ConocoPhillips

PHA-HAZOP ANALYSIS

FIELDWIDE -NIOBRARA

Niobrara Quad Well Design Risk

Cyndee R. Clouse, Certified Facilitator /Michael H. Mead, Engineer of Record / Janaury 29, 2017 -

Items missed during assessment but shouldn't require further review as Safety System Valves.

1. Well Head, HP / LP Separator (Heater Treater) Green - Os Sales Gas Orange - Xs				Risk Ranking										
Deviation	Causes	Consequences	Description	IPL?	S	E	Max Sev	L	RR	LOPA?	HAZOP Recommendations	Responsibility	Date Complete	Action Taken
1. More Flow	2. Failure of control valve / control loop Choke 100x Open when it is desired to be closed.	2. Increased flow/pressure to LP separator. DP = 260 psig Well pressure ~ 1000 psig Overpressure > 3	5. PSV-2001 @ 260 psig vents to the atmosphere	Yes	5		5	2	II	Yes	1.1.2. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
			6. PAHH-2001 will close ESDV on well	Yes										
			7. PAHH-103x will close ESDV at well	No										
	3. Inadvertent Opening or failure to car-seal 2" manual valve between line 1013 and 2011 open.	2. Potential for flow from well to divert to the VRT tower. DP- V-3001 @ 125 psig Well Pressure~ 1000 psig Overpressure > 3 times	10. 2" valve on 1013 is CSC	Yes	5		5	2	II	Yes	1.1.3. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
			11. Normally closed valve at header.											
			12. PSV-3001 @ 125 psig vents to atmosphere	Yes										
		3. Potential for flow from well to divert to the VRT tower. A Class Piping Line 2011 @ 285 psig Well Pressure~ 1000 psig Overpressure > 3 times	5. PSV-2001 @ 260 psig vents to the atmosphere	Yes	5		5	2	II	Yes	1.1.3.2. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
			6. PAHH-2001 will close ESDV on well	Yes										
	4. Failure of control valve / control loop LCV-2001 Open when desired to be closed. or manual valves closed	1. Loss of liquid level with gas blow thru to V-2101. DP V-2101 = 125 psig Well pressure ~ 1000 psig Overpressure > 3	8. PSV-2101 @ 125 psig vents to atmosphere	Yes	5		5	2	II	Yes	1.1.4. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
			9. PAHH-2101 will close ESDV on well											
			41. PAHH-103x will close ESDV at well	Yes										
10. Contaminants	3. Sand from the Frac	1. Increased corrosion of piping with plugging of equipment. No safety hazard, an Operational issue.									1.10.3. Incorporate findings from Sand Task Force - Consider addition of sand probe, extra heavy wall pipe and/or sand. Mike / Louise - sand task force	Mead	6/30/2018	MOC to add sand probes will be created if excessive sand is noticed during flowback activities
19. Maintenance	1. Corrosion of Pipeline over time.	1. Potential for leak of pipeline overtime.									1.19.1. Ensure that there is a PM for the cathodic protection on the pipeline	Mead	3/30/2018	Bronco PM exists for cathodic protection testing
2. Flash Gas / VRU Purple - - - - (dashed line)														
1. More Flow	3. Failure of TCV-3100/3102 - B to A Open More than desired.	1. Majority of Lube Oil around cooler. Potential for bearing failure due to lube oil temperature greater than desired.	17. TAHH-3210/20 will shutdown VRU SC-3101/2.		3		3	2	II	No				
	4. Failure of TCV-3100/3102 - C to A Open More than desired.	1. Majority of flow thru cooler - potentially too cold. Potential for damage to the compressor due to lube oil colder than desired.	18. TALL-3210/20 will shutdown SC-3101/2.		3		3	2	II	No				
2. Less Flow	2. Plugging of demister pad in V-3101/V-3102.	1. Increased pressure to VRU. V-3102 @ 100 psig V-2101 @ 125 psig Overpressue @ 1.25 Gasket leaks not thought to occur Although PSV is located above the demister, complete blocking of the relief path thru the vessel is not anticipated as paraffin not thought to be an issue	16. PSV-3102 @ 100 psig sits above the demister pad		3	2	3	2	II	No				
3. Reverse / Mis-Directed Flow	1. Failure of 2" check valve to prevent backflow - downstream of PCV-2001B	1. PCV-2001B fails there is a potentail to for flow from other wells/separators to back flow into V-2101 which could exceed the design of PSV-2101									2.3.1. Ensure check valve downstream of PCV-2001B is listed as a critical check - needs to be dissimilar, numbered, and put into a PM program.	Mead	8/30/2018	1st check valve is a swing check, 2nd check valve is a piston check. Not numbered or in a PM program.
	3. Leak in after cooler EA-3121/22.	1. Hydrocarbon leak within VRU enclosure. Potential Flash Fire in Building with Personnel Injury	13. Class I / Div I within enclosure		3		3	3	II	No				
			14. No hydrocarbon detection within the enclosure											
			15. Cooler location is near vent location and has fan for dispersion.											
5. Low Pressure	3. Failure of PCV-3130/3230 closed more than desired. or manual valve closed	1. Blocked discharge on SC-3102 outlet. Potential Overpressure A Class Piping: 285 psig SC-3102: ???? Overpressure assuming > 3 times or manual valves closed	19. PSV-3220 @ 200 psig vents to the atmosphere	Yes	4		4	2	II	Yes	2.5.3. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
			20. PAHH-3230 will shutdown SC-3102	No										
6. High Temperature	1. Poor performance of After cooler EA-3122 / Oil Cooler. Fans not running.	2. For oil. Potential for bearing failure due to lube oil temperature greater than desired.	17. TAHH-3210/20 will shutdown VRU SC-3101/2.		3		3	2	II	No				
7. Low Temperature	1. Better than design performance of After cooler EA-3122 / Oil Cooler. Cold Ambient Conditions	2. For oil. Potential for damage to the compressor due to lube oil colder than desired.	18. TALL-3210/20 will shutdown SC-3101/2.		3		3	2	II	No				
10. Contaminants	1. Condensate / Water contamination of oil	1. Potential loss of seal and bearing failure overtime.	22. 3000 Run Hour PM - inspection of lube oil - filter, oil,		3		3	2	II	No				
16. Mis-Identification	1. PSV Weep Holes	1. Spec / PSSR Discrepancy									2.16.1. Weep Hole Requirement - inconsistency between P&ID which shows 1/4" weep hole, PSSR asks for 3/8" weep hole - decide which is correct.	Mead	3/30/2018	Utilize both depending on size of PSV outlet pipe.
3. Flash Gas / Vent Orange - ^^^^														

2. Less Flow	2. Plugging of Flame Arrestor FA-9410B. or manual valves closed	1. Loss of vapor line from the storage tanks to flare. Potential overpressure of atmospheric oil tanks due to ambient temperature changes. Potential overpressure with Fire.	24. PVRV-4001/2/3/4/5/6/7 and 4101/02 @ 16 oz vent to the atmosphere		3	2	3	2	II	No				
4. High Pressure	1. Failure of PCV-3100 Open more than desired. or manual valves being open	1. Upstream pressure < 5 psig. Loss of VRU gas to the combuster. Reduced environmental gas recovery. No hazardous consequence, an Environmental issue.			1	2	1	2	I	No				
5. Low Pressure	2. Failure of PCV-4101 Closed more than desired. or manual valve closed	1. Upstream pressure > 3 oz. Loss of vapor line from the storage tanks to flare. Potential overpressure of atmospheric oil tanks due to ambient temperature changes. Potential overpressure with Fire.	24. PVRV-4001/2/3/4/5/6/7 and 4101/02 @ 16 oz vent to the atmosphere		3	2	3	2	II	No				
6. High Temperature	1. Combustion of Niobrara Gas - High Heating Value	1. Temperature within the combustor has exceeded the design of the refractory / refractory support pins. Potential for a gas leak with fire from the combustor.	25. Visual inspection of the combustor is part of normal operator rounds. Combustor is painted - paint blistering or hot spot can be noticed.		3		3	3	II	No				
19. Maintenance	1. Isolation of V-9301/02 for maintenance.	1									3.19.1. Consider revision to allow for installation of isolation valves around V-9301/02 to allow for easier isolation for preventative maintenance. As valve installation does not create any new hazard (different than the flame arrestors being plugged) they do not require that valves be car sealed open.	Mead	3/30/2018	Isolation valves are located at flash gas header and upstream of flame arrestor. No extra work to utilize these valves for isolation.
4. Oil to VRT Pink Diamonds														
1. More Flow	1. Failure of control valve / control loop LCV-2101A Open when it is desired to be closed.	2. Potential for fire tube failure due to loss of sufficient liquid level in V-2101/2/3/4. Heater Treater Fire	55. LSLL-2104 will shutdown BMS system.		3		3	2	II	No	4.1.1. Ensure Low Level Shutdown Taps are appropriately set to prevent fire tube exposure for all heater treaters V-2101/2/3/4 and V-2901. Also confirm whether the heat transfer differences for hydrocarbon or water coverage of the fire tubes creates issues to prevent damage.	Mead	3/30/2018	Taps are located correctly to prevent burning through fire tubes. Tubes are adequate for heat transfer coefficient differences between water and HC.
	2. Failure of control valve / control loop LCV-2901A Open when desired to be closed.	2. Potential for fire tube failure due to loss of sufficient liquid level in V-2901. Heater Treater Fire	37. LSLL-2901 will shutdown BMS system.		3		3	2	II	No				
	3. Inadvertent opening of 2" manual valve on line 2041 - produced fluids bypass line. same for line 2031 / 2021 / 2011	1. Increased vapor to the atmospheric storage tanks. Tank Overpressure and Fire	54. PVRV-4001/2/3/4/5/6/7 @ 16 oz vent to the atmosphere		3		3	2	II	No				
			26. Open vent line to the flare - 4"											
	4. Inadvertent opening of 2" manual valve bypass around V-3001.	1. Potential to have unvaporized crude to atmospheric storage tanks. No safety hazard, a potential Environmental violation.			1	2	2	3	II	No				
	5. Inadvertent opening of 2" manual valve (recycle oil) to P-4201.	1. Potential to drain water and /or unvaporized crude to atmospheric oil tanks. No safety hazard, a potential Environmental violation.			1	2	2	3	II	No				
2. Less Flow	8. Inadvertent closure of 4" manual valves to truck load out station.	2. Inability to load out water. Potential liquid filling of water tanks TK-4101/02 with potential water spill to dike through thief hatches. Enviornmental issue, no safety hazard.	50. Tank Dike		1	1	1	3	I	No	4.2.8. Confirm whether it is desired for LSHH-4101/02 to ESD the facility as there is minimum safety risk with overfilling water tanks.	Mead	3/30/2018	Leave ESD on HH as designed. There is potential for HC to be recycled into the water tanks as well as hightened awareness of environmental issues in the state of Colorado.
			51. LSHH-4101/02 will ESD the facility											
			52. Equalization line between water / oil storage tanks.											
	10. Inadvertent closing of butterfly valves (SP-02) on equalization lines between oil tanks.	1. Loss equalization between the tanks. Potential to carry over liquid out of the thief hatch (accidental lifting) to the tank dike. Potential Tank Dike with Fire	27. LSHH-4001/2/3/4/5/6/7 and 4101/02 will ESD the well		3		3	2	II	No	4.2.10. Review use of butterfly valves on equalization between tanks. As depicted the equalization line is normally open. During review it was mentioned that the tanks must be fully isolated prior to sales - not sure whether the isolation includes the equalization line. Need to confirm requirements for sales and also if the valve must be used, it must be accessible.	Mead	3/30/2018	Equalization line isolation valves are Normally Closed and are only used as an expeption. P&ID's will be changed to depict this.
			28. LAHH-4001/2/3/4/5/6/7 and 4101/02 will ESD the well											
	11. Inadvertent closing of 2" manual valve to P-4201. or manual valve closed	1. Potential to damage P-4201 due to a blocked suction. Pump damage with seal leak	29. Operating Procedures		3		3	3	II	No				
3. Reverse / Mis-Directed Flow	5. Poor Hose Connection at Oil Load Out. Manaul drain left open Hole in load out hose	1. Leak to the load out container. Environmental issue			1	1	1	3	I	No				
5. Produced Water Blue Squares														
1. More Flow	1. Failure of control valve / control loop LCV-2101B. Open when desired to be closed.	1. Water level in V-2101 will be drained with gas blow thru to the produced water tanks. Increased vapor to the atmospheric storage tanks. Tank Overpressure and Fire	49. PVRV-4101/02 @ 16 oz vent to the atmosphere		3		3	2	II	No				

