time cylinder is changed 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Check packing on cylinder valves before use	42 43

Node: 54. Operation of Emergency Generator GN-004 for Vinyl Control Room	
Type: Generator	Drawing: (OP) VINYL-OM-E007, 05/01/99
Design Conditions/Parameters: Step 1.1 and 1.2 of Operating Procedure (Automatic Operation)	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
54.1 Low/No Power								
	1. Batteries/Starter Malfunction	1. DCS loses power after UPS runs down	S/E	4	B	5	1. UPS Power supply 2. Weekly Check of Generator-Fuel,water,belts, oil, indicator lights, 15 min. run test, voltage, battery charger, engine block. 3. Manual valves in field	1
		2. Plant Telephone system power failure	S/E	4	B	5		
		3. Control Room Pressurization failure	S	3	D	5		
		4. Control Room Pressurization failure-E	E	4	D	5		
		5. Vinyl Unit and VCM Tank Farm instrument/valve power failure	S/E	3	D	5		
	2. No fuel	1. DCS loses power after UPS runs down	S/E	4	B	5	1. UPS Power supply 2. Weekly Check of Generator 3. Manual valves in field	1
		2. Plant Telephone system power failure	S/E	4	B	5		
		3. Control Room Pressurization failure	S	3	D	5		
		4. Control Room Pressurization failure-E	E	4	D	5		
		5. Vinyl Unit and VCM Tank Farm instrument/valve power failure	S/E	3	D	5		
	3. Generator not in auto	1. DCS loses power after UPS runs down	S/E	4	B	5	1. UPS Power supply 2. Weekly Check of Generator 3. Manual valves in field	1
		2. Plant Telephone system power failure	S/E	4	B	5		
		3. Control Room Pressurization failure	S	3	D	5		
		4. Control Room Pressurization failure-E	E	4	D	5		
		5. Vinyl Unit and VCM Tank Farm instrument/valve power failure	S/E	3	D	5		
	4. Transfer switch fails to switch	1. DCS loses power after UPS runs down	S/E	4	B	5	1. UPS Power supply 2. Weekly Check of Generator 3. Manual valves in field	1
		2. Plant Telephone system power failure	S/E	4	B	5		
		3. Control Room Pressurization failure	S	3	D	5		
		4. Control Room Pressurization failure-E	E	4	D	5		
		5. Vinyl Unit and VCM Tank Farm instrument/valve power failure	S/E	3	D	5		

Node: 55. Cooling Tower #7 Standby Generator Operation	
Type: Procedural Step	Drawing: (OP) VINYL-NM-E013, 04/27/99
Design Conditions/Parameters: Step A and B	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
55.1 Other than specified action								
	1. Communication failure between operators	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5	2. Automatic Emergency kill system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Manual emergency kill system	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High temperature alarms on reactor	
							6. Emergency operating procedures/training/ qualification	
							7. Gaitronics system - alternative communication system	
	2. Confusion in emergency situation	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5	2. Automatic Emergency kill system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Manual emergency kill system	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High temperature alarms on reactor	
							6. Emergency operating procedures/training/ qualification	
							7. Gaitronics system - alternative communication system	
	3. Operator omits step	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5	2. Automatic Emergency kill system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Manual emergency kill system	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. High pressure alarms on reactor	
		5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	5. High temperature alarms on reactor	
							6. Emergency operating procedures/training/ qualification	
							7. Gaitronics system - alternative communication system	
	4. Insufficient training	1. Loss of cooling - Reactor overpressure	S/E	4	B	5	1. Deluge system	1
		2. Loss of cooling - Reactor overheat	S/E	4	B	5	2. Automatic Emergency kill system	
		3. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release	S	3	D	5	3. Manual emergency kill system	
		4. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release-E	E	4	D	5	4. High pressure alarms on reactor	
							5. High temperature alarms on reactor	
							6. Emergency operating procedures/training/	

Node: 55. Cooling Tower #7 Standby Generator Operation	
Type: Procedural Step	Drawing: (OP) VINYL-NM-E013, 04/27/99
Design Conditions/Parameters: Step A and B	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
55.1 cont'd								
	4. cont'd	5. Loss of cooling - Reactor overpressure - relief valve lifts - VCM Release - Ignition source - Fire/Explosion	S/E	3	D	5	6. cont'd qualification 7. Gaitronics system - alternative communication system	

Node: 56. Cooling Tower Fan Control	
Type: Procedural Step	Drawing: (OP) VINYL-NM-N475, 08/31/00
Design Conditions/Parameters: Step 1 and 2 (DCS Operation)	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
56.1 Other than specified action								
	1. Manual overide of DCS Controls	1. High cooling water temperature	S/E	4	B	5	1. Cooling tower temperature indication	1

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 Low/No Power								
	1. Batteries/Starter Malfunction	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Battery Charger 4. Engine Block Heater 5. Fire Protection System	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Fixed point monitor 7. Operating procedures/training	
		4. Loss of power to Catalyst Freezers	S	3	C	4	8. Personal Protective Equipment	
		5. Loss of power to Catalyst Freezers -E	E	4	C	5	9. Reactor pressure/temperature indication 10. Automatic/Manual Emergency Kill 11. Beacon Light for catalyst freezers 12. Blowout door for catalyst freezer 13. Camera for catalyst freezer 14. Door open/close indication - 84Z953/954 east. Similar west freezer 15. Floor grating and aisle promote air circulation for catalyst freezer 16. Hydrocarbon detector - 84A962 east. Similar west freezer 17. Line in catalyst freezer showing max stacking height 18. High temperature Alarm and local temperature indicator for catalyst freezer.	
	2. No fuel	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Fire Protection System 4. Fixed point monitor 5. Operating procedures/training	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Personal Protective Equipment	
		4. Loss of power to Catalyst Freezers	S	3	C	4	7. Reactor pressure/temperature indication	
		5. Loss of power to Catalyst Freezers -E	E	4	C	5	8. Automatic/Manual Emergency Kill 9. Beacon Light for catalyst freezers 10. Blowout door for catalyst freezer 11. Camera for catalyst freezer 12. Door open/close indication - 84Z953/954 east. Similar	

