Company: Smith's Company
Facility: Ammonia Refrigeration Facility

Session: 1 09-29-93 Revision: 0 - - Dwg#: P&ID 606A/B
Node: 1 Ultra Low Compressors (UB-1 and UB-2)
Parameter: Flow
Intention: Ammonia flow of 5 to 80 lb/min per ultra low compressor at 18 in Hg to 25 in HG nominal suction pressure

GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
No	No Flow	1. Valve closed in individual compressor suction line	Individual compressor will develop low suction pressures - No safety or environmental consequences (operability issue)	Compressors equipped with low suction pressure alarm and cutout	4	3	8	: No recommendations	
		2. Strainer plugged in compressor suction line	Individual compressor will develop low suction pressures -No safety or environmental consequences (operability issue)	Compressors equipped with low suction pressure alarm and cutout	4	2	7	Consider checking the strainers in the compressor suction lines on an annual basis	CFT
		3. Main valve closed in common suction line to both compressors	Both compressors will develop low suction pressures - No safety or environmental consequences (operability issue)	Compressors equipped with low suction pressure alarm and cutout	4	3	8	: No recommendations	
		4. Valve closed in individual compressor discharge line	Individual compressor will develop high discharge pressures which could lead to equipment damage or an ammonia release in the engine room	Compressors equipped with high discharge pressure alarm and cutout Compressors equipped with pressure relief valves (PSV- Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	1	4	4	: No recommendations	

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				Ammonia detector in engine room; detector will alarm in control room and start ventilation fans automatically when setpoint (100 ppm) is reached					
		5. Main valve closed in common discharge line from all compressors	Same consequences and safeguards as for cause #4		1	4	4	: No recommendations	
		6. Compressor stops (due to either mechanical failure or failure of one of the compressor cutouts)	Other compressor will attempt to compensate by ramping up; if compressors can't compensate, suction pressure will increase to a higher level (well below PSV setpoint) - No safety or environmental consequences (operability issue)	Refrigeration system equipped with high suction pressure alarm Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	2	7	: No recommendations	
		7. Slide valve on compressor permits no flow	Other compressor will attempt to compensate by ramping up; if compressors can't compensate, suction pressure will increase to a higher level (well	Refrigeration system equipped with high suction pressure alarm Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	2	7	: No recommendations	

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			below PSV setpoint) -No safety or environmental consequences (operability issue)						
More	More Flow	8. Higher suction pressures due to upset in system	Compressors will attempt to compensate for higher suction pressures - pressure may stabilize at a higher suction pressure, but this pressure will be well below PSV setpoint -No safety or environmental consequences (operability issue)	Refrigeration system equipped with high suction pressure alarm Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	1	4	: No recommendations	
		9. Lower discharge pressure	Compressors will attempt to compensate for lower discharge pressures - No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	2	7	: No recommendations	
Reverse	Reverse Flow	10. Not credible, since compressor would have to stop and both suction and						: No recommendations	

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		discharge check valves would have to fail simultaneously							
Other Than	Other Than Flow	11. Leak from compressor seal	Release of ammonia into engine room	Ammonia detector in engine room; detector will alarm in control room and start ventilation fans automatically when setpoint (100 ppm) is reached Routine lubrication oil analysis and leak checking should prevent and/or readily detect seal problems	3	3	7	: No recommendations	
		12. Leak from compressor fittings, valves, flanges, oil separator manway, sight glasses and other instrumentation	Release of ammonia into engine room	Ammonia detector in engine room; detector will alarm in control room and start ventilation fans automatically when setpoint (100 ppm) is reached Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	2	3	6	: No recommendations	
		13. Excessive vibration on compressor	Damage to compressor could result, leading to an ammonia leak	Ammonia detector in engine room; detector will alarm in control room and start ventilation fans automatically when setpoint (100 ppm) is	2	3	6	Consider conducting regular vibration analyses of the compressors	CFT