			26. Open vent line to the flare - 4"											
	2. Failure of control valve / control loop LCV-2901B Open when desired to be closed.	3. Potential for fire tube failure due to loss of sufficient liquid level in V-2901. Heater Treater Fire	37. LSLL-2901 will shutdown BMS system.		3		3	2	II	No				
2. Less Flow	6. Inadvertent closure of manual valve on suction of pump P-3111/12.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
		2. Inability to remove liquid from V-3101 with liquid carryover to the screw compressor. Resulting in compressor damage due to dilution of lube oil.	31. LSHH-3100 will shutdown the VRU skid		3	1	3	2	II	No				
	8. Inadvertent closure of manual valve on discharge of P-3111.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
	10. Inadvertent closure of 4" manual valve to truck load out.	1. Inability to load out water. Potential liquid filling of water tanks TK-4101/02 with potential water spill to dike through thief hatches. Enviornmental issue, no safety hazard.	50. Tank Dike		1	1	1	3	I	No	5.2.10. Confirm whether it is desired for LSHH-4101/02 to ESD the facility as there is minimum safety risk with overfilling water tanks.	Mead	3/30/2018	Leave ESD on HH as designed. There is potential for HC to be recycled into the water tanks as well as hightened awareness of environmental issues in the state of Colorado.
			51. LSHH-4101/02 will ESD the facility											
			52. Equalization line between water / oil storage tanks.											
	12. Manual valve on inlet of P-9001 inadvertently closed.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
		2. Inability to remove liquid from V-9001 with liquid carryover to flare.	32. LSHH-9001 will close ESD valve on Well and will shut off flare burner.		3	1	3	2	II	No				
	14. Manual valve on discharge of P-9001 closed when pump running.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
	15. Manual valve on inlet of P-9301/02 inadvertently closed.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
		2. Inability to remove liquid from V-9301/2 with liquid carryover to combustor. Leak of water/hydrocarbon to the combustor berm area with potential for localized fired.	53. LSHH-9301/02 will ESD the facility		3	1	3	2	II	No				
	17. Manual valve on discharge of P-9301/02 closed when pump running.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
3. Reverse / Mis-Directed Flow	8. Poor Hose Connection at Oil Load Out. Manaul drain left open Hole in load out hose	1. Leak to the load out container. Environmental issue				1	1	3	I	No				
16. Mis-Identification	1. P&ID Correction	1. P&ID Redline Error									5.16.1. P&ID Correction: Bottom water line 3126 has drafting error - see the arrow head on the right hand side of the page - it isn't on the line.	Mead	3/30/2018	Drafting error fixed.
6. Fuel Gas Green / / / / Flare Yellow Line														
1. More Flow	1. Failure of control valve / control loop SDV-2101 Open when desired to be closed. [Safety System Valve]	1. Failure of this safety system valve did not initiate the event. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the main burner. Manual block valves are available to be closed.									6.1.1. Confirm that manual isolation valves are available outside of the "fire envelope" to allow for isolation of the fuel gas should there be a fire at the heater treater skid. Based upon risk, may also want to have a redundant SDV to isolate all of fuel gas if fire is detected at the facility.	Mead	3/30/2018	Fuel gas can be isolated at each individual piece of equipment. If there is a fire at the heater treater the well can be shut in at the wellhead which will in turn kill the fuel gas eventually.
	2. Failure of control valve / control loop FCV-2101A Open when desired to be closed.	1. Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	42. TAHH-2101A will shutdown BMS closing SDV-2101		3	2	3	2	II	No	6.1.2. Update P&ID 2101/2/3/4 to show high temperature shutdown - the transmitter is showing whereas the high shutdown TAHH isn't represented on the P&ID.	Mead		TAHH not shown on P&IDs
		2. Increased fuel gas flow to the main burner. Resulting increased firing resulting in a high stack temperature. Potential to exceed the design tempereature of the stack.	36. No safeguards listed		3	2	3	3	II	No				
	3. Failure of control valve / control loop FCV-2101B Open when desired to be closed.	1. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the pilot. Unregulated fuel gas to the V-2101/2/3/4 Heater treater LP Gas to atmosphere < 1/4"	43. Manual Block Valves can be closed upstream of skid		3	2	3	3	II	No				

	5. Failure of control valve / control loop FCV-2901A Open when desired to be closed.	1. Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	35. TAHH-2901A will shutdown BMS closing SDV-2901/2901B.		3	2	3	2	II	No				
		2. Increased fuel gas flow to the main burner. Resulting increased firing resulting in a high stack temperature. Potential to exceed the design tempereature of the stack.	36. No safeguards listed		3	2	3	3	II	No				
	7. Failure of control valve / control loop SDV-9201 Open when desired to be closed. [Safety System Valve]	1. The SDV-9201 valve is desired to be closed when there is a ??????												
	8. Failure of control valve / control loop SDV-9420 Open when desired to be closed. [Safety System Valve]	1. The SDV-9420 valve is desired to be closed when there is a ??????												
2. Less Flow		2. Downstream pressure > 15 psig. Higher pilot gas than desired potential to lift flame off of the pilot resulting in uncombusted gas from the flare stack. Environmental incident	39. BMS Flame detection will ESD well.		1	1	1	3	I	No				
	9. Plugging of Flame Arrestor FA-9201.	1. Blocked flow to the hp flare. Upstream pressure > 100 psig. Potential to have an environmental release of uncombusted material from the flare KO drum. A class piping @ 285 psig V-2001/2/3/4 @ 260 psig (limited by PSV-2001) Overpressure = not anticipated	45. PSV-9001 @ 125 psig vents to the atmosphere		1	1	1	2	I	No				
			46. PAHH-2001 will close ESDV on well											
3. Reverse / Mis-Directed Flow	3. Tube Leak in V-2901.	1. Potential for fire tube failure with oil to fuel gas resulting in ignition and fire of the treater.	36. No safeguards listed		3	2	3	3	II	No				
4. High Pressure	1. Failure of PCV-2201 Open more than desired	1. Downstream pressure > 30 psig. V-2201 will be overpressured. V-2001 @ 250 psig V-2201 @ 125 psig Overpressure = 2 times Gasket / Pin Hole failure	33. PSV-2201 @ 125 psig vents to the atmosphere	Yes	4	2	4	2	II	Yes	6.4.1. No LOPA Gap, Sufficient safeguards provided	Mead	1/29/2018	No LOPA gap, no additional actions.
	2. Failure of regulator PCV-2101A Open when desired to be closed.	1. Downstream pressure > 12 psig Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	42. TAHH-2101A will shutdown BMS closing SDV-2101		3		3	2	II	No	6.4.2. Update P&ID 2101/2/3/4 to show high temperature shutdown - the transmitter is showing whereas the high shutdown TAHH isn't represented on the P&ID.	Mead		TAHH not shown on P&IDs
	3. Failure of PCV-2101 Open more than desired.	1. Downstream pressure > ?? psig. Increased fuel gas pressure to the pilot. Potential to blow pilot out and have unrestricted fuel gas venting to the atmosphere.	44. BMS Flame detection will close FCV-2101B & SDV-2101.		3	1	3	2	II	No	6.4.3. Update P&ID 2101/2/3/4 to show set pressure for regulator PCV-2101/2/3/4	Mead	6/30/2018	Both 2101A/2A/3A/4A and 2101B/2B/3B/4B were updated to show set pressure
	5. Failure of PCV-2901B Open more than desired.	1. Downstream pressure > 5 psig. Increased fuel gas pressure to the pilot. Potential to blow pilot out and have unrestricted fuel gas venting to the atmosphere.	34. BMS Flame detection will close FCV-2901B & SDV-2901.		3	1	3	2	II	No				
5. Low Pressure	5. Failure of PCV-2901B Closed more than desired. or manual valves closed	1. Downstream pressure > ?? psig. Loss of pilot gas. Inability to start heater treater resulting in an inability to break emulsion of recycled oil. No safety hazard, an Operational issue.									6.5.5. Update P&ID 2901 to show set pressure for regulator PCV-2901B	Mead	6/30/2018	Complete PCV-2901B is set @ 5 psig
5. Low Pressure	9. Failure of PCV-7100 Closed more than desired.	1. Upstream pressure > 100 psig. Potential for increased pressure to the sales gas line. A class piping @ 285 psig V-2001/2/3/4 @ 260 psig (limited) Overpressure not anticipated for piping - may have higher pressure than sales contract.	47. PSV-2001 @ 260 psig vents to the atmosphere		1	1	1	2	I	No				
			48. PAHH-2001 will close ESDV on well											
16. Mis-Identification	1. Page Connection - incorrect	1. P&ID Redline Error									6.16.1. Update P&ID connector on left hand side of the page - currently says from P&ID 2001 and it should be from P&ID 2002.	Mead	6/30/2018	Complete now says P&ID 2002

Niobrara Quad Well Design Risk Assessment
Cyndee R. Clouse, Certified Facilitator/ Michael H. Mead, Engineer of Record / Janaury 29, 2017 - Draft

1. Well Head, HP / LP Separator (Heater Treater) Green - Os Sales Gas Orange - Xs					Risk Ranking										
Deviation	Drawings	Causes	Consequences	Description	IPL?	S	E	Max Sev	L	RR	LOPA?	HAZOP Recommendations	Responsibility	Date Complete	Action Taken
1. More Flow	NIO-S6020-00-011-1001	1. Failure of control valve / control loop ESDV-100x Open when it is desired to be closed [Safety Valve]	1. This valve is desired to be closed when there is a total plant shutdown (flow line high, flow line low pressure, high level treater, high level VRT, high level combustor, knock out high, high level flare, high tank levels, low pressure treater, high pressure treater, and hp separtor). Will address individual shutdowns throughout the risk assessment. have alternative accessible manual valves that can be closed if SDV does close (e.g. choke 100x)												
	NIO-S6020-00-011-1001	2. Failure of control valve / control loop Choke 100x Open when it is desired to be closed.	1. Increased flow / pressure to the facility. All piping D1 Class rated at 1440 psig Overpresure not a concern for piping												
			2. Increased flow/pressure to LP separator. DP = 260 psig Well pressure ~ 1000 psig Overpressure > 3	5. PSV-2001 @ 260 psig vents to the atmosphere	Yes	5		5	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
				6. PAHH-2001 will close ESDV on well	Yes										
				7. PAHH-103x will close ESDV at well	No										
	NIO-S6020-00-011-2001	3. Inadvertent Opening or failure to car-seal 2" manual valve between line 1013 and 2011 open.	1. Potential for flow from well to divert to the heater treater. No new consequence - same as gas blow thru from LCV-2001 - see below												
			2. Potential for flow from well to divert to the VRT tower. DP- V-3001 @ 125 psig Well Pressure~ 1000 psig Overpressure > 3 times	10. 2" valve on 1013 is CSC	Yes	5		5	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
				11. Normally closed valve at header.											
				12. PSV-3001 @ 125 psig vents to atmosphere	Yes										
			3. Potential for flow from well to divert to the VRT tower. A Class Piping Line 2011 @ 285 psig Well Pressure~ 1000 psig Overpressure > 3 times	5. PSV-2001 @ 260 psig vents to the atmosphere	Yes	5		5	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
				6. PAHH-2001 will close ESDV on well	Yes										
	NIO-S6020-00-011-2001	4. Failure of control valve / control loop LCV-2001 Open when desired to be closed. or manual valves closed	1. Loss of liquid level with gas blow thru to V-2101. DP V-2101 = 125 psig Well pressure ~ 1000 psig Overpressure > 3	8. PSV-2101 @ 125 psig vents to atmosphere	Yes	5		5	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
				9. PAHH-2101 will close ESDV on well											
				41. PAHH-103x will close ESDV at well	Yes										
2. Less Flow	NIO-S6020-00-011-1001	1. Failure of control valve / control loop ESDV-100x Closed when it is desired to be open [Safety Valve] Failure of control valve / control loop Choke 100x Closed when it is desired to be open. or manual valves closed	1. If the valve inadvertently closes during normal operation then there will just be loss of prodcution from the well. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-2001	2. Inadvertent closing of manual valve on inlet to line 1013 to V-2101.	1. If this valve is left open, same overpressure consideration as listed above with potential contamination issue.												
	NIO-S6020-00-011-2001	3. Failure of control valve / control loop LCV-2001 closed when desired to be open.	1. Potental fo fill V-2001 with liquid carryover to sales gas. No Safety Hazard, an Operational issue, loss of profit												
		4. Inadvertent closure of 3" manual valve on vapor outlet to sales gas.	1. No new consequence - copy V-2001 overpressure.												
3. Reverse / Mis-Directed Flow	NIO-S6020-00-011-2001	1. Failure of 2" check valve on V-2001 overhead line.	1. No hazardous consequence identified with failure of this check valve - poor flow measurement.												
4. High Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2001A Open more than desired -	1. Upstream pressure not maintained at 40 psig. Increased liquid level in V-2001 with potential liquid carryover to the sales gas. No new consequence												
	NIO-S6020-00-011-7101	2. Failure of PCV-7001B Open more than desired. Not Initially installed - only required during gas lift operation - not covered at this time.	1. Upstream pressure < 75 psig.												
	NIO-S6020-00-011-7101	3. Failure of PCV-7001A Open more than desired. Not Initially installed - only required during gas lift operation - not covered at this time.	1. Upstream pressure < 40 psig.												
5. Low Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2001A Closed more than desired or manual valves on line 2012 closed	1. Upstream pressure > 40 psig- copy from Node 2.												
	NIO-S6020-00-011-7101	2. Failure of PCV-7001B closed more than desired. or manual valves closed Not Initially installed - only required during gas lift operation - not covered at this time.	1. Upstream pressure > 75 psig.												