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	2. cont'd						12. cont'd west freezer 13. Floor grating and aisle promote air circulation for catalyst freezer 14. Hydrocarbon detector - 84A962 east. Similar west freezer 15. Line in catalyst freezer showing max stacking height 16. High temperature Alarm and local temperature indicator for catalyst freezer.	
	3. Transfer switch fails to switch	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Fire Protection System 4. Fixed point monitor 5. Operating procedures/training	
		3. Loss of power to seal oil pumps	S/E	4	C	5	6. Personal Protective Equipment	
		4. Loss of power to Catalyst Freezers	S	3	C	4	7. Reactor pressure/temperature indication	
		5. Loss of power to Catalyst Freezers -E	S/E	4	C	5	8. Automatic/Manual Emergency Kill 9. Beacon Light for catalyst freezers 10. Blowout door for catalyst freezer 11. Camera for catalyst freezer 12. Door open/close indication - 84Z953/954 east. Similar west freezer 13. Floor grating and aisle promote air circulation for catalyst freezer 14. Hydrocarbon detector - 84A962 east. Similar west freezer 15. Line in catalyst freezer showing max stacking height 16. High temperature Alarm and local temperature indicator for catalyst freezer.	
	4. Generator Mechanical failure	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	C	4	1. Annual PM of Generator 2. Weekly Operator Check of Generator	31 40
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	C	5	3. Engine Block Heater 4. Fire Protection System 5. Fixed point monitor	

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.	
Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83
Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	4. cont'd	3. Loss of power to seal oil pumps	S/E	4	C	5	6. Operating procedures/training 7. Personal Protective Equipment 8. Reactor pressure/temperature indication 9. Automatic/Manual Emergency Kill 10. Beacon Light for catalyst freezers 11. Blowout door for catalyst freezer 12. Camera for catalyst freezer 13. Door open/close indication - 84Z953/954 east. Similar west freezer 14. Floor grating and aisle promote air circulation for catalyst freezer 15. Hydrocarbon detector - 84A962 east. Similar west freezer 16. Line in catalyst freezer showing max stacking height 17. High temperature Alarm and local temperature indicator for catalyst freezer.	
		4. Loss of power to Catalyst Freezers	S	3	C	4		
		5. Loss of power to Catalyst Freezers -E	E	4	C	5		
	5. Generator not in auto	1. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion	S	3	D	5	1. Weekly Operator Check of Generator 2. Fire Protection System 3. Fixed point monitor 4. Operating procedures/training 5. Personal Protective Equipment 6. Reactor pressure/temperature indication 7. Automatic/Manual Emergency Kill 8. Beacon Light for catalyst freezers 9. Blowout door for catalyst freezer 10. Camera for catalyst freezer 11. Door open/close indication - 84Z953/954 east. Similar west freezer 12. Floor grating and aisle promote air circulation for catalyst freezer 13. Hydrocarbon detector - 84A962 east. Similar west freezer	31
		2. Loss of instrument air - Reactor Overpressure - VCM Release - Fire/Explosion -E	E	4	D	5		
		3. Loss of power to seal oil pumps	S/E	4	D	5		
		4. Loss of power to Catalyst Freezers	S	3	D	5		
		5. Loss of power to Catalyst Freezers -E	E	4	D	5		

Node: 57. Emergency Generator GN-001 that provides power for the OM & NM seal oil pumps, catalyst freezers, the instrument air compressors CP-708 & CP-709, the instrument air dryer DR-030, Pall air dryer, and the emergency cooling water pump PP-247.

Type: Generator	Drawings: MCC10A1-E-EL-D, 10/28/02, MCC10A1-E1-EL-D, 08/24/94, GP-9721-62-6D,08/23/83

Design Conditions/Parameters: Automatic start when power failure occurs. Provide 415kW

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
57.1 cont'd								
	5. cont'd						14. Line in catalyst freezer showing max stacking height 15. High temperature Alarm and local temperature indicator for catalyst freezer.	

Node: 58. Air line from DM-175 (West Joy) to EX-300 including local control actuated valve at DM-175	
Type: Line	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02
Design Conditions/Parameters: Air flow up to 3500 SCFM @ 100 psig. Pressures to approximately 115 psig. (Performance curve for 720912 08/14/73)	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
58.1 Low/No Flow								
	1. Compressor shutdown - local interlocks	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 2. Low sump level Alarm #2 cooling Tower 3. PM on #2 Cooling Tower Pumps and Tower 4. Routine cleaning of Y-strainer 5. Daily operator check of oil level 6. Oil pressure switch (shutdown switch) 7. Routinely change oil in compressors 8. Standby Instrument Air Compressors CP-708 & CP-709	1
	2. Valve failure - closes	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 2. Standby Instrument Air Compressors CP-708 & CP-709	51
	3. Compressor fail to run (motor, internals, no power)	1. Loss of Instrument Air	S/E	4	B	5	1. Daily operator check of oil level 2. Oil pressure switch (shutdown switch) 3. Routinely change oil in compressors 4. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 5. Standby Instrument Air Compressors CP-708 & CP-709 6. Routine cleaning of Y-strainer 7. PM inlet air filter regularly 8. Regular PM of West Joy	1
	4. Inlet air filter plugged	1. Loss of Instrument Air	S/E	4	D	5	1. PM inlet air filter regularly 2. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090	1
58.2 Low Pressure								
	1. Low air flow from compressors	1. Loss of Instrument Air	S/E	4	B	5	1. PM inlet air filter regularly	1