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				reached Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables					
		14. Leak from drain and purge points	Release of ammonia into engine room	Ammonia detector in engine room; detector will alarm in control room and start ventilation fans automatically when setpoint (100 ppm) is reached Oil drain lines contain two manual valves, and one of these valves is spring loaded (closed)	2	3	6	: No recommendations	

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Session: 1 09-29-93 Revision: 0 - - **Dwg#: P&ID 606A/B**
Node: 1 Ultra Low Compressors (UB-1 and UB-2)
Parameter: Temperature Intention: D'scharge temperature: 120 to 200oF

GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
More	Higher Discharge Temperature	1. Failure of oil lubrication system	Compressor bearings or seals could be damaged	Compressors equipped with low lube oil pressure alarm and cutout Differential pressure indicator associated with the lubrication oil filters Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	3	3	7	: No recommendations	
		2. High suction gas temperatures	Compressor discharge temperatures could increase, which could damage the compressor bearings and seals	Compressor is equipped with high discharge temperature alarms and cutouts Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	3	3	7	: No recommendations	
Less	Lower Temperature	3. Reduction in load from plant user points	Compressor system will compensate for reduced loads by shutting off compressors or reducing capacity on individual compressors -No safety or environmental consequences (operability issue)		4	1	4	: No recommendations	

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Session: 1 09-29-93 Revision: 0 - - Dwg#: P&ID 606A/B
Node: 1 Ultra Low Compressors (UB-1 and UB-2)
Parameter: Pressure
Intention: Suction side pressure: 18 in Hg to 25 in Hg; Discharge side pressure: 9 psig to 34 psig

GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
More	Higher Pressure	1. Load increase in plant usage points	Compressors will attempt to compensate by ramping up; if compressors can't compensate, suction pressure will increase to a higher level (well below PSV setpoint) - No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	1	4	: No recommendations	
		2. Overall loss in booster compressor capacity	Other compressor will attempt to compensate by ramping up; if compressors can't compensate, suction pressure will increase to a higher level (well below PSV setpoint) - No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	3	8	: No recommendations	
		3. Wear in compressors over extended periods of time	Compressors will attempt to compensate by ramping up; if compressors can't compensate, suction pressure will increase to a higher level (well	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	3	8	: No recommendations	

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GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
			below PSV setpoint) - No safety or environmental consequences (operability issue)						
		4. Manual valves closed in compressor discharge lines	See causes #4 and #5, no flow, this node, for consequences and safeguards					: No recommendations	
Less	Lower Pressure	5. Reduction in load from plant user points	Compressor system will compensate for reduced loads by shutting off compressors or reducing capacity on individual compressors -No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	1	4	: No recommendations	
		6. Both compressors running (when only one compressor is needed)	Compressor system will compensate for reduced loads by reducing capacity on individual compressors -No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	3	8	: No recommendations	
		7. Manual valves closed in	See causes #1 and #3, no flow, this					: No recommendations	

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GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
		compressor suction lines	node, for consequences and safeguards						
		8. Suction side blockage	See cause #2 no flow, this node, for consequences and safeguards					: No recommendations	
		9. Compressor capacity control malfunction	Compressor system will compensate for reduced loads by shutting off compressors or reducing capacity on individual compressors -No safety or environmental consequences (operability issue)	Compressor parameters will be logged every four hours; microprocessor continuously logs and trends process variables	4	3	8	: No recommendations	

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Node: 1 Ultra Low Compressors (UB-1 and UB-2)
Parameter: Phase
Intention: Ammonia is handled as a gas in the compressor suction and dicharge lines

GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	RECOMMENDATIONS	BY
More	More Phase	1. Liquid carryover from ultra low vessel	Small quantities of liquid will have no effect -No safety or environmental consequences (operability issue)		4	2	7	: No recommendations	
			Slug of liquid could cause potential compressor damage	Level control system (LCV-101) and high level switch (LSH-102) associated with ultra low vessel Noise on compressor caused by liquid will provide indication of liquid carryover - operators would respond to problem once noise is observed Low lube oil temperature cutout and alarm may detect problem before compressor damage results	1	4	4	: No recommendations	