	NIO-S6020-00-011-7101	3. Failure of PCV-7001A closed more than desired. or manual valves closed Not Initially installed - only required during gas lift operation - not covered at this time.	1. Upstream pressure > 40 psig.												
6. High Temperature		1. High Ambient Temperature.	1. No hazardous consequences identified.												
7. Low Temperature		1. Low ambient conditions	1. Potential for increased parafin/hydrate accumulation - Operational issue.												
8. High Level		No causes identified													
9. Low Level		No causes identified													
10. Contaminants	NIO-S6020-00-011-1001	1. Well with Higher H2S than designed for.	1. H2S < 20 ppm - not considered a concern with metallurgy. No hazardous consequence identified.												
	NIO-S6020-00-011-1001	2. Well with Higher CO2 than designed for.	1. CO2 < 3 % - not considered a concern with metallurgy. No hazardous consequence identified.												
	NIO-S6020-00-011-1001	3. Sand from the Frac	1. Increased corrosion of piping with plugging of equipment. No safety hazard, an Operational issue.									4. Incorporate findings from Sand Task Force - Consider addition of sand probe, extra heavy wall pipe and/or sand. Mike / Louise - sand task force			
			2. Increased corrosion of piping with plugging of equipment. No safety hazard, an Operational issue.												
11. Composition		1. No hazardous causes identified.													
12. Sampling	NIO-S6020-00-011-1001	1. Have sample location with double block downstream of PIT-103x.													
13. Injection Points	NIO-S6020-00-011-1001	1. 1" valves are provided for methanol inject at a later date if required.													
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.													
15. Out of Sequence		1. No hazardous causes identified.													
16. Mis-Identification		1. No hazardous causes identified.													
17. Critical Tasks		1. No hazardous causes identified.													
18. Pressure Surge	NIO-S6020-00-011-1001	1. ESD-100x	1. Covered by Operating Procedures - choke is closed. Hazards associated with EDV opening are mitigated by procedure.												
19. Maintenance		1. Corrosion of Pipeline over time.	1. Potential for leak of pipeline overtime.									3. Ensure that there is a PM for the cathodic protection on the pipeline			
2. Flash Gas / VRU Purple - - - - (dashed line)															
1. More Flow	NIO-S6020-00-011-3101	1. Failure of control valve / control loop PCV-3110 open when desired to be closed. or PCV-3210 closed	1. One VRU in Operation: This valve is desired to be open when the VRU is running. No hazard identified.												
	NIO-S6020-00-011-3102		2. Two VRUs in Operation: Valve may remain open but gas flow to the off-line VRU will be halted.												
	NIO-S6020-00-011-3101	2. Failure of control valve / control loop PCV-3120/3220 open when desired to be closed.	1. If the valve is open, loss of capacity of VRU. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	3. Failure of TCV-3100/3102 - B to A Open More than desired.	1. Majority of Lube Oil around cooler. Potential for bearing failure due to lube oil temperature greater than desired.	17. TAHH-3210/20 will shutdown VRU SC-3101/2.			3	3	2	II	No				
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	4. Failure of TCV-3100/3102 - C to A Open More than desired.	1. Majority of flow thru cooler - potentially too cold. Potential for damage to the compressor due to lube oil colder than desired.	18. TALL-3210/20 will shutdown SC-3101/2.			3	3	2	II	No				
	NIO-S6020-00-011-3102														
2. Less Flow	NIO-S6020-00-011-3100	1. Failure of control valve / control loop PCV-3110 Closed when desired to be open. or PCV-3210 closed or manual valves closed	1. One VRU in Operation: Loss of gas to the VRU - PCV-3100 will open with gas going to flash gas. Environmental issue, no safety hazard.												
	NIO-S6020-00-011-3101		2. Two VRU in Operation: Capacity of VRU will be limited. Environmental issue, no safety hazard.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	2. Plugging of demister pad in V-3101/V-3102.	1. Increased pressure to VRU. V-3102 @ 100 psig V-2101 @ 125 psig Overpressue @ 1.25 Gasket leaks not thought to occur Although PSV is located above the demister, complete blocking of the relief path thru the vessel is not anticipated as paraffin not thought to be an issue	16. PSV-3102 @ 100 psig sits above the demister pad			3	2	3	2	II	No				
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	3. Plugging of oil filter.	1. Loss of lube oil to the SC-3102 with compressor damage. Bearing Damage	21. Differential Pressure PT-3210 and 3220 will shut the compressor down.											
	NIO-S6020-00-011-3102			17. TAHH-3210/20 will shutdown VRU SC-3101/2.											
	NIO-S6020-00-011-3101	4. Failure of control valve / control loop PCV-3120/3220 closed when desired to be open.	1. If this valve is closed more than desire, potential to have less pressure to the VRU. No damage to compressor, potential inadvertent shutdown due to low pressure. An Operational issue.												
	NIO-S6020-00-011-3102														
3. Reverse / Mis-Directed Flow	NIO-S6020-00-011-2001	1. Failure of 2" check valve to prevent backflow - downstream of PCV-2001B	1. PCV-2001B fails there is a potentail to for flow from other wells/separators to back flow into V-2101 which could exceed the design of PSV-2101									5. Ensure check valve downstream of PCV-2001B is listed as a critical check - needs to be dissimilar, numbered, and put into a PM program.			

	NIO-S6020-00-011-3101	2. Failure of 3" check valve on inlet of SC-3101/02.	1. No hazardous consequence identified with failure of this check valve.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	3. Leak in after cooler EA-3121/22.	1. Hydrocarbon leak within VRU enclosure. Potential Flash Fire in Building with Personnel Injury	13. Class I / Div I within enclosure			3	3	3	II	No				
	NIO-S6020-00-011-3102			14. No hydrocarbon detection within the enclosure											
				15. Cooler location is near vent location and has fan for dispersion.											
	NIO-S6020-00-011-3101	4. Leak in lube oil cooler.	1. Oil leak to the skid, if sufficient oil leaks there may be a loss of the seal/lubrication in SC-3102. No new consequence, same as high lube oil temperature with compressor damage - see below.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-3101	5. Failure of 3" check valve on gas outlet from VRU skid.	1. No hazardous consequence identified with failure of this check valve.												
	NIO-S6020-00-011-3102														
4. High Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2001B Open more than desired	1. Upstream pressure < 20 psig. Loss of pressure in V-2101 so there won't be sufficient pressure to dump liquid to tankage. Potentail for liquid carryover to sales gas. No new consequence.												
			2. Upstream pressure < 20 psig. Loss of pressure in V-2101 so there won't be sufficient pressure to dump liquid to tankage. Potentail for liquid carryover to flash gas (VRU) Operational issue.												
	NIO-S6020-00-011-2901	2. Failure of PCV-2901D Open more than desired	1. Upstream pressure < 60 psig. No new consequene - insufficient pressure to dump liquids form V-2101.												
	NIO-S6020-00-011-3101	3. Failure of PCV-3130/3230 open more than desired.	1. Loss of pressure on the VRU discharge. No new consequence, less severe than elevated lube oil temperature.												
	NIO-S6020-00-011-3102														
5. Low Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2001B Closed more than desired or manual valves closed	1. Upstream pressure > 20 psig. Increased pressure in V-2101. No hazardous consequence.												
	NIO-S6020-00-011-2901	2. Failure of PCV-2901D Closed more than desired or manual valves closed	1. Upstream pressure > 60 psig. Loss of flash gas flow from V-2101. Increased liquid level in V-2101. Operational issue.												
			2. Upstream pressure > 60 psig. Loss of flash gas flow from V-2101 with potential for contamination of the Sales gas thru PCV-2001B if sales line pressure is low enough. Operational issue.												
	NIO-S6020-00-011-3101	3. Failure of PCV-3130/3230 closed more than desired. or manual valve closed	1. Blocked discharge on SC-3102 outlet. Potential Overpressure A Class Piping: 285 psig SC-3102: ???? Overpressure assuming > 3 times or manual valves closed	19. PSV-3220 @ 200 psig vents to the atmosphere	Yes	4		4	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
	NIO-S6020-00-011-3102			20. PAHH-3230 will shutdown SC-3102	No										
6. High Temperature		1. Poor performance of After cooler EA-3122 / Oil Cooler. Fans not running.	1. For gas leaving. No consequence with higher outlet temperature.												
			2. For oil. Potential for bearing failure due to lube oil temperature greater than desired.	17. TAHH-3210/20 will shutdown VRU SC-3101/2.			3	3	2	II	No				
7. Low Temperature		1. Better than design performance of After cooler EA-3122 / Oil Cooler. Cold Ambient Conditions	1. For gas leaving. No hazard identified.												
			2. For oil. Potential for damage to the compressor due to lube oil colder than desired.	18. TALL-3210/20 will shutdown SC-3101/2.			3	3	2	II	No				
8. High Level		1. No new causes identified													
9. Low Level		1. No new causes identified													
10. Contaminants		1. Condensate / Water contamination of oil	1. Potential loss of seal and bearing failure overtime.	22. 3000 Run Hour PM - inspection of lube oil - filter, oil,			3	3	2	II	No				
11. Composition		1. No hazardous causes identified.													
12. Sampling		1. Oil sampling - acceptable location and procedures.													
13. Injection Points		1. No injection points identified.													
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.													
15. Out of Sequence		1. No hazardous causes identified.													
16. Mis-Identification		1. PSV Weep Holes	1. Spec / PSSR Discrepancy									6. Weep Hole Requirement - inconsistency between P&ID which shows 1/4" weep hole, PSSR asks for 3/8" weep hole - decide which is correct.			
17. Critical Tasks		1. No hazardous causes identified.													
18. Pressure Surge		1. No hazardous causes identified.													
19. Maintenance		1. No hazardous causes identified.													
3. Flash Gas / Vent Orange - ^^^^^															
1. More Flow	NIO-S6020-00-011-9401	1. Failure of SDV-9400A/B Open when desired to be closed. [Safety System Valve]	1. The SDV-9400A is desired to be closed if there is a loss of pilot. If the SDV does not go closed. Potential for uncombusted hydrocarbon to the comubuster. An Environmental Issue.												

2. Less Flow	NIO-S6020-00-011-9401	1. Plugging of Flame Arrestor FA-9401A. or manual valves around arrestor closed. or SDV-9400A/B closed	1. VRUs Down: Upstream pressure > 5 psig. Loss of venting to the combustor. Increased pressure in V-2101 - no new consequence, see Node 1.	23. PSV-9301 @ 125 psig vents to the atmsophere											
	NIO-S6020-00-011-9401	2. Plugging of Flame Arrestor FA-9410B. or manual valves closed	1. Loss of vapor line from the storage tanks to flare. Potential overpressure of atmospheric oil tanks due to ambient temperature changes. Potential overpressure with Fire.	24. PVRV-4001/2/3/4/5/6/7 and 4101/02 @ 16 oz vent to the atmosphere		3	2	3	2	II	No				
	NIO-S6020-00-011-9401	3. Plugging of Flame Arrestor FA-9401. (two separate air intakes)	1. Insufficient air for complete combustion - uncombusted material out of the stack.												
			2. Potential for gas to be put to the stack with potential combustion occuring at top when sufficient oxygen content is met. Would require residual hot temperature of refractory. Potential refractory/pilot damage. No safety hazard as directionally will be up.												
3. Reverse / Mis-Directed Flow		1. No causes identified													
4. High Pressure	NIO-S6020-00-011-3100	1. Failure of PCV-3100 Open more than desired. or manual valves being open	1. Upstream pressure < 5 psig. Loss of VRU gas to the combuster. Reduced environmental gas recovery. No hazardous consequence, an Environmental issue.			1	2	1	2	I	No				
	NIO-S6020-00-011-4100	2. Failure of PCV-4101 Open more than desired.	1. Upstream pressure < 3 oz. No hazardous consequence identified.												
5. Low Pressure	NIO-S6020-00-011-3100	1. Failure of PCV-3100 Closed more than desired. or manual valve closed	1. VRUs Down: Upstream pressure > 5 psig. Loss of venting to the combustor. Increased pressure in V-2101 - no new consequence.												
	NIO-S6020-00-011-4100	2. Failure of PCV-4101 Closed more than desired. or manual valve closed	1. Upstream pressure > 3 oz. Loss of vapor line from the storage tanks to flare. Potential overpressure of atmospheric oil tanks due to ambient temperature changes. Potential overpressure with Fire.	24. PVRV-4001/2/3/4/5/6/7 and 4101/02 @ 16 oz vent to the atmosphere		3	2	3	2	II	No				
6. High Temperature	NIO-S6020-00-011-9401	1. Combustion of Niobrara Gas - High Heating Value	1. Temperature within the combustor has exceeded the design of the refractory / refractory support pins. Potential for a gas leak with fire from the combustor.	25. Visual inspection of the combustor is part of normal operator rounds. Combustor is painted - paint blistering or hot spot can be noticed.		3		3	3	II	No				
		2. High Ambient Temperature.	1. No hazardous consequences identified.												
7. Low Temperature		1. Low Ambient Temperature	1. No hazardous consequences identified.												
8. High Level		1. No new causes identified													
9. Low Level		1. No new causes identified													
10. Contaminants		1. No hazardous causes identified.													
11. Composition		1. No hazardous causes identified.													
12. Sampling		1. No sampling anticipated.													
13. Injection Points		1. No injection points identified.													
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.													
15. Out of Sequence		1. No hazardous causes identified.													
16. Mis-Identification		1. No hazardous causes identified.													
17. Critical Tasks		1. No hazardous causes identified.													
18. Pressure Surge		1. No hazardous causes identified.													
19. Maintenance	NIO-S6020-00-011-9301	1. Isolation of V-9301/02 for maintenance.	1									7. Consider revision to allow for installation of isolation valves around V-9301/02 to allow for easier isolation for preventative maintenance. As valve installation does not create any new hazard (different than the flame arrestors being plugged) they do not require that valves be car sealed open.			
4. Oil to VRT Pink Diamonds															
1. More Flow	NIO-S6020-00-011-2001	1. Failure of control valve / control loop LCV-2101A Open when it is desired to be closed.	1. Potential loss of liquid from V-2101 with gas blow thru to the VRT. Overpressure not a concern, an Operational issue.												
	NIO-S6020-00-011-2002		2. Potential for fire tube failure due to loss of sufficient liquid level in V-2101/2/3/4. Heater Treater Fire	55. LSLL-2104 will shutdown BMS system.		3		3	2	II	No	16. Ensure Low Level Shutdown Taps are appropriately set to prevent fire tube exposure for all heater treaters V-2101/2/3/4 and V-2901. Also confirm whether the heat transfer differences for hydrocarbon or water coverage of the fire tubes creates issues to prevent damage.			
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2901	2. Failure of control valve / control loop LCV-2901A Open when desired to be closed.	1. Loss of liquid from V-2901 with gas blow thru (fuel gas) to VRT. Overpressure not a concern, an Operational issue.												
			2. Potential for fire tube failure due to loss of sufficient liquid level in V-2901. Heater Treater Fire	37. LSLL-2901 will shutdown BMS system.		3		3	2	II	No				
	NIO-S6020-00-011-3001	3. Inadvertent opening of 2" manual valve on line 2041 - produced fluids bypass line. same for line 2031 / 2021 / 2011	1. Increased vapor to the atmospheric storage tanks. Tank Overpressure and Fire	54. PVRV-4001/2/3/4/5/6/7 @ 16 oz vent to the atmosphere		3		3	2	II	No				
				26. Open vent line to the flare - 4"											