Node: 58. Air line from DM-175 (West Joy) to EX-300 including local control actuated valve at DM-175	
Type: Line	Drawings: UT-090109-PID-D, 12/11/02, UT-090108-PID-D, 12/11/02
Design Conditions/Parameters: Air flow up to 3500 SCFM @ 100 psig. Pressures to approximately 115 psig. (Performance curve for 720912 08/14/73)	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
58.2 cont'd								
	1. cont'd						2. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 3. Standby Instrument Air Compressors CP-708 & CP-709	
	2. Leak	1. Loss of Instrument Air	S/E	4	B	5	1. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 2. Standby Instrument Air Compressors CP-708 & CP-709	1
	3. Compressor internals failure (valves, innercooler, etc.)	1. Loss of Instrument Air	S/E	4	B	5	1. Daily operator check of oil level 2. Oil pressure switch (shutdown switch) 3. PM inlet air filter regularly 4. Routine cleaning of Y-strainer 5. Routinely change oil in compressors 6. Low instrument Air pressure alarm 82PA085 and Instrument Air pressure indication 82PI090 7. Standby Instrument Air Compressors CP-708 & CP-709	1

Node: 59. Chlorine Ton Cylinder Backup Chlorination System at Water Plant.	
Type: Tank	Drawing:
Design Conditions/Parameters: Chlorine at ambient temperatures and pressures.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
59.1 Leak								
	1. Corrosion	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	3 4	D D	5 5	1. Chlorine "B" kit located at water plant 2. Emergency Response Procedures/Training	47 52 53
	2. Gasket or packing or valve seal failure	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	4 4	C D	5 5	1. Buddy system when hooking and unhooking chlorine cylinders 2. Personal Protective Equipment 3. Check packing on cylinder valves before use 4. Leak check cylinder connection with amonia every time cylinder is changed 5. Use new washer every time cylinder is changed	47 52 53
	3. Fusible Plug blowout	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	2 4	D D	4 5	1. Personal Protective Equipment 2. Chlorine "B" kit located at water plant 3. Emergency Response Procedures/Training	47 52 53
	4. Vehicle collision with cylinder	1. Chlorine release 2. Loss of chlorine to water plant	S/E S/E	2 4	D D	4 5	1. Chlorine "B" kit located at water plant 2. Emergency Response Procedures/Training	47 52 53 54

Node: 60. Chlorine supply line from chlorine container to ejector. Backup chlorination at Water Plant.	
Type: Line	Drawing:
Design Conditions/Parameters: Chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
60.1 High Pressure								
	1. Water backing up into line through ejector.	1. Regulator malfunction	S/E	4	D	5	1. Regular water plant checks	43
		2. Loss of chlorine to water plant	S/E	4	D	5	2. Daily visual checks	
	2. Regulator relief (vent) valve failure under venting conditions	1. Regulator malfunction	S/E	4	D	5	1. Screen on vent line	43
		2. Chlorine release	S/E	4	D	5		52
	3. Regulator Failure to control flow/pressure	1. Loss of chlorine to water plant	S/E	4	D	5	1. Regular water plant checks	43
		2. Tubing rupture/leak	S	3	C	4	2. Daily visual checks	52
		3. Tubing rupture/leak-E	E	4	C	5	3. Drip leg heater	
		4. Overfeed chlorine to water plant	S/E	4	C	5	4. Operating Procedures/ Training for cylinder valve alignment	
							5. Buddy system when hooking and unhooking chlorine cylinders	
							6. Personal Protective Equipment	
60.2 Low/No Flow								
	1. Blocked discharge	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks	1
							2. Regular water plant checks	
	2. Chlorine cylinder is empty	1. Loss of chlorine to water plant	S/E	4	B	5	1. Daily visual checks	1
							2. Regular water plant checks	
							3. Spare chlorine cylinder	
	3. High upstream pressure	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks	1
							2. Regular water plant checks	
	4. Plugged regulator inlet filter	1. Loss of chlorine to water plant	S/E	4	D	5	1. Daily visual checks	1
							2. Regular water plant checks	
							3. Spare chlorine cylinder with regulator	
	5. Ruptured/cracked line	1. Loss of chlorine to water plant	S/E	4	C	5	1. Daily visual checks	1
							2. Regular water plant checks	
							3. Isolation valves	
60.3 Leak								
	1. Corrosion	1. Loss of chlorine to water plant	S/E	4	D	5	1. Buddy system when hooking and unhooking chlorine cylinders	43
		2. Chlorine release	S/E	4	C	5		52
	2. Gasket or packing or valve seal at cylinder or rotameter failure	1. Loss of chlorine to water plant	S/E	4	B	5	1. Buddy system when hooking and unhooking chlorine cylinders	43
		2. Chlorine release	S/E	4	C	5	2. Use new washer every time cylinder is changed	52
							3. Leak check cylinder connection with amonia every time cylinder is changed	

Node: 60. Chlorine supply line from chlorine container to ejector. Backup chlorination at Water Plant.	
Type: Line	Drawing:
Design Conditions/Parameters: Chlorine gas at ambient vapor pressure before regulator and at 0 psig or below after regulator to ejector.	

Dev	Causes	Consequences	CAT	S	L	RR	Safeguards	Rec.
60.3 cont'd								
	2. cont'd						4. Check packing on cylinder valves before use	

APPENDIX G

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix G. DOW FIRE & EXPLOSION INDEX CALCULATION

Attached information is from:

Facility Siting Process Hazard Analysis Report For Condea/Vista Aberdeen Chemical Plant, April 28, 1998

FIRE & EXPLOSION INDEX

AREA / COUNTRY	DIVISION	LOCATION	DATE
USA	MS	Aberdeen	5/1/97

SITE	MANUFACTURING UNIT	PROCESS UNIT
Condea Vista Co.	Utilities	Propane Tank Farm

PREPARED BY:	APPROVED BY: (Superintendent)	BUILDING

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 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 ($F_3 \times MF$ = 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)

2
3/4

- **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

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.

LOSS CONTROL CREDIT FACTORS

1. **Process Control Credit Factor (C_1)**

Feature	Credit Factor Range	Credit Factor Used(2)	Feature	Credit Factor Range	Credit Factor Used(2)
a. Emergency Power	0.98		f. Inert Gas	0.94 to 0.96	
b. Cooling	0.97 to 0.99		g. Operating Instructions/Procedures	0.91 to 0.99	0.96
c. Explosion Control	0.84 to 0.98		h. Reactive Chemical Review	0.91 to 0.98	
d. Emergency Shutdown	0.96 to 0.99	.99	i. Other Process Hazard Analysis	0.91 to 0.98	.94
e. Computer Control	0.93 to 0.99				

C_1 Value(3) 0.89

2. **Material Isolation Credit Factor (C_2)**

Feature	Credit Factor Range	Credit Factor Used(2)	Feature	Credit Factor Range	Credit Factor Used(2)
a. Remote Control Valves	0.96 to 0.98	.96	c. Drainage	0.91 to 0.97	0.95
b. Dump/Blowdown	0.96 to 0.98		d. Interlock	0.98	

C_2 Value(3) 0.91

3. **Fire Protection Credit Factor (C_3)**

Feature	Credit Factor Range	Credit Factor Used(2)	Feature	Credit Factor Range	Credit Factor Used(2)
a. Leak Detection	0.94 to 0.98	0.94	f. Water Curtains	0.97 to 0.98	
b. Structural Steel	0.95 to 0.98	.95	g. Foam	0.92 to 0.97	
c. Fire Water Supply	0.94 to 0.97	0.97	h. Hand Extinguishers/Monitors	0.93 to 0.98	
d. Special Systems	0.91		i. Cable Protection	0.94 to 0.98	
e. Sprinkler Systems	0.74 to 0.97	0.97			

C_3 Value(3) 0.84

Loss Control Credit Factor = C_1 X C_2 X C_3(3) = 0.68 (Enter on line 7 below)

PROCESS UNIT RISK ANALYSIS SUMMARY

1. Fire & Explosion Index (F&EI)........................ (See Front)	127	
2. Radius of Exposure ....(Figure 7)	107 ft or m	
3. Area of Exposure	35753 ft² or m²	
4. Value of Area of Exposure		$MM
5. Damage Factor ....(Figure 8)		
6. Base Maximum Probable Property Damage – (Base MPPD) [4 x 5]		$MM
7. Loss Control Credit Factor............................(See Above)	0.68	
8. Actual Maximum Probable Property Damage – (Actual MPPD) [6 x 7]		$MM
9. Maximum Probable Days Outage – (MPDO)......(Figure 9)	days	
10. Business Interruption – (BI)		$MM

(2) For no credit factor enter 1.00. (3) Product of all factors used.
Refer to *Fire & Explosion Index Hazard Classification Guide* for details.

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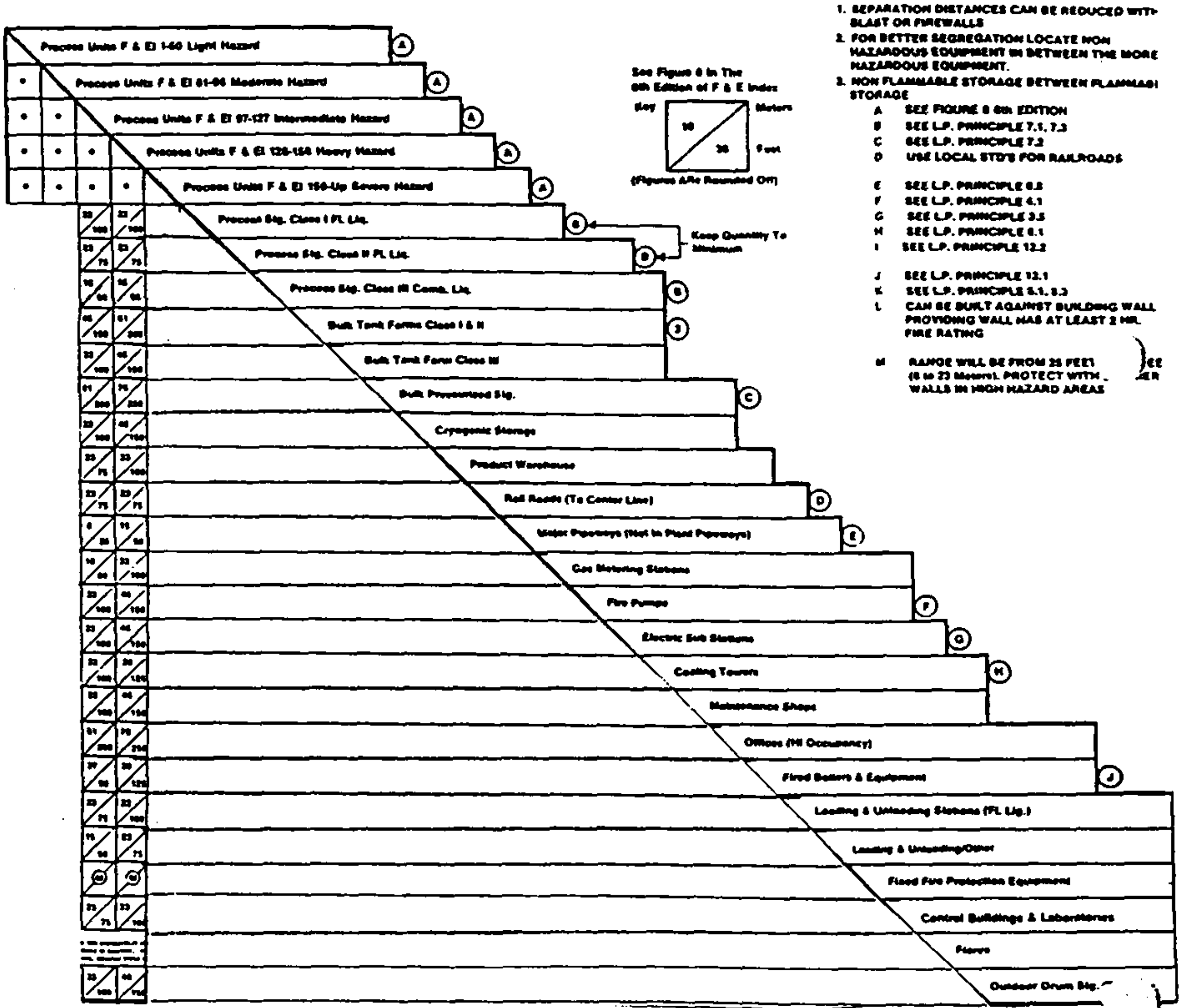
2.2.6 Use of Table I