	NIO-S6020-00-011-3001	4. Inadvertent opening of 2" manual valve bypass around V-3001.	1. Potential to have unvaporized crude to atmospheric storage tanks. No safety hazard, a potential Environmental violation.			1	2	2	3	II	No				
	NIO-S6020-00-011-3001	5. Inadvertent opening of 2" manual valve (recycle oil) to P-4201.	1. Potential to drain water and /or unvaporized crude to atmospheric oil tanks. No safety hazard, a potential Environmental violation.			1	2	2	3	II	No				
	NIO-S6020-00-011-4000														
	NIO-S6020-00-011-4000	6. Inadvertent opening of manual recycle valve at P-4201.	1. Flow from pump may be recycled to the suction of the pump. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-4000	7. Manual valve on discharge of P-4201 open when pump idled.	1. No hazard identified.												
	NIO-S6020-00-011-4001	8. Inadvertent opening of 4" manual valves from multiple tanks to truck load out station.	1. Potential to load out unapproved tank. Accounting / Operational issue, no safety hazard.												
	NIO-S6020-00-011-4001	9. Inadvertent opening of 4" manual valve to off spec oil tank.	1. Potential to add good oil to an off spec tank. No safety hazard, an Operational / Metering issue.												
	NIO-S6020-00-011-4001	10. Inadvertent opening of manual valve on line 5672 - from Tk-4003 vapor space to oil line. or manual valve to LP vent line	1. If the valve is inadvertently left open there is no identified safety hazard.												
2. Less Flow	NIO-S6020-00-011-2001	1. Failure of control valve / control loop LCV-2101A Closed when it is desired to be open. or manual valves closed	1. Potential for liquid carryover from V-2101 to the flash gas KO. Operational issue.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2901	2. Failure of control valve / control loop LCV-2901A Closed when desired to be open. or manual valves closed	1. Loss of oil draw from the Recycle treater. Potential for oil carryover to the flash gas KO. No new consequence												
	NIO-S6020-00-011-3001	3. Inadvertent closure of 4" manual valve (combined header valve) on inlet of V-3001.	1. No new consequence - same as failure of LCV-2101/2/3/4A or LCV-2901A.												
	NIO-S6020-00-011-3001	4. Plugging of demister pad in V-3001.	1. Not considered creditable.	56. PSV-3001 @ 125 psig vents to atmosphere											
	NIO-S6020-00-011-3001	5. Inadvertent closure of 4" manual valve on discharge of V-3001 to tankage.	1. Potential to fill V-3001 with liquid with carryover to the VRT KO drum. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-4001	6. Inadvertent closure of manual valves at oil storage tanks from V-3001.	1. Potential to fill V-3001 with liquid with carryover to the VRT KO drum. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-4001	7. Inadvertent closure of manual valves on truck vapor return line.	1. Potential to overpressure the truck.	30. Trucks have their own internal relief.											
	NIO-S6020-00-011-4001	8. Inadvertent closure of 4" manual valves to truck load out station.	1. Inability to load. Operational issue.												
			2. Inability to load out water. Potential liquid filling of water tanks TK-4101/02 with potential water spill to dike through thief hatches. Enviornmental issue, no safety hazard.	50. Tank Dike		1	1	1	3	I	No	15. Confirm whether it is desired for LSHH-4101/02 to ESD the facility as there is minimum safety risk with overfilling water tanks.			
				51. LSHH-4101/02 will ESD the facility											
				52. Equalization line between water / oil storage tanks.											
	NIO-S6020-00-011-4001	9. Inadvertent closure of manual valve on line 5672 - from Tk-4003 vapor space to oil line.	1. Valves are normally closed and only used for draining (venting) of headers.												
	NIO-S6020-00-011-4001	10. Inadvertent closing of butterfly valves (SP-02) on equalization lines between oil tanks.	1. Loss equalization between the tanks. Potential to carry over liquid out of the thief hatch (accidental lifting) to the tank dike. Potential Tank Dike with Fire	27. LSHH-4001/2/3/4/5/6/7 and 4101/02 will ESD the well			3	3	2	II	No	8. Review use of butterfly valves on equalization between tanks. As depicted the equalization line is normally open. During review it was mentioned that the tanks must be fully isolated prior to sales - not sure whether the isolation includes the equalization line. Need to confirm requirements for sales and also if the valve must be used, it must be accessible.			
	NIO-S6020-00-011-4002			28. LAHH-4001/2/3/4/5/6/7 and 4101/02 will ESD the well											
	NIO-S6020-00-011-3001	11. Inadvertent closing of 2" manual valve to P-4201. or manual valve closed	1. Potential to damage P-4201 due to a blocked suction. Pump damage with seal leak	29. Operating Procedures			3	3	3	II	No				
	NIO-S6020-00-011-4000														
	NIO-S6020-00-011-4000	12. P-4201 not running when desired.	1. Inability to recycle off spec tanks No safety hazard, an Operational issue.												
	NIO-S6020-00-011-4000	13. Manual valve on discharge of P-4201 closed when pump running.	1. Potential to operate the pump with a blocked discharge. Pump can not exceed the design pressure of the downstream piping. Pump damage with seal leak - no new consequence.												
3. Reverse / Mis-Directed Flow	NIO-S6020-00-011-2001	1. Failure of check valve to prevent back flow downstream of LCV-2101A	1. If this valve fails there is a potential to back flow from one of the other operating LP separators and/or tankage. Normalized liquid levels. No safety hazard, an Operational issue. Mis-measurement issue.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2901	2. Failure of 2" check valve to prevent backflow - downstream of LCV-2901A	1. No hazardous consequence identified with failure of this check valve.												

	NIO-S6020-00-011-4001	3. Failure of 4" check valves on Tk-4001/02/03/04 feed lines.	1. If the valve fails, potential to equalization of numerous tanks. No safety hazard, check valve is required for containment sizing												
	NIO-S6020-00-011-4000	4. Failure of check valve on discharge of P-4201.	1. No hazardous consequence identified with failure of this check valve.												
	NIO-S6020-00-011-4001	5. Poor Hose Connection at Oil Load Out. Manaul drain left open Hole in load out hose	1. Leak to the load out container. Environmental issue				1	1	1	3	I	No			
	NIO-S6020-00-011-4002														
	NIO-S6020-00-011-4000	6. Poor Hose Connection at Gas Vapor Return. Manaul drain left open Hole in load out hose	1. Gas leak to the atmosphere. Flash fire not anticipated.												
	NIO-S6020-00-011-4001														
	NIO-S6020-00-011-4002														
	NIO-S6020-00-011-4001	7. Failure of check valve on vapor return line.	1. Potential to have vapors from tank to exist the vapor return line to atmosphere. No new consequence. Vapor to the atmosphere.												
4. High Pressure		1. No new causes identified													
5. Low Pressure		1. No new causes identified													
6. High Temperature		1. High Ambient Temperature.	1. No hazardous consequences identified.												
7. Low Temperature		1. Low Ambient Temperature	1. Heat Tracing / Insulation is defined on the P&IDs for anticipated freeze-ups												
8. High Level		1. No new causes identified													
9. Low Level		1. No new causes identified													
10. Contaminants		1. No hazardous causes identified.													
11. Composition		1. No hazardous causes identified.													
12. Sampling		1. Appropriate access is provided for tank sampling.													
13. Injection Points		1. No injection points identified.													
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.													
15. Out of Sequence		1. No hazardous causes identified.													
16. Mis-Identification		1. No hazardous causes identified.													
17. Critical Tasks		1. No hazardous causes identified.													
18. Pressure Surge		1. No hazardous causes identified.													
19. Maintenance		1. Tanks are coated appropriately for service - oil or water.	1. No hazardous consequences identified.												
		2. Sacrificial anodes are provided within the heater treater to minimize corrosion.	1. No hazardous consequences identified.												
5. Produced Water Blue Squares															
1. More Flow	NIO-S6020-00-011-2001	1. Failure of control valve / control loop LCV-2101B. Open when desired to be closed.	1. Water level in V-2101 will be drained with gas blow thru to the produced water tanks. Increased vapor to the atmospheric storage tanks. Tank Overpressure and Fire	49. PVRV-4101/02 @ 16 oz vent to the atmosphere			3		3	2	II	No			
	NIO-S6020-00-011-2002			26. Open vent line to the flare - 4"											
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2901	2. Failure of control valve / control loop LCV-2901B Open when desired to be closed.	1. Water level in V-2901 will be drained with gas oil carryover to the water tank.												
			2. Water/Oil level in V-2901 will be drained with fuel gas blow thru to the water tanks. Increased vapor to the atmospheric storage tanks. Tank Overpressure and Fire No new consequence												
			3. Potential for fire tube failure due to loss of sufficient liquid level in V-2901. Heater Treater Fire	37. LSLL-2901 will shutdown BMS system.			3		3	2	II	No			
	NIO-S6020-00-011-3101	3. Inadvertent opening of manual valve on bypass line around P-3111.	1. Fluid in V-3101 will not be drained as there is insufficient system pressure in V-3101 to move liquid. No new consequence, same as failure of P-3111 to run - see no flow below.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-4101	4. Inadvertent opening of 4" manual valve on inlet of water tanks TK-4101/02.	1. Potential to add water/hydrocarbon to the tank that is being loaded out. Procedural issue as could have gas blow thru while a tank is loading. Sufficient safeguards are provided on the truck.												
	NIO-S6020-00-011-4101	5. Inadvertent opening of 4" manual valve to truck load out.	1. Potential to load out from an active tank. No new consequence.												
	NIO-S6020-00-011-4101	6. Inadvertent opening of manual valve to off spec line.	1. Potential contamination of recycle or unnecessarily recycling tank. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-9001	7. Manual valve on discharge of P-9001 open when pump idled.	1. No safety hazard with failure of this check valve.												
2. Less Flow	NIO-S6020-00-011-2001	1. Failure of control valve / control loop LCV-2101B. Closed when desired to be open. or manual valves closed	1. Increased water level in V-2101 with carryover of water to the oil tanks. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2001	2. Inadvertent closure of manual vapor return from V-2201. or manual drain from V-2201.	1. Inability to dump liquid from V-2201 resulting in liquid carryover to the fuel gas system. Significant Operational issue - specific consequences will be addressed separately.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														

	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2901	3. Failure of control valve / control loop LCV-2901B. Closed when desired to be open. or manual valves closed	1. Increased water level in V-2901 with carryover of water to the flash gas system. No safety hazard, an Operational issue.												
			2. Increased water level in V-2901 with carryover to the Oil Tanks. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-2901	4. Inadvertent closure of manual vapor return from V-2902. or manual drain from V-2902. or failure of liq/vapor trap SP008.	1. Inability to dump liquid from V-2901 resulting in liquid carryover to the fuel gas system. Significant Operational issue - specific consequences will be addressed separately.												
	NIO-S6020-00-011-2901	5. Inadvertent closure of manual valve on line 2506 downstream of V-2902 and V-2901 interconnect.	1. Inability to dump liquid from V-2901 resulting in liquid carryover to the fuel gas system. Significant Operational issue - specific consequences will be addressed separately.												
			2. Increased water level in V-2901 with carryover of water to the flash gas system. No safety hazard, an Operational issue.												
			3. Increased water level in V-2901 with carryover to the Oil Tanks. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-3101	6. Inadvertent closure of manual valve on suction of pump P-3111/12.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
	NIO-S6020-00-011-3102		2. Inability to remove liquid from V-3101 with liquid carryover to the screw compressor. Resulting in compressor damage due to dilution of lube oil.	31. LSHH-3100 will shutdown the VRU skid		3	1	3	2	II	No				
	NIO-S6020-00-011-3101	7. P-3111 not running when desired.	1. Inability to remove liquid from V-3101 with liquid carryover to the screw compressor. Resulting in compressor damage due to dilution of lube oil. No new consequence.												
	NIO-S6020-00-011-3101	8. Inadvertent closure of manual valve on discharge of P-3111.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
	NIO-S6020-00-011-4101	9. Inadvertent closure of 4" manual valve on inlet of water tanks TK-4101/02.	1. No new consequence - same as P-9001/9301/9302 or LCV-2101/2/3/4B or LCV-2901B closed.												
	NIO-S6020-00-011-4101	10. Inadvertent closure of 4" manual valve to truck load out.	1. Inability to load out water. Potential liquid filling of water tanks TK-4101/02 with potential water spill to dike through thief hatches. Enviornmental issue, no safety hazard.	50. Tank Dike		1	1	1	3	I	No	15. Confirm whether it is desired for LSHH-4101/02 to ESD the facility as there is minimum safety risk with overfilling water tanks.			
				51. LSHH-4101/02 will ESD the facility											
				52. Equalization line between water / oil storage tanks.											
	NIO-S6020-00-011-4101	11. Inadvertent closure of manual valve to off spec line.	1. Delay in recycling off spec material in the water tanks. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-9001	12. Manual valve on inlet of P-9001 inadvertently closed.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
			2. Inability to remove liquid from V-9001 with liquid carryover to flare.	32. LSHH-9001 will close ESD valve on Well and will shut off flare burner.		3	1	3	2	II	No				
	NIO-S6020-00-011-9001	13. P-9001 not running when desired.	1. Inability to remove liquid from V-9001 with liquid carryover to flare. No new consequence												
	NIO-S6020-00-011-9001	14. Manual valve on discharge of P-9001 closed when pump running.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
	NIO-S6020-00-011-9301	15. Manual valve on inlet of P-9301/02 inadvertently closed.	1. Operation of pump with a blocked suction resulting in pump damage with a seal leak of water to grade.			1	1	1	3	I	No				
			2. Inability to remove liquid from V-9301/2 with liquid carryover to combustor. Leak of water/hydrocarbon to the combustor berm area with potential for localized fired.	53. LSHH-9301/02 will ESD the facility		3	1	3	2	II	No				
	NIO-S6020-00-011-9301	16. P-9301/02 not running when desired.	1. Inability to remove liquid from V-9301/2 with liquid carryover to combustor. Leak of water/hydrocarbon to the combustor berm area with potential for localized fired. No new consequence												
	NIO-S6020-00-011-9301	17. Manual valve on discharge of P-9301/02 closed when pump running.	1. Operation of pump with a blocked discharge resulting in pump damage with a seal leak of water to grade. Overpressure of downstream piping is not considered creditable			1	1	1	3	I	No				
3. Reverse / Mis-Directed Flow	NIO-S6020-00-011-2001	1. Failure of 1" check valve on V-2201.	1. Potential for produced water to back flow to V-2201. With liquid carryover to the fuel gas system. No new consequence.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														