A reduction of up to 30% is acceptable on distances outlined when a small scale plant is being evaluated, or when the total insurable value (Property Damage and Business Interruption) does not exceed $20MM.

TABLE I



NOTES: GENERAL

1. SEPARATION DISTANCES CAN BE REDUCED WITH BLAST OR FIREWALLS
2. FOR BETTER SEGREGATION LOCATE NON HAZARDOUS EQUIPMENT IN BETWEEN THE MORE HAZARDOUS EQUIPMENT.
3. NON FLAMMABLE STORAGE BETWEEN FLAMMABLE STORAGE

- A SEE FIGURE 6 6th EDITION
- B SEE L.P. PRINCIPLE 7.1, 7.3
- C SEE L.P. PRINCIPLE 7.2
- D USE LOCAL STD'S FOR RAILROADS
- E SEE L.P. PRINCIPLE 6.8
- F SEE L.P. PRINCIPLE 4.1
- G SEE L.P. PRINCIPLE 3.5
- H SEE L.P. PRINCIPLE 6.1
- I SEE L.P. PRINCIPLE 12.2
- J SEE L.P. PRINCIPLE 12.1
- K SEE L.P. PRINCIPLE 5.1, 5.3
- L CAN BE BUILT AGAINST BUILDING WALL PROVIDING WALL HAS AT LEAST 2 HR. FIRE RATING
- M RANGE WILL BE FROM 25 FEET (8 to 23 Meters). PROTECT WITH _ WALLS IN HIGH HAZARD AREAS

General Recommendations for Spacing in Petrochemical Plants

MINIMUM DISTANCE IN FEET

	Process Unit—HH	Process Unit—LH	Tank Farms—HH	Tank Farms—LH	Product Whse—LH	Ship'g & Rec'g—HH	Ship'g & Rec'g—LH	Service Buildings	Boiler Area	Fire Pumps	Emergency Controls	Water Spray Controls	Turret Nozzles	Emergency Flares	Pilot Plants	Large Cooling Towers	Fire Hydrants	Fired Process Heaters	
Process Unit— HIGH HAZARD [B]	200									250	100	50[5]	50 - 100 to Center of Target.	For 100' Flare that is 25' above Surrounding Equipment, Use 300'	200	150	50 to 250	50 to 100	
Process Unit— LOW HAZARD	100	50								150	50				200	100		50	
Tank Farms— HIGH HAZARD [C]	250[1]	250[2]	1½ Dia. Larger							250		100[6]			250	250		200	
Tank Farms— LOW HAZARD	200[3]	100[3]	One Dia. Larger	½ Dia. Larger						200					200	200		200	
Product Warehouse LOW HAZARD [D]	150	50[4]	250[1]	100[3]	50[4]					200					200	150		100	
Shipping & Receiving— HIGH HAZARD [E]	200	200	150[2]	100[3]	150	50				150	100	50[5]			200	200		200	
Shipping & Receiving— LOW HAZARD	150	100	100	50	20	50	—			100	50				150	150		100	
Service Buildings [G]	200	100	200	100	100	150	100	See Bldg. Chart		100					200	100		100	
Boiler Area	200	150	200	150	100	200	100	100	—	—					200	100		100	

Recommended Spacing Within Process Units

	React.	Comp.	Tanks	Fract. Equip.	Cont. Rooms
Reactor	25[6]				
Small Compressor House or Pump House	40[6]				
Intermediate Stge. Tanks High Hazard Rundown-Feed	100 to 200	100 to 200	One Dia.[7]		
Fractionation Equipment	50	30	100		
Control Rooms *	50[6] to 100	50 to 100	100	50 to 100	10

*Control houses serving unusually large or hazardous units and central control houses for multiple units or housing computer equipment, require greater spacing and may require blast-resistant construction.

A. Distance between process units is measured from battery limits.

B. A high hazard process unit has explosion classification under petrochemical schedule of E-4 or E-5.

C. High hazard tanks are class "D" under the above schedule. Class "E" requires special consideration.

D. High hazard product warehouses contain unstable materials, low-flash flammable liquids, or highly combustible solids. These require special consideration.

E. High hazard shipping and receiving denotes stable materials with flash point below 110° F.

F. High hazard shipping and receiving of unstable materials requires special consideration.

G. Service buildings include offices, gate houses, change houses, laboratories, shops, garages, maintenance warehouses, cafeterias, hospitals, etc. Experimentals laboratories classify as process units.

H. Keep open flames 100' from vapor hazard area.

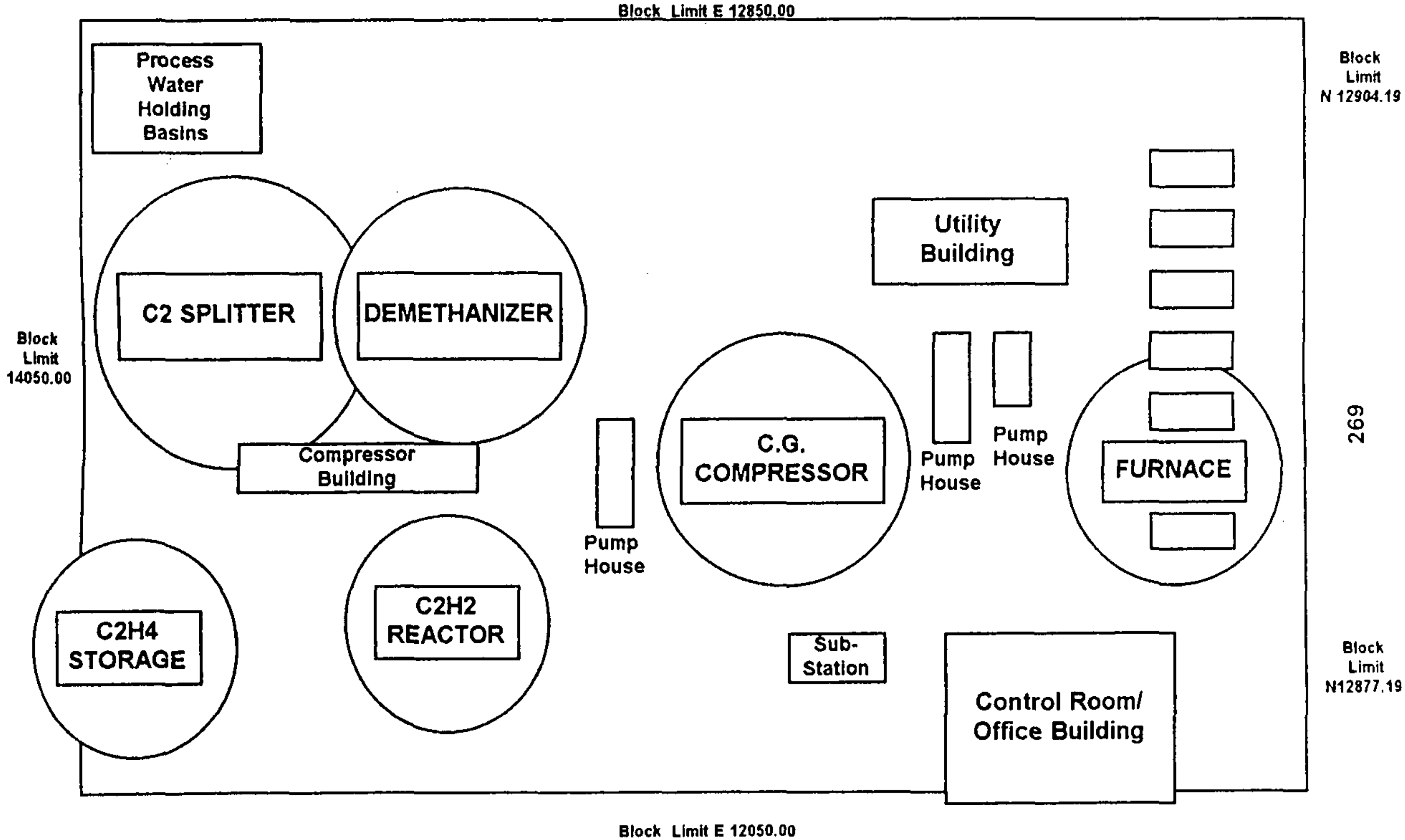
I. Deviation from these distances requires special protective installations such as fixed foam systems, water spray, automatic sprinklers, fire-system grading of 4 or better, or superior construction.

J. In borderline cases, high value requires high hazard classification.

K. Vertical storage tanks should be individually diked. If not, capacity in single dike should not exceed 25,000 bbls. For horizontal storage tanks, maximum is 400,000 gallons per group, with 100' between groups, or other suitable arrangement.

1. For specific vertical tank, use 5 diameters.
2. For specific vertical tank, use 4 diameters.
3. For specific vertical tank, use 3 diameters.
4. Standard firewall and sprinklered warehouse acceptable. Limit warehouse to maximum 25,000 sq. ft. floor area.
5. Two stations desirable.
6. Barricades desirable for hazardous reactors.
7. Over 100,000 gallons requires special consideration.