	NIO-S6020-00-011-2001	2. Failure of 2" check valve to prevent backflow - combined bottom drain from V-2201/02/03/04.	1. If this valve fails there is a potential to back flow from one of the other operating LP separators and/or tankage. Normalized liquid levels. No safety hazard, an Operational issue. Mis-measurement issue.													
	NIO-S6020-00-011-2002															
	NIO-S6020-00-011-2003															
	NIO-S6020-00-011-2004															
	NIO-S6020-00-011-2901	3. Failure of 1" check valve on V-2901.	1. Potential for produced water to back flow to V-2901. With liquid carryover to the fuel gas system. No new consequence.													
	NIO-S6020-00-011-2901	4. Failure of 2" check valve to prevent backflow - combined bottom drain from V-2901/V-2902.	1. If this valve fails there is a potential to back flow from one of the other operating LP separators and/or tankage. Normalized liquid levels. No safety hazard, an Operational issue. Mis-measurement issue.													
	NIO-S6020-00-011-3101	5. Failure of 1/2" check valve to prevent back flow - discharge of P-3111/12	1. No safety hazard with failure of this check valve.													
	NIO-S6020-00-011-3102															
	NIO-S6020-00-011-3101	6. Failure of 1" check valve to prevent back flow - discharge of P-3111/12	1. No safety hazard with failure of this check valve.													
	NIO-S6020-00-011-3102															
	NIO-S6020-00-011-4101	7. Failure of 4" check valves on Tk-4101/02/03/04 feed lines.	1. If the valve fails, potential to equalization of numerous tanks. No safety hazard, check valve is required for containment sizing													
	NIO-S6020-00-011-4101	8. Poor Hose Connection at Oil Load Out. Manaul drain left open Hole in load out hose	1. Leak to the load out container. Environmental issue				1	1	3	I	No					
	NIO-S6020-00-011-9001	9. Failure of 2" check valve on discharge of P-9001.	1. No safety hazard with failure of this check valve.													
4. High Pressure		1. No new causes identified														
5. Low Pressure		1. No new causes identified														
6. High Temperature		1. High Ambient Temperature.	1. No hazardous consequences identified.													
7. Low Temperature		1. Low Ambient Temperature	1. No hazardous consequences identified.													
8. High Level		1. No new causes identified														
9. Low Level		1. No new causes identified														
10. Contaminants		1. No hazardous causes identified.														
11. Composition		1. No hazardous causes identified.														
12. Sampling		1. No sampling anticipated.														
13. Injection Points		1. No injection points identified.														
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.														
15. Out of Sequence		1. No hazardous causes identified.														
16. Mis-Identification	NIO-S6020-00-011-4100	1. P&ID Correction	1. P&ID Redline Error									14. P&ID Correction: Bottom water line 3126 has drafting error - see the arrow head on the right hand side of the page - it isn't on the line.				
17. Critical Tasks		1. No hazardous causes identified.														
18. Pressure Surge		1. No hazardous causes identified.														
19. Maintenance		1. No hazardous causes identified.														
6. Fuel Gas Green / / / / Flare Yellow Line																
1. More Flow	NIO-S6020-00-011-2101	1. Failure of control valve / control loop SDV-2101 Open when desired to be closed. [Safety System Valve]	1. Failure of this safety system valve did not initiate the event. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the main burner. Manual block valves are available to be closed.									10. Confirm that manual isolation valves are available outside of the "fire envelope" to allow for isolation of the fuel gas should there be a fire at the heater treater skid. Based upon risk, may also want to have a redundant SDV to isolate all of fuel gas if fire is detected at the facility.				
	NIO-S6020-00-011-2102															
	NIO-S6020-00-011-2103															
	NIO-S6020-00-011-2104															
	NIO-S6020-00-011-2101	2. Failure of control valve / control loop FCV-2101A Open when desired to be closed.	1. Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	42. TAHH-2101A will shutdown BMS closing SDV-2101			3	2	3	2	II	No	9. Update P&ID 2101/2/3/4 to show high temperature shutdown - the transmitter is showing whereas the high shutdown TAHH isn't represented on the P&ID.			
	NIO-S6020-00-011-2102		2. Increased fuel gas flow to the main burner. Resulting increased firing resulting in a high stack temperature. Potential to exceed the design tempereature of the stack.	36. No safeguards listed			3	2	3	3	II	No				
	NIO-S6020-00-011-2103															
	NIO-S6020-00-011-2104															
	NIO-S6020-00-011-2101	3. Failure of control valve / control loop FCV-2101B Open when desired to be closed.	1. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the pilot. Unregulated fuel gas to the V-2101/2/3/4 Heater treater LP Gas to atmosphere < 1/4"	43. Manual Block Valves can be closed upstream of skid			3	2	3	3	II	No				
	NIO-S6020-00-011-2102															
	NIO-S6020-00-011-2103															
	NIO-S6020-00-011-2104															
	NIO-S6020-00-011-2901	4. Failure of control valve / control loop FCV-2901B Open when desired to be closed.	1. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the pilot. Manual block valves are available to be closed.													

	NIO-S6020-00-011-2901	5. Failure of control valve / control loop FCV-2901A Open when desired to be closed.	1. Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	35. TAHH-2901A will shutdown BMS closing SDV-2901/2901B.		3	2	3	2	II	No				
			2. Increased fuel gas flow to the main burner. Resulting increased firing resulting in a high stack temperature. Potential to exceed the design tempereature of the stack.	36. No safeguards listed		3	2	3	3	II	No				
	NIO-S6020-00-011-2901	6. Failure of control valve / control loop SDV-2901 Open when desired to be closed. [Safety System Valve]	1. Failure of this safety system valve did not initiate the event. This valve is desired to be open during normal operation. If it fails to close during an ESD / BMS event unregulated fuel gas may continue to the main burner. Manual block valves are available to be closed.												
	NIO-S6020-00-011-9201	7. Failure of control valve / control loop SDV-9201 Open when desired to be closed. [Safety System Valve]	1. The SDV-9201 valve is desired to be closed when there is a ??????												
	NIO-S6020-00-011-9401	8. Failure of control valve / control loop SDV-9420 Open when desired to be closed. [Safety System Valve]	1. The SDV-9420 valve is desired to be closed when there is a ??????												
2. Less Flow	NIO-S6020-00-011-2101	1. Failure of control valve / control loop FCV-2101A Closed when desired to be open. or SDV-2101 closed or manual valves closed	1. Loss of fuel gas to the main burner. Potential to have insufficient heat to remove emulsion from oil. No safety hazard, an operational issue.												
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2101	2. Failure of control valve / control loop FCV-2101B Closed when desired to be open	1. Loss of pilot gas. Inability to start heater treater resulting in a delayed start-up or shutdown of heater treater. No safety hazard, an operational issue.												
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2101	3. Plugging of Screen on Heater Treater Stack (insect / debris)	1. Full plugging of the incinerator stack is not considered a creditable consequence. A partial plugging is considered an Operational issue as the control of the heat may be impacted.												
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-9800	4. Inadvertent closure of manual valve to V-2902 from main header.	1. Loss of fuel gas to V-2902. Loss of fuel gas to provide pressure to V-2901 and to the V-2901 burners. No safety hazard, an operational issue. Results for both scenarios are covered separately.												
	NIO-S6020-00-011-2901	5. Inadvertent closure of 1" manual valve between V-2902 and V-2901 ovhd line 2303.	1. Loss of fuel gas flow to the V-2901. Inability to provide pressure to V-2901 may result in an inability to remove liquid from V-2901 with liquid carryover to the flash gas system. Operational issue, no safety hazard.												
	NIO-S6020-00-011-2901	6. Failure of control valve / control loop FCV-2901B Closed when desired to be open. or manual valves closed	1. Loss of pilot gas. Inability to start heater treater resulting in an inability to break emulsion of recycled oil. No safety hazard, an Operational issue.												
	NIO-S6020-00-011-2901	7. Failure of control valve / control loop FCV-2901A Closed when desired to be open. or SDV-2901 closed	1. Loss of fuel gas to the main burner. Potential to have insufficient heat to remove emulsion from recylcled oil. No safety hazard, an operational issue.												
	NIO-S6020-00-011-9201	8. Failure of control valve / control loop SDV-9201 Closed when desired to be open. [Safety System Valve]	1. Downstream pressure > 15 psig. Higher pilot gas than desired. Potential waste of fuel gas.												
			2. Downstream pressure > 15 psig. Higher pilot gas than desired potential to lift flame off of the pilot resulting in uncombusted gas from the flare stack. Environmental incident	39. BMS Flame detection will ESD well.		1	1	1	3	I	No				
	NIO-S6020-00-011-9401	9. Plugging of Flame Arrestor FA-9201.	1. Blocked flow to the hp flare. Upstream pressure > 100 psig. Potential to have an environmental release of uncombusted material from the flare KO drum. A class piping @ 285 psig V-2001/2/3/4 @ 260 psig (limited by PSV-2001) Overpressure = not anticipated	45. PSV-9001 @ 125 psig vents to the atmosphere		1	1	1	2	I	No				
				46. PAHH-2001 will close ESDV on well											
3. Reverse / Mis-Directed Flow	NIO-S6020-00-011-3101	1. Failure of 1" check valve to prevent back flow - line 9804 (inst gas to VRU Skid 1/2)	1. No safety hazard with failure of this check valve.												
	NIO-S6020-00-011-3102														
	NIO-S6020-00-011-2901	2. Failure of 1" check valve on V-2902 overhead line.	1. No safety hazard with failure of this check valve.												
	NIO-S6020-00-011-2901	3. Tube Leak in V-2901.	1. Potential for fire tube failure with oil to fuel gas resulting in ignition and fire of the treater.	36. No safeguards listed		3	2	3	3	II	No				

4. High Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2201 Open more than desired	1. Downstream pressure > 30 psig. V-2201 will be overpressured. V-2001 @ 250 psig V-2201 @ 125 psig Overpressure = 2 times Gasket / Pin Hole failure	33. PSV-2201 @ 125 psig vents to the atmosphere	Yes	4	2	4	2	II	Yes	2. No LOPA Gap, Sufficient safeguards provided			
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2101	2. Failure of regulator PCV-2101A Open when desired to be closed.	1. Downstream pressure > 12 psig Increased fuel gas flow to the main burner. Resulting increased firing. Process hotter than desired. Potential to exceed design temperature for atmospheric storage - potential flashing of water resulting in damage.	42. TAHH-2101A will shutdown BMS closing SDV-2101		3		3	2	II	No	9. Update P&ID 2101/2/3/4 to show high temperature shutdown - the transmitter is showing whereas the high shutdown TAHH isn't represented on the P&ID.			
	NIO-S6020-00-011-2102		2. Downstream pressure > 12 psig. If this regulator fails then PCV-2101 and FCV-2101A will see 30 psig gas. No safety hazard.												
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2101	3. Failure of PCV-2101 Open more than desired.	1. Downstream pressure > ?? psig. Increased fuel gas pressure to the pilot. Potential to blow pilot out and have unrestricted fuel gas venting to the atmosphere.	44. BMS Flame detection will close FCV-2101B & SDV-2101.		3		3	2	II	No	11. Update P&ID 2101/2/3/4 to show set pressure for regulator PCV-2101/2/3/4			
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2901	4. Failure of PCV-2901A Open more than desired.	1. Downstream pressure > 12 psig. If this regulator fails then PCV-2901B and FCV-2901A will see 30 psig gas. No safety hazard.												
	NIO-S6020-00-011-2901	5. Failure of PCV-2901B Open more than desired.	1. Downstream pressure > 5 psig. Increased fuel gas pressure to the pilot. Potential to blow pilot out and have unrestricted fuel gas venting to the atmosphere.	34. BMS Flame detection will close FCV-2901B & SDV-2901.		3		3	2	II	No				
	NIO-S6020-00-011-9201	6. Failure of PCV-9201A Open more than desired.	1. Downstream pressure > 20 psig. If this regulator fails then PCV-9201B will see 30 psig gas. No safety hazard.												
	NIO-S6020-00-011-9201	7. Failure of PCV-9201B Open more than desired.	1. Downstream pressure > 15 psig. Higher pilot gas than desired. Potential waste of fuel gas.												
			2. Downstream pressure > 15 psig. Higher pilot gas than desired potential to lift flame off of the pilot resulting in uncombusted gas from the	39. BMS Flame detection will ESD well.											
	NIO-S6020-00-011-9401	8. Failure of PCV-9400 Open more than desired.	1. Downstream pressure > 5 psig. Increased fuel gas to the combuster, with potential lift off of pilot.	40. BMS Flame detection will ESD the well.											
	NIO-S6020-00-011-7000	9. Failure of PCV-7100 Open more than desired.	1. Upstream pressure < 100 psig. Loss of sales gas to the flare. Flare is designed for quantity of gas that can pass through the failure regulator. Sales and Environmental issue.												
5. Low Pressure	NIO-S6020-00-011-2001	1. Failure of PCV-2201 Closed more than desired or Inadvertent closing of manual valves to/from V-2201	1. Downstream pressure < 30 psig. Loss of fuel gas / instrument gas to heater treater skid resulting in a significant operational issue with shutdown of the wells.												
	NIO-S6020-00-011-2002														
	NIO-S6020-00-011-2003														
	NIO-S6020-00-011-2004														
	NIO-S6020-00-011-2101	2. Failure of PCV-2101A Closed more than desired or manual valves closed	1. Downstream pressure < 12 psig. Loss of fuel gas to the pilot and main burner. Potential to have insufficient heat to remove emulsion from oil. No safety hazard, an operational issue.												
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2101	3. Failure of PCV-2101 Closed more than desired. or manual valves closed	1. Downstream pressure < 5 psig. Loss of pilot gas. Inability to start heater treater resulting in a delayed start-up.												
	NIO-S6020-00-011-2102														
	NIO-S6020-00-011-2103														
	NIO-S6020-00-011-2104														
	NIO-S6020-00-011-2901	4. Failure of PCV-2901A Closed more than desired. or manual valves closed	1. Downstream pressure < 12 psig. Loss of fuel gas to the pilot and main burner. Potential to have insufficient heat to remove emulsion from recycle oil. No safety hazard, an operational issue.												
	NIO-S6020-00-011-2901	5. Failure of PCV-2901B Closed more than desired. or manual valves closed	1. Downstream pressure > ?? psig. Loss of pilot gas. Inability to start heater treater resulting in an inability to break emulsion of recycled oil. No safety hazard, an Operational issue.									13. Update P&ID 2901 to show set pressure for regulator PCV-2901B			
	NIO-S6020-00-011-9201	6. Failure of PCV-9201A Closed more than desired. or manual valve closed or SDV-9201 closed	1. Downstream pressure < 20 psig. Loss of pilot to the main flare. Potential for unregualated hydrocarbon venting. Environmental issue.	38. BMS failure will will close the ESD on the well											
	NIO-S6020-00-011-9201	7. Failure of PCV-9201B Closed more than desired. or manual valve closed	1. Downstream pressure > 20 psig. Loss of pilot to the main flare. Potential for unregualated hydrocarbon venting. Environmental issue.	38. BMS failure will will close the ESD on the well											