APPENDIX F
LIGHT HYDROCARBON PLANT LAYOUT



JFM/APPF.ppt/jl
02/01/95

Appendix G

MANUFACTURING UNIT RISK ANALYSIS SUMMARY

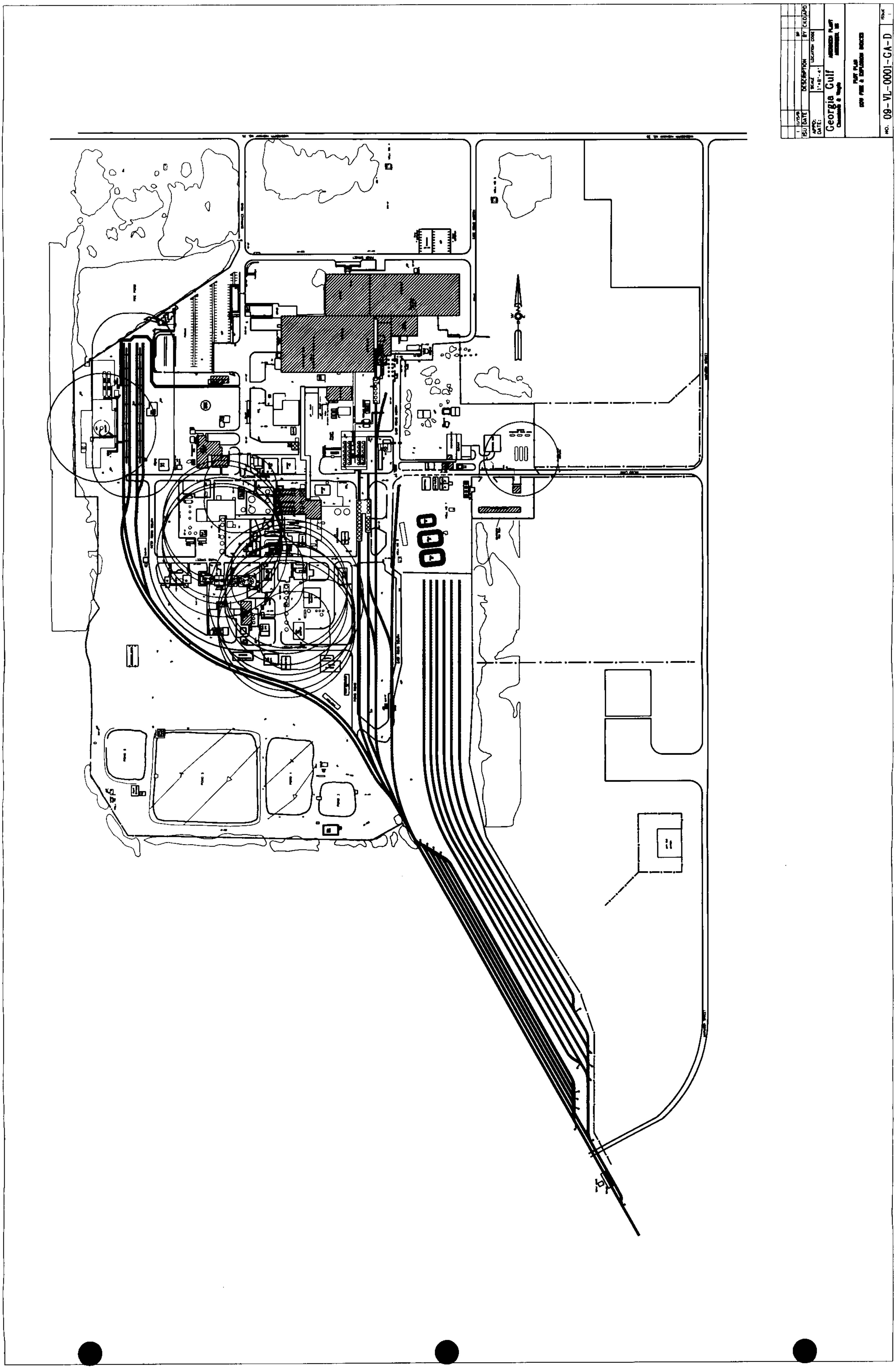
AREA / COUNTRY North America / USA	DIVISION	LOCATION
SITE Midland	MANUFACTURING UNIT Light Hydrocarbon	TYPE OF OPERATION Chemical Processing
PREPARED BY JFM	TOTAL MFG. UNIT REPLACEMENT VALUE $ 1 Billion	DATE 11/01/94

Process Unit ——— Major Material	Material Factor	F&EI	Value of Area of Exposure $MM	Base MPPD[1] $MM	Actual MPPD[1] $MM	Days Outage MPDO[2]	BI[3] Loss $MM
Cracked Gas Compressor	24	114.3	14.64	11.52	5.04	55	
C2 Compressor	24	96	19.22	14.04	7.41	69	
C2 Splitter	24	154.4	19.16	16.25	8.48	74	
C2H2 Reactor	24	103.4	5.24	3.94	2.12	33	
C3 Compressor	21	82.4	14.77	9.79	5.17	56	
Furnace	29	100.93	23.84	18.38	10.97	45	
Storage (C2C3)	24	95.95	5.88	4.29	2.17	33	

[1] Maximum Probable Property Damage
[2] Maximum Probable Days Outage
[3] Business Interruption

FORM C-50010 REV/10-93

ABD00031650



APPENDIX H

Georgia Gulf Chemicals & Vinyls, ABERDEEN PLANT
UTILITIES AREA HAZOP

Appendix H. Team Leader Training Documentation

ABD00031653

PrimaTech
Specialists in Risk, Safety and Reliability

Certificate of Achievement

Erik Smith

has attended the training course

Process Hazard Analysis Revalidation

presented in

Pittsburgh, PA

July 12, 2002

Instructor: D. Alex Taylor

The above participant has been awarded .7 continuing education units (CEU) for completing this course.

PrimaTech
Specialists in Risk, Safety and Reliability

Certificate of Achievement

Erik Smith

has attended the training course

Process Hazard Analysis for Team Leaders

presented in

Pittsburgh, PA

July 9-11, 2002

Instructor: D. Alex Taylor

The above participant has been awarded 2.1 continuing education units (CEU) for completing this course.

PrimaTech
Specialists in Risk, Safety and Reliability

Certificate of Achievement

Erik Smith

has attended the training course

Principles of Process Hazard Analysis

presented in

Pittsburgh, PA

July 8, 2002

D. Alex Taylor

Instructor: D. Alex Taylor

The above participant has been awarded .7 continuing education units (CEU) for completing this course.

APPENDIX I

Appendix I. Georgia Gulf Chemicals & Vinyls, LLC, PSM-004

Approved Electronically by the Engineering Manager

1.0 SCOPE

This document applies to the Georgia Gulf Chemicals & Vinyls, LLC processes located at Aberdeen, MS as defined in Aberdeen PSM Compliance Manual PSM-001. The Process Hazard Analysis for the process units is conducted per the OSHA regulation for Process Safety Management of Highly Hazardous Chemicals – 1910.119(e) Process Hazard Analysis.

2.0 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.

3.0 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 group.

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).

3.0 DEFINITIONS - Continued

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 guidewords 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.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

Each covered facility shall conduct Process Hazard Analyses (PHAs) 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 PHAs will be completed by May 26, 1995.

4.1.2 No less than 75 percent of the initial PHAs will be completed by May 26, 1996.

4.1.3 No less than 100 percent of the initial PHAs 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.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

4.2 The initial process hazards analyses were 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. All initial HAZOP studies have been completed at the Aberdeen facility.