	NIO-S6020-00-011-9401	8. Failure of PCV-9400 Closed more than desired. or manual valve closed or SDV-9420 closed	1. Downstream pressure < 5 psig. Loss of gas to the combustor with un-regulated tank vapors to the atmosphere. An environmental issue.	38. BMS failure will will close the ESD on the well												
	NIO-S6020-00-011-7000	9. Failure of PCV-7100 Closed more than desired.	1. Upstream pressure > 100 psig. Potential for increased pressure to the sales gas line. A class piping @ 285 psig V-2001/2/3/4 @ 260 psig (limited) Overpressure not anticipated for piping - may have higher pressure than sales contract.	47. PSV-2001 @ 260 psig vents to the atmosphere		1	1	1	2	I	No				
				48. PAHH-2001 will close ESDV on well												
6. High Temperature		1. High Ambient Temperature.	1. No hazardous consequences identified.													
7. Low Temperature		1. Low Ambient Temperature	1. No hazardous consequences identified.													
8. High Level		1. No causes identified														
9. Low Level		1. No causes identified														
10. Contaminants		1. No hazardous causes identified.														
11. Composition		1. No hazardous causes identified.														
12. Sampling		1. No causes identified														
13. Injection Points		1. No causes identified														
14. Start-up, Shutdown, Non-Normal Operation		1. No hazardous causes identified.														
15. Out of Sequence		1. No causes identified														
16. Mis-Identification	NIO-S6020-00-011-2102	1. Page Connection - incorrect	1. P&ID Redline Error									12. Update P&ID connector on left hand side of the page - currently says from P&ID 2001 and it should be from P&ID 2002.			
17. Critical Tasks		1. No causes identified														
18. Pressure Surge		1. No causes identified														
19. Maintenance		1. No causes identified														

Flow line Segment	PSH	PSL	PSV	FSV								
Wellhead Injection Lines	PSH	PSL	PSV	FSV								
Headers	PSH	PSL	PSV									
Pressure Vessels	PSH	PSL	PSV	LSH	LSL	FSV	TSH					
Atmospheric Vessels	Vent	PSV	LSH	LSL	TSH							
Fired or Exhaust Heated Equipment	TSH Fluid	TSH Stack	PSL Air	PSH	PSL Fuel	BSL	FSL	MI	FA Intake	SA	PSV	FSV
Pumps	PSH Pipeline Pumps	PSH Other Pumps	PSL Pipeline Pumps	PSL Other Pumps	PSV Pipeline Pumps	PSV Other Pumps	FSV					
Compressors	PSH Suction	PSH Discharge	PSL Suction	PSL Discharge	PSV Suction	PSV Discharge	FSV Final Discharge	TSH				
Pipelines	PSH	PSL	PSV	FSV								
Heat Exchangers	PSH	PSL	PSV									
Safety Shutdown System	SSDS	MSDS	SDV Isolation	FD	CGDS	TGDS	US					
Buildings Enclosures	Enclosures											
Tank_Containment_Systems_and_Sumps	Containment											

Yes
No
N/A

X

Alarm
Close Valve
Open Valve
Pressure Relief
Shut Down Compressor
Shut Down System
Shut in Component
Shut in Well
Vacuum Relief

PSH	Pressure Sensor High	PSH	Pressure Sensor High
PSL	Pressure Sensor Low	PSL	Pressure Sensor Low
PSV	Pressure Safety Valve	PSV	Pressure Safety Valve
FSV	Flow Safety Valve (Check Valve)	FSV	Flow Safety Valve (Check Valve)
LSH	Level Sensor High	LSH	Level Sensor High
LSL	Level Sensor Low	LSL	Level Sensor Low
TSH	Temp Sensor High	TSH	Temp Sensor High
TSL	Temp. Sensor Low	TSL	Temp. Sensor Low
BSL	Flame Failure Indicator	BSL	Flame Failure Indicator
MI	Motor Interlock	MI	Motor Interlock
FA	Flame Arrestor	FA	Flame Arrestor
SSDS	Safety Shut Down System	SSDS	Safety Shut Down System
MSDS	Manual Shut Down System	MSDS	Manual Shut Down System
FD	Fire Detection	FD	Fire Detection
CGDS	Combustible Gas Detection System	CGDS	Combustible Gas Detection System
TGDS	Toxic Gas Detection System	TGDS	Toxic Gas Detection System
US	Utility Systems	US	Utility Systems
SDV	Shut Down Valve	SDV	Shut Down Valve

PSH installed and block valves between source and PSH are locked or car sealed open - Flow Line Segment	A.1.a.1
Flow line segment has a maximum allowable working pressure greater than maximum shut in pressure and is protected by a PSH on a downstream flow line segment.	A.1.a.2
Flow line segment has a maximum allowable working pressure greater than maximum shut in pressure (this includes formation pressure and artificial lift).	A.1.a.3
Oil facility, < 100 psi, < 10 BOPD, and the well has a pumping unit	A.1.a.4
PSH Not Installed - Flow Line Segment	ATTENTION!
PSL Installed on Flow line segment	A.1.b.1
Flow line segment is between the well and the first choking device and is less than 10 feet in length or, in the case of an underwater installation, reasonably close to that distance.	A.1.b.2
Flow line segment operates <250 psi and the line is monitored weekly.	A.1.b.3
Location is remote with minimal potential for public impact.	A.1.b.4
PSL Not Intsalled - Flow Line Segment	ATTENTION!
PSV installed on Flow line segment	A.1.c.1
Flow line segment has a maximum allowable working pressure greater than the maximum shut in pressure.	A.1.c.2
Two SDV (one of which may be the SSV) with independent PSHs, relays, and sensing points are installed where there is adequate flow line volume upstream of any block valves to allow sufficient time for the SDVs to close before exceeding the maximum allowable working pressure.	A.1.c.3
Flow line segment is protected by a PSV on upstream segment.	A.1.c.4
Flow line segment is protected by a PSV on downstream component that can not be isolated (valves are car sealed or locked open) from the flow line segment and there are no chokes or other restrictions between the flow line segment and the PSV.	A.1.c.5
PSV Not Installed - Flow Line Segment	ATTENTION!
FSV installed on Flow line segment	A.1.d.1
Flow line segment is protected by FSV in final flow line segment.	A.1.d.2
Can document in comments that backflow is not possible or cannot create a consequence of concern - Flow Line	A.1.d.3
FSV Not Installed - Flow Line Segment	ATTENTION!
PSH installed on Wellhead Injection Line	A.2.a.1
Line and equipment are protected by an upstream PSH.	A.2.a.2
PSH Not Intsalled on Wellhead Injection Line	ATTENTION!
PSL Installed on Wellhead Injection Line	A.2.b.1
Line and equipment are protected by an upstream PSL.	A.2.b.2
PSL Not Intsalled on Wellhead Injection Line	ATTENTION!
PSV installed on Wellhead Injection Line	A.2.c.1
Flow line segment has a maximum allowable working pressure greater than the maximum pressure that can be imposed by the injection source..	A.2.c.2
Line and equipment are protected by an upstream PSV.	A.2.c.3
PSV Not Installed on Wellhead Injection Line	ATTENTION!
FSV installed on Wellhead Injection Line	A.2.d.1
FSV Not Installed on Wellhead Injection Line	ATTENTION!
PSH installed and block valves between source and PSH are locked or car sealed open on Header	A.3.a.1
Each input source is equipped with a PSH set less than the maximum allowable working pressure of the header.	A.3.a.2
Header is protected by downstream PSH that cannot be isolated from the header.	A.3.a.3
Header is for flare, relief, vent or other atmospheric service and has no valving in the outlet piping - Headers - PSH	A.3.a.4
PSH with alarm is installed, PCV relieves to tank or vessels - Headers	A.3.a.5
Header has a maximum allowable working pressure greater than maximum shut in pressure of all sources (this includes formation pressure and artificial lift) - Header	A.3.a.6
PSH Not Intsalled on Header	ATTENTION!
PSL Installed on Header	A.3.b.1
Each input source is protected by a PSL and there are no pressure control devices or restrictions between the PSL and the header.	A.3.b.2
Header is for flare, relief, vent or other atmospheric service.	A.3.b.3
Header operates < 250 psi and header is monitored weekly	A.3.b.4
Location is remote with minimal potential for public impact	A.3.b.5
PSL Not Intsalled on Header	ATTENTION!
PSV installed on Header	A.3.c.1
Header has a maximum allowable working pressure greater than the maximum shut in pressure of any connected well.	A.3.c.2
Pressure relief protection is provided on each input source having a maximum shut in pressure greater than the maximum allowable working pressure of the header.	A.3.c.3
Header is protected by downstream PSV that cannot be isolated from the header.	A.3.c.4
Header is for flare, relief, vent or other atmospheric service and has no valving in the outlet piping - Headers - PSV	A.3.c.5
Input source is a well having a pressure greater than the mawp of the header and equipped with 2 SDV (SSV) using independent PSHs with separate relays and sensing points. Other sources capable of > than the mawp of the headers are PSV protected	A.3.c.6
PSV Not Installed on Header	ATTENTION!
PSH installed on Vessel	A.4.a.1
Input is from a pump or compressor that cannot develop pressure greater than the maximum allowable working pressure of the vessel.	A.4.a.2
Each input source is protected by a PSH that protects the vessel.	A.4.a.3
Adequately sized piping without a block or regulating valves connects gas outlet to downstream equipment protected by a PSH that also protects the upstream vessel.	A.4.a.4
Vessels is final scrubber in a flare, relief, or vent system and is designed to withstand maximum built up back pressure - Header	A.4.a.5
Vessel operates at atmospheric pressure and has an adequate vent system.	A.4.a.6
Vessel has a maximum allowable working pressure greater than maximum shut in pressure of all sources (this includes formation pressure and artificial lift).	A.4.a.7
PSH Not Intsalled on Vessel	ATTENTION!
PSL Installed on Vessel	A.4.b.1
Minimum operating pressure is atmospheric pressure when in service.	A.4.b.2
Each input source is protected by a PSL and there are no [pressure control devices or restrictions between the PSL(s) and the vessel.	A.4.b.3
Vessel is scrubber or small trap, is not a process component, and adequate protection is provided by downstream PSL or design function (e.g. vessel is gas scrubber for pneumatic safety systems or final scrubber for flare, relief or vent system.)	A.4.b.4
Operates <250 psi and the line is monitored weekly.	A.4.b.5
Location is remote with minimal potential for public impact - Pressure Vessel	A.4.b.6
PSL Not Intsalled on Vessel	ATTENTION!
PSV installed on Vessel	A.4.c.1
Each input source is protected by a PSV set no higher than the maximum allowable working pressure of the vessel	A.4.c.2
Each input source is protected by a PSV set no higher than the vessel's, at least one of these PSV's cannot be isolated from the vessel.	A.4.c.3
PSV's on downstream equipment can satisfy relief requirements of the vessel and cannot be isolated from the vessel.	A.4.c.4
Vessel is final scrubber in a flare, relief or vent system, is designed for max back pressure, and has no obstructions.	A.4.c.5
Vessel is final scrubber in a flare, relief, or vent system, is designed for max back pressure, and is equipped with a rupture disk or safety head (PSE) to bypass any internal or external obstructions.	A.4.c.6
PSV Not Installed on Vessel	ATTENTION!
LSH installed on Vessel	A.4.d.1
Equipment downstream of gas outlet is not a flare or vent system and can safely handle maximum liquid carry-over.	A.4.d.2
Equipment downstream has an LSH	A.4.d.3
Vessel function does not require handling separated fluid phases.	A.4.d.4
Vessel is a small trap from which liquids are manually drained.	A.4.d.5
LSH Not Installed on Vessel	ATTENTION!
LSL installed to protect each liquid outlet on Vessel	A.4.e.1
Liquid level is not automatically maintained in the vessel and the vessel does not have an immersed heating element subject to excess temperature.	A.4.e.2
Downstream equipment safely handle gas rates. Vessel doesn't have an immersed heating element. Economic consequences of gas blowby are acceptable.No environmental concerns from venting gas.	A.4.e.3
Vessel is a small trap from which liquids are manually drained.	A.4.e.4
LSL Not Installed on Vessel	ATTENTION!
FSV installed on each outlet of Vessel	A.4.f.1
The maximum volume of hydrocarbons that could backflow from downstream equipment is insignificant.	A.4.f.2
A control device in the line will effectively minimize backflow.	A.4.f.3
Can document in comments that backflow is not possible or cannot create a consequence of concern - Pressure Vessel	A.4.f.4
FSV Not Installed on Vessel	ATTENTION!
TSH installed on Vessel	A.4.g.1
Heat source is incapable of causing excess temperature.	A.4.g.2
TSH not installed on Vessel	ATTENTION!
Vent installed - Atmospheric Vessel	A.5.a.1
Vent Not Installed - Atmospheric Vessel	ATTENTION!
PSV installed - Atmospheric Vessel	A.5.b.1
Vessel has second vent capable of handling maximum gas volume	A.5.b.2
Component is a pressure vessel. Not subject to collapse, that operates in atmospheric service and is equipped with an adequately sized vent.	A.5.b.3
Vessel has no pressure sources (except blanket gas and/or manual drains) and is equipped with an adequately sized vent.	A.5.b.4
PSV Not Installed - Atmospheric Vessel	ATTENTION!
LSH installed - Atmospheric Vessel	A.5.c.1
Fill operations are continually attended.	A.5.c.2
Overflow is diverted or contained by other process components	A.5.c.3
Tank volume is sized to contain the volume produced in 3 times the normal route check rate (i.e. tank volume > 3 times avg daily production x number of days between operator visits)	A.5.c.4
LSH Not Installed - Atmospheric Vessel	ATTENTION!
LSL installed - Atmospheric Vessel	A.5.d.1
Adequate containment system is provided.	A.5.d.2
Liquid level is not automatically maintained in the vessel and vessel does not have an immersed heating element subject to excess temperature.	A.5.d.3
Component is final vessel in a containment system designed to collect and direct hydrocarbon liquids to a safe location.	A.5.d.4
LSL Not Installed - Atmospheric Vessel	ATTENTION!
High temperature sensors are applicable only to vessels having a heat source.	A.5.e.1

Heat source is incapable of causing excess temperature.	A.5.e.2
TSH Not Installed - Atmospheric Vessel	ATTENTION!
TSH installed which completely isolates fuel source from both burner and pilot and is separate from the temperature controller.	A.6.a.1
Component is a steam generator protected by a PSH and if fired protected by a LSL	A.6.a.2
Component is an indirect water bath heater in atmospheric service and is protected by an LSL.	A.6.a.3
TSH not installed - Fired and Exhaust Heated Components - Fluid	ATTENTION!
TSH installed - Fired and Exhaust Heated Components	A.6.b.1
Cost of unit and impact to production within acceptable consequence levels	A.6.b.2
Component is isolated and does not handle combustible medium or process fluids other than fuel - Fired and Exhaust Heated Components - TSH	A.6.b.3
Component is exhaust heated without supplemental firing and medium is not combustible - Fired and Exhaust Heated Components - TSH	A.6.b.4
TSH not installed - Fired and Exhaust Heated Components - Stack	ATTENTION!
PSL installed - Fired and Exhaust Heated Components - Air - PSL	A.6.d.1
Component is equipped with a natural draft burner - Air - PSL	A.6.d.2
Forced draft burner is equipped with another type of low air supply sensor.	A.6.d.3
Component is exhaust heated without supplemental firing - Air - PSL	A.6.d.4
PSL Not Intsalled - Fired and Exhaust Heated Components - Air - PSL	ATTENTION!
PSH installed - Fired and Exhaust Heated Components - Fuel - PSH	A.6.e.1
Component is exhaust heated without supplemental firing - Fuel - PSH	A.6.e.2
Fuel line contains two (2) pressure controlling devices upstream of fuel flow control valve (temperature control valve)	A.6.e.3
PSH Not Intsalled - Fired and Exhaust Heated Components - Fuel - PSH	ATTENTION!
PSL installed - Fired and Exhaust Heated Components - Fuel - PSL	A.6.f.1
Component is equipped with a natural draft burner - Fuel - PSL	A.6.f.2
Component is exhaust heated without supplemental firing - Fuel - PSL	A.6.f.3
PSL Not Intsalled - Fired and Exhaust Heated Components - Fuel - PSL	ATTENTION!
BSL installed - Fired and Exhaust Heated Components	A.6.g.1
Component is exhaust heated without supplemental firing - Fired and Exhaust Heated Components - BSL	A.6.g.2
BSL not Installed - Fired and Exhaust Heated Compoonents	ATTENTION!
FSL installed - Fired and Exhaust Heated Components	A.6.h.1
Component is not a closed heat transfer type in which a combustible medium flows through tubes located in the firing or exhaust heated chamber.	A.6.h.2
FSL not installed - Fired and Exhaust Heated Components	ATTENTION!
Motor interlock installed - Fired and Exhaust Heated Components	A.6.i.1
Component is equipped with a natural draft burner - Fired and Exhaust Heated Components - MI	A.6.i.2
Component is exhaust heated without supplemental firing - Fired and Exhaust Heated Components - MI	A.6.i.3
Motor Interlock not installed - Fired and Exhaust Heated Components	ATTENTION!
Flame arrestor installed - Fired and Exhaust Heated Components	A.6.j.1
Component is equipped with a forced draft burner - Fired and Exhaust Heated Components - FA	A.6.j.2
Component is located in an isolated area and not handling combustible medium or process fluids other than fuel.	A.6.j.3
Component is exhaust heated without supplemental firing - Fired and Exhaust Heated Components - FA	A.6.j.4
Flame arrestor not installed - Fired and Exhaust Heated Components	ATTENTION!
Stack arrestor installed.	A.6.k.1
Bird/Bat Cone installed	A.6.k.2
Component is equipped with a forced draft burner and (i) the fluid being heated is non-flammable, or (ii) the burner draft pressure at the exit of the transfer section is higher than the fluid pressure (head)..	A.6.k.3
Component is isolated so process fluids will not contact stack emissions.	A.6.k.4
Component is exhaust heated without supplemental firing.	A.6.k.5
Stack arrestor not installed	ATTENTION!
PSV installed - Fired and Exhaust Heated Components	A.6.l.1
Component is not a tube type heater.	A.6.l.2
PSV installed on another component will provide necessary protection and the PSV cannot be isolated from the tube section.	A.6.l.3
PSV Not Installed - Fired and Exhaust Heated Components	ATTENTION!
PSV installed on each outlet - Fired and Exhaust Heated Components	A.6.m.1
The maximum volume of combustible media that could backflow from downstream equipment is insignificant, or medium is not combustible.	A.6.m.2
Component is not a tube type heater.	A.6.m.3
FSV Not Installed - Fired and Exhaust Heated Components	ATTENTION!
PSH installed - Pipeline Pumps	A.7.a.1
PSH Not Intsalled - Pipeline Pumps	ATTENTION!
PSH installed - Other Pumps	A.7.b.1
Maximum pump discharge pressure does not exceed 70 percent of the Maximum allowable working pressure of the discharge piping.	A.7.b.2
Pump is manually operated and continuously attended - PSH	A.7.b.3
Small, low volume pumps, e.g. chemical injection pumps - PSH	A.7.b.4
Pump discharges to an atmospheric vessel - PSH	A.7.b.5
Pump is a glycol powered glycol pump.	A.7.b.6
PSH Not Intsalled - Other Pumps	ATTENTION!
PSL installed - Pipeline Pumps	A.7.c.1
Pump does not handle hydrocarbons.	A.7.c.2
PSL Not Intsalled - Pipeline Pumps	ATTENTION!
PSL installed - Other Pumps	A.7.d.1
Pump is manually operated and continuously attended - PSL	A.7.d.2
Adequate containment is provided.	A.7.d.3
Small, low volume pumps, e.g. chemical injection pumps - PSL	A.7.d.4
Pump discharges to an atmospheric vessel - PSL	A.7.d.5
PSL Not Intsalled - Other Pumps	ATTENTION!
PSV installed - Pipeline Pumps	A.7.e.1
Pump is a kinetic energy type and incapable of generating a head greater than the maximum allowable working pressure of the discharge piping.	A.7.e.2
PSV Not Installed - Pipeline Pumps	ATTENTION!
PSV installed - Other Pumps	A.7.f.1
Maximum pump discharge pressure is less than the maximum allowable working pressure of the discharge piping.	A.7.f.2
Pump has internal pressure relief capacity.	A.7.f.3
Pump is a glycol powered glycol pump, and the wet glycol low pressure discharge piping is rated higher than the maximum discharge pressure..	A.7.f.4
Pump is a glycol powered glycol pump, and the wet glycol low pressure discharge piping is protected by a PSV on a downstream component that cannot be isolated from the pump.	A.7.f.5
PSV Not Installed - Other Pumps	ATTENTION!
Check valve installed - All Pumps	A.7.g.1
FSV Not Installed - All Pumps	ATTENTION!
PSH installed (Suction)	A.8.a.1
Each input source is protected by a PSH that will also protect the compressor.	A.8.a.2
PSH Not Intsalled (Suction)	ATTENTION!
PSH installed (Discharge)	A.8.b.1
Compressor is protected by a downstream PSH, located upstream of any cooler, that cannot be isolated from the compressor.	A.8.b.2
PSH Not Intsalled (Discharge)	ATTENTION!
PSL installed (Suction)	A.8.c.1
Each input source is protected by a PSL that will also protect the compressor.	A.8.c.2
PSL Not Intsalled (Suction)	ATTENTION!
PSL installed (Discharge)	A.8.d.1
Compressor is protected by a downstream PSL, located upstream of any cooler, that cannot be isolated from the compressor.	A.8.d.2
PSL Not Intsalled (Discharge)	ATTENTION!
PSV installed (Suction)	A.8.e.1
Each input source is protected by a PSV that will also protect the compressor.	A.8.e.2
PSV Not Installed (Suction)	ATTENTION!
PSV installed (Discharge)	A.8.f.1
Compressor is protected by a downstream PSV, located upstream of any cooler, that cannot be isolated from the compressor.	A.8.f.2
Compressor is kinetic energy type and incapable of generating a pressure greater than the maximum allowable working pressure of the compressor or discharge piping.	A.8.f.3
PSV Not Installed (Discharge)	ATTENTION!
PSV installed (Final Discharge)	A.8.g.1
FSV Not Installed (Final Discharge)	ATTENTION!
TSH installed - Compressor	A.8.h.1
TSH not installed - Compressor	ATTENTION!
PSH installed - Pipelines	A.9.a.1
Delivering pipeline protected by PSH located on upstream component.	A.9.a.2
Each input source is protected by a PSH that also protects a departing or bi-directional pipeline.	A.9.a.3
The pipeline is protected by a PSH located on a parallel component.	A.9.a.4
PSH Not Intsalled - Pipelines	ATTENTION!
PSL installed - Pipelines	A.9.b.1
Delivering pipeline protected by PSL located on upstream component.	A.9.b.2
Each input source is protected by a PSL that also protects a departing or bi-directional pipeline.	A.9.b.3
The pipeline is protected by a PSL located on a parallel component.	A.9.b.4