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 The priority order for the initial PHAs was east module, west module, utilities & VCM sphere & tank farm. The priority order for conducting the initial process hazard analyses was based on a rationale which included 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 Process Hazard Analysis Requirements

Except as provided in this standard, all Process Hazard Analyses of covered processes in Georgia Gulf 's Aberdeen Plant require:

4.4.1 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.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

4.4 Process Hazard Analysis Requirements - continued

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.

4.4.2 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 PHAs is not considered formal training.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

4.4 Process Hazard Analysis Requirements - continued

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.

4.5 Process Hazard Analysis Pre-work Requirements

The following information must be available to the PHA team when they conduct the PHA:

4.5.1 The information requirements contained in 1910.199 (d) - Process Safety Information.

4.5.2 A chemical interaction matrix.

4.5.3 Documentation of any previous incidents that had a likely potential for catastrophic consequences in the work place being evaluated.

4.5.4 Documentation of relevant safety audits or studies in the facility's files that addressed the potential for catastrophic consequences in the work place.

4.5.5 Facility siting information. At a minimum, this will include calculations for occupied plant buildings using the Dow Fire and Explosion Index.

4.5.6 Shutdown, startup, and emergency operating procedures.

4.5.7 Plant Safety & Health Manual.

4.6 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:

4.6.1 A review of the purpose and scope of the PHA.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY

4.6 Process Hazard Analysis Team Orientation - continued

4.6.2 A review of why the PHA method chosen is appropriate for the PHA. Currently, only the HAZOP method is approved for Georgia Gulf's Aberdeen Plant's initial PHAs. 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.

4.6.3 A review of the PHA methodology that the team will use.

4.6.4 A review of all pre-work information. This is not intended to be a detailed review. The intent is to make the team members aware of the resources available to the team.

4.6.5 A review of the process description.

4.6.6 Process or Unit tour (if necessary to ensure all team members are physically oriented and familiarized with the process or unit being evaluated).

4.6.7 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.

4.6.8 A review of previous incidents that had a likely potential for catastrophic consequences in the work place.

4.6.9 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.

4.6.10 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.

4.0 PROCESS HAZARD ANALYSIS (PHA) METHODOLOGY - Continued

4.6 Process Hazard Analysis Team Orientation - continued

4.6.11 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.

5.0 HAZOP METHODOLOGY FOR PROCESS OR UNIT PHAs

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.

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

5.0 HAZOP METHODOLOGY FOR PROCESS OR UNIT PHAs - Continued

5.4 Guide Words and Phrases

5.4.1 Common guidewords 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.

5.0 HAZOP METHODOLOGY FOR PROCESS OR UNIT PHAs - Continued

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.

5.0 HAZOP METHODOLOGY FOR PROCESS OR UNIT PHAs - Continued

5.7 Team Process - continued

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 should 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. 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.

6.0 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 teamwork 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.

6.10Attendance records.

6.11Team orientation. This documentation should identify the steps covered in the PHA orientation and copies of any completed checklists.

6.12Listing of updates and revalidations to the PHA report.

6.13Copies of the P&I Diagrams with the study nodes marked and identified.

6.14Work sheets from the team meetings.

6.15A 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.

6.16A listing of actions steps requiring further evaluation including identifying nodes which require further evaluation due to missing process safety information.

6.0 PROCESS HAZARD ANALYSIS REPORT - Continued

6.17Separate 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.

7.0 SYSTEM FOR ADDRESSING PHA TEAM'S FINDINGS

As clarified in Appendix E, the Georgia Gulf Aberdeen Plant Management shall address the PHA Team's process hazards (as defined by this standard), findings and recommendations, as follows:

7.1 Mitigation Requirements

7.1.1 1 Ranked Scenarios

A written schedule for responding to a scenario ranked 1 shall 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 shall 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 shall 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 shall 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.

7.0 SYSTEM FOR ADDRESSING PHA TEAM'S FINDINGS - Continued

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.

7.0 SYSTEM FOR ADDRESSING PHA TEAM'S FINDINGS - Continued

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

The Georgia Gulf Aberdeen Faciltiy must have a documented system to track the status of each team's findings.

8.0 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.

8.0 PROCESS HAZARD ANALYSIS COMMUNICATIONS - Continued

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 PHAs are provided to employees, management shall take measures if necessary to make sure recipients understand the information being communicated.

9.0 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 4.4.2 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 PHAs Revalidation Schedule – The schedule per PHA revalidation at the Georgia Gulf Aberdeen facility is:

VCM Sphere and Tank Farm	April / 2004
West Module	July / 2005
East Module	April / 2006

Utilities May / 2003

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	

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	

"+" = 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

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	

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	

"+" = 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

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/precipitati on/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

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	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.
		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

		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.

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

Instructions:

This checklist represents item #36 on the Appendix C 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	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.
			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 of its allowable liquid storage capacity. Submerged part of tank shall not exceed two and one-half (2 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 floodwaters 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:

<u>Combustible Liquid</u>. A liquid having a flash point at or above 100°F (37.8°C).

<u>Flammable Liquid</u>. A liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psig at 100°F (37.8°C).

<u>Unstable Liquid</u>. 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
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

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.

APPENDIX D (continued)

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 • PERMANENT SIGNIFICANT DAMAGE TO AN ENVIRONMENTALLY SENSITIVE AREA • SIGNIFICANT PROPERTY DAMAGE.
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. • MINOR DAMAGE TO AN ENVIRONMENTALLY SENSITIVE AREA.
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	• SHELTER IN PLACE REQUIRED. • EVACUATION OF COMMUNITY REQUIRED.
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 $100,000.	• NO IMPACT

APPENDIX D (continued)

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

APPENDIX D (continued)

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.

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 findings 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 measure would provide a sufficient level of protection; **or**

4. The recommendation is infeasible.

11.0 REVISION HISTORY

Description of Change	**Revision**
Word Changes	1
Format to DMS	2
Match Corporate Standard	3
Reference Corporate Standard/ Change Document Approver	4 (3-26-1998)
Revised procedure to reflect several changes.	5 (3-13-2001)