PSL Not Intsalled - Pipelines	ATTENTION!
PSV installed - Pipelines	A.9.c.1
Pipeline has a maximum allowable operating pressure greater than the maximum pressure of any input source.	A.9.c.2
Each input source having a pressure grater than the maximum allowable operating pressure of the pipeline is protected by a PSV set no higher than the maximum allowable operating pressure of the pipeline.	A.9.c.3
The pipeline does not receive input from the platform process.	A.9.c.4
Input source is a well having a pressure greater than the maximum allowable operating pressure of the pipeline and is equipped with two SDVs (one of which may be the SSV) controlled by independent PSH independent PSHs connected to separate relays	A.9.c.5
PSV Not Installed - Pipelines	ATTENTION!
FSV installed - Pipelines	A.9.d.1
Departing pipeline is equipped with an SDV controlled by a PSL.	A.9.d.2
Each input source is protected by an FSV located so that no significant length of pipeline is unprotected from backflow.	A.9.d.3
Pipeline is used for bi-directional flow.	A.9.d.4
FSV Not Installed - Pipelines	ATTENTION!
PSH installed - Heat Exchangers	A.10.a.1
Input source to heat exchanger section cannot develop pressure greater than the maximum allowable working pressure of the heat exchanger section.	A.10.a.2
Each input source is protected by a PSH that also protects the heat exchanger section.	A.10.a.3
A PSH is installed on a downstream component and cannot be isolated from the heat exchanger section by block or regulating valves.	A.10.a.4
PSH Not Intsalled - Heat Exchangers	ATTENTION!
PSL installed - Heat Exchangers	A.10.b.1
Minimum operating pressure is atmospheric pressure when in service.	A.10.b.2
PSL installed on another component will provide necessary protection and the PSL cannot be isolated from the heat exchanger section when the heat exchanger is in service.	A.10.b.3
PSL Not Intsalled - Heat Exchangers	ATTENTION!
PSV installed - Heat Exchangers	A.10.c.1
Each input source is protected by a PSV set no higher than the maximum allowable working pressure of the heat exchanger section and a PSV is installed on the heat exchanger section for fire exposure and thermal relief.	A.10.c.2
Each input source is protected by a PSV set no higher than the maximum allowable working pressure of the heat exchanger section and that cannot be isolated from the heat exchanger section.	A.10.c.3
PSVs on downstream equipment can satisfy relief requirement of the heat exchanger section and cannot be isolated from the heat exchanger section.	A.10.c.4
Sources to the exchanger section can't develop pressure greater than the mawp of the exchanger section and the heat exchanger section cannot be over pressured due to temperature or pressure in the other section.	A.10.c.5
Each input source is protected by a PSV set no higher than the maximum allowable working pressure on the heat exchanger section and the heat exchanger section cannot be over pressured due to temperature or pressure in the other section.	A.10.c.6
PSV Not installed - Heat Exchangers	ATTENTION!
Location is remote, unoccupied well site with consequence severity of 1 or 2 - SSDS	A.11.a.1
Location is a simple process or test facility with consequence severity of 1 or 2 - SSDS	A.11.a.2
Onsite controller such as a PLC or PC to shutdown compressor or treating process during upset conditions. Shut down notification alarm sent through SCADA system	A.11.a.3
Complex facility with severity consequence of 3,4,or 5. Safety shutdown system is installed with appropriate consideration given to safety system components (isolation valves, fire detection, gas detections, critical alarm shutdowns)	A.11.a.4
Facility is a regulated or complex facility and ESD system is required	A.11.a.5
Facility is a regulated or complex facility and ESD system is required and must be segregated from the process controls	A.11.a.6
Location is remote, unoccupied well site with consequence severity of 1 or 2 - MSDS	A.11.b.1
Location is a simple process or test facility with consequence severity of 1 or 2 - MSDS	A.11.b.2
Single unit compressor station or treating process with shutdown on unit control panel	A.11.b.3
Multiple unit installation or treating facility. Combined horsepower >1000 hp. Consequence severity rating is 3 >. Local PLC type controller to shut down each compressor or process during upset conditions. Shut alarm sent via SCADA.	A.11.b.4
Multiple compressor installation or complex facility with severity consequence of 4 or 5. Safety system is installed with manual shutdown stations at exit points.	A.11.b.5
ESD system with manual shutdown stations at exit points and at common control stations.	A.11.b.6
Location is a remote, normally unoccupied well site with consequence severity of 1 or 2 - Isolation	A.11.c.1
Manual isolation valves installed. Location is a simple process or test facility with consequence severity of 1 or 2.	A.11.c.2
Non-complex facility with manual isolation valves installed, which can still be accessed in the event of an incident at the facility.	A.11.c.3
Compressor station with less than 1000 hp and manual isolation valves installed at inlet and discharge of facility, which can still be accessed in the event of an incident at the facility	A.11.c.4
Actuated isolation valves installed at inlet and discharge of facility which can be initiated by personnel or safety system/ESD system components.	A.11.c.5
Location is remote, unoccupied well site with consequence severity of 1 or 2 with no buildings or enclosures	A.11.d.1
Location is a simple process or test facility with consequence severity of 1 or 2 with no buildings or enclosures	A.11.d.2
Location has no buildings or enclosures and the consequence severity of an event is not a 4 or 5	A.11.d.3
Temperature detection is installed (such as fusible plug)	A.11.d.4
Flame detection is installed	A.11.d.5
Smoke detection is installed	A.11.d.6
Combination of 2 or more temperature/flame/some detection installed	A.11.d.7
Location is remote, unoccupied well site with consequence severity of 1 or 2 with no buildings or enclosures - CGDS	A.11.e.1
Location is a simple process or test facility with consequence severity of 1 or 2 with no buildings or enclosures - CGDS	A.11.e.2
Equipment is installed in a well ventilated location, not in a building or enclosure	A.11.e.3
Equipment is installed in a building or enclosure, but processes or handles non-flammable fluids and any prime movers are not natural gas-fired	A.11.e.4
Gas detection installed where equipment may be installed in inadequately ventilated buildings or enclosures. (Gas detectors should be located in area where combustible gas can accumulate)	A.11.e.5
Location is remote, unoccupied well site with consequence severity of 1 or 2 with no buildings or enclosures - TGDS	A.11.f.1
Location is a simple process or test facility with consequence severity of 1 or 2 with no buildings or enclosures - TGDS	A.11.f.2
Equipment is installed in a well ventilated location, i.e. not in a building or enclosure. Personnel wear gas detectors and off-site impact is not expected. 100 ppm ROE does not encompass public area (house, road)	A.11.f.3
Gas detection installed where equipment may be installed in inadequately ventilated buildings or enclosures. (Gas detectors should be located in areas where toxic gas can accumulate)	A.11.f.4
Gas detection installed at perimeter of location, due to possible public or off-site impact	A.11.f.5
Location is remote, unoccupied well site with consequence severity of 1 or 2	A.11.g.1
Location is a simple process or test facility with consequence severity of 1 or 2	A.11.g.2
Controls are designed to fail in a safe position if power, instrument air/gas supply is interrupted.	A.11.g.3
All equipment installed outdoors. Any enclosures are small and rated for the appropriate area classification	A.12.1
Natural draft has been determined to be adequate to maintain ventilation	A.12.2
Gas detection is installed. Enclosure/building is artificially maintained to be Cl. 1 Div 2. Ventilation equipment has alarms in event of failure. Equipment is shut down upon gas detection.	A.12.3
Ventilation is artificially maintained. All electrical equipment is Cl 1, Div 1. and there is not fired or internal combustion equipment.	A.12.4
Ventilation is artificially maintained and ventilation equipment has malfunction alarms. All electrical equipment is Cl. 1, Div. 1. Fired or internal combustion equipment allowed.	A.12.5
Containment installed equal to 1.1 x largest tank capacity plus 100 year rainfall	A.13.1
Facility is not a SPCC facility and tank capacity is > (5 times avg daily production x number of days between operator visits). LSH alarms operator through SCADA system	A.13.2
Facility is not a SPCC facility and tank capacity is > (5 times avg daily production x number of days between operator visits). LSH shuts down operation preventing ongoing overflow situation.	A.13.3
Containment alarm with shutdown (LSH) installed if daily tank throughput is > tank capacity.	A.13.4

Safety Analysis Function Evaluation Chart (SAFE)

Facility Name:	**Nio Bulk Facility Standard (Design)**
Location:	**Watkins, CO**
Date Assessed:	**13-Jun-19**
Assessment Team:	**Daniel Paul; Shaun Gravois; John Kobert**
Facility Description	**Nio Bulk Facility**

PSH Pressure Sensor High
PSL Pressure Sensor Low
PSV Pressure Safety Valve
FSV Flow Safety Valve (Check Valve)
LSH Level Sensor High
LSL Level Sensor Low
TSH Temp Sensor High
TSL Temp. Sensor Low
BSL Flame Failure Indicator
MI Motor Interlock
FA Flame Arrestor
FD Fire Detection
SSDS Safety Shut Down System
MDSD Manual Shut Down System
CGDS Combustible Gas Detection System
TGDS Toxic Gas Detection System
US Utility Systems
SDV Shut Down Valve

Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed / Shutdown or Control Device I.D.
		Buildings_Enclosures	Enclosures	A.12.1		All equipment installed outdoors. Any enclosures are small and rated for the appropriate area classification				
3"-HC-S6050-00X-D1AL		Flow_line_Segment	PSH	A.1.a.1		PSH installed and block valves between source and PSH are locked or car sealed open - Flow Line Segment	PIT XXXX			
			PSL	A.1.b.1		PSL Installed on Flow line segment	PIT XXXX			
			PSV	A.1.c.2		Flow line segment has a maximum allowable working pressure greater than the maximum shut in pressure.				
			FSV	A.1.d.3		Can document in comments that backflow is not possible or cannot create a consequence of concern - Flow Line		Backflow is not a consequrence of concern at the well head		
Artificial Lift		Flow_line_Segment	PSH	A.1.a.1		PSH installed and block valves between source and PSH are locked or car sealed open - Flow Line Segment				
2"-HG-S6050-19X-D1AL-1.5"H			PSL	A.1.b.1		PSL Installed on Flow line segment				
			PSV	A.1.c.2		Flow line segment has a maximum allowable working pressure greater than the maximum shut in pressure.				
			FSV	A.1.d.1		FSV installed on Flow line segment				
Bulk 3-Phase Separator		Pressure_Vessels	PSH	A.4.a.1		PSH installed on Vessel	PIT XXXX			
SE-200			PSL	A.4.b.1		PSL Installed on Vessel	PIT XXXX			
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.1		LSL installed to protect each liquid outlet on Vessel	LSLL XXXX			
			FSV	A.4.f.1		FSV installed on each outlet of Vessel		Gas outlet will have insignificant hydrocarbon backflow; liquid outlet is equipped with an FSV to prevent backflow		
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.		Temperature indicator present to monitor temperature		
Test 3-Phase Separator		Pressure_Vessels	PSH	A.4.a.1		PSH installed on Vessel	PIT XXXX			
SE-300			PSL	A.4.b.1		PSL Installed on Vessel	PIT XXXX			
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.1		LSL installed to protect each liquid outlet on Vessel	LSLL XXXX			
			FSV	A.4.f.1		FSV installed on each outlet of Vessel		Gas outlet will have insignificant hydrocarbon backflow; liquid outlet is equipped with an FSV to prevent backflow		
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.		Temperature indicator present to monitor temperature		
Bulk Heater Treater		Pressure_Vessels	PSH	A.4.a.1		PSH installed on Vessel	PIT XXXX			
HT-400			PSL	A.4.b.1		PSL Installed on Vessel	PIT XXXX			
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.1		LSL installed to protect each liquid outlet on Vessel	LSLL XXXX			
			FSV	A.4.f.1		FSV installed on each outlet of Vessel				

Safety Analysis Function Evaluation Chart (SAFE)

Facility Name:	**Nio Bulk Facility Standard (Design)**
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Date Assessed:	**13-Jun-19**
Assessment Team:	**Daniel Paul; Shaun Gravois; John Kobert**
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PSL Pressure Sensor Low
PSV Pressure Safety Valve
FSV Flow Safety Valve (Check Valve)
LSH Level Sensor High
LSL Level Sensor Low
TSH Temp Sensor High
TSL Temp. Sensor Low

BSL Flame Failure Indicator
MI Motor Interlock
FA Flame Arrestor
FD Fire Detection
SSDS Safety Shut Down System
MDSD Manual Shut Down System
CGDS Combustible Gas Detection System
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US Utility Systems
SDV Shut Down Valve

Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed / Shutdown or Control Device I.D.
			TSH	A.4.g.1		TSH installed on Vessel	TSHH XXXX			
Bulk HT Burner		Fired or Exhaust Heated Equipment	TSH_Fluid	A.6.a.1		TSH installed which completely isolates fuel source from both burner and pilot and is separate from the temperature controller.	TSH XXXX			
HT-400			TSH_Stack	A.6.b.2		Cost of unit and impact to production within acceptable consequence levels				
			PSL_Air	A.6.d.2		Component is equipped with a natural draft burner - Air - PSL				
			PSH	A.6.e.3		Fuel line contains two (2) pressure controlling devices upstream of fuel flow control valve (temperature control valve)	PCV XXXX (fuel gas) PCV XXXX (burner)			
			PSL_Fuel	A.6.f.2		Component is equipped with a natural draft burner - Fuel - PSL				
			BSL	A.6.g.1		BSL installed - Fired and Exhaust Heated Components	BSL XXXX			
			FSL	A.6.h.2		Component is not a closed heat transfer type in which a combustible medium flows through tubes located in the firing or exhaust heated chamber.				
			MI	A.6.i.2		Component is equipped with a natural draft burner - Fired and Exhaust Heated Components - MI				
			FA_Intake	A.6.j.1		Flame arrestor installed - Fired and Exhaust Heated Components	FA XXXX			
			SA	A.6.k.2		Bird/Bat Cone installed				
			PSV	A.6.l.2		Component is not a tube type heater.				
			FSV	A.6.l.2		Component is not a tube type heater.				
Test Heater Treater		Pressure_Vessels	PSH	A.4.a.1		PSH installed on Vessel	PIT XXXX			
HT-410			PSL	A.4.b.1		PSL Installed on Vessel	PIT XXXX			
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.1		LSL installed to protect each liquid outlet on Vessel	LSLL XXXX			
			FSV	A.4.f.1		FSV installed on each outlet of Vessel				
			TSH	A.4.g.1		TSH installed on Vessel	TSHH XXXX			
Test HT Burner		Fired_or_Exhaust_Heated_Equipment	TSH_Fluid	A.6.a.1		TSH installed which completely isolates fuel source from both burner and pilot and is separate from the temperature controller.	TSH XXXX			
HT-410			TSH_Stack	A.6.b.2		Cost of unit and impact to production within acceptable consequence levels				
			PSL_Air	A.6.d.2		Component is equipped with a natural draft burner - Air - PSL				
			PSH	A.6.e.3		Fuel line contains two (2) pressure controlling devices upstream of fuel flow control valve (temperature control valve)	PCV XXXX (fuel gas) PCV XXXX (burner)			
			PSL_Fuel	A.6.f.2		Component is equipped with a natural draft burner - Fuel - PSL				
			BSL	A.6.g.1		BSL installed - Fired and Exhaust Heated Components	BSL XXXX			
			FSL	A.6.h.2		Component is not a closed heat transfer type in which a combustible medium flows through tubes located in the firing or exhaust heated chamber.				
			MI	A.6.i.2		Component is equipped with a natural draft burner - Fired and Exhaust Heated Components - MI				
			FA_Intake	A.6.j.1		Flame arrestor installed - Fired and Exhaust Heated Components	FA XXXX			
			SA	A.6.k.2		Bird/Bat Cone installed				
			PSV	A.6.l.2		Component is not a tube type heater.				
			FSV	A.6.l.2		Component is not a tube type heater.				
Tank Vapor / VRT VRU		Compressors	PSH_Suction	A.8.a.1		PSH installed (Suction)	PIT XXXX (Vendor Package)			
VRU-710			PSH_Discharge	A.8.b.1		PSH installed (Discharge)	PIT XXXX (Vendor Package)			
VRU-711			PSL_Suction	A.8.c.2		Each input source is protected by a PSL that will also protect the compressor.		VRU inlet is from atmospheric vessel, desighed to operate at low suction pressures		

Nodes

Nodes	Design Intent	Failures	Drawings	Session	Comment
1. Well Head, HP / LP Separator (Heater Treater) Green - Os Sales Gas Orange - Xs	Well Head - 500 psig may be > 1000 psig Design Pressure: 5000 psig including choke Pipeline - D1 Class Piping Design Pressure: 1440 psig A Class Piping: 285 psig V-2001/2/3/4 HP Separator DP/T = 260 psig / 200 F PSV-2001 @ 280 psig vents to atms V-2101/2/3/4/5 LP Separator DP/T = 125 psig / 350 F PSV-2102 @ 125 psig vents to atms	1. ESDV-100x Choke 100x PCV-2002/3/4A PCV-2011A	NIO-S6020-00-011-1001 NIO-S6020-00-011-2001 NIO-S6020-00-011-2002 NIO-S6020-00-011-2003 NIO-S6020-00-011-2004 NIO-S6020-00-011-3001 NIO-S6020-00-011-7000 NIO-S6020-00-011-7101		
2. Flash Gas / VRU Purple - - - - (dashed line)	V-3101/3102 Suction Scrubber DP/T = 100 psig / ??? F PSV-3100 @ 100 psig vents to atms EA-3122 DP = 250 psig	1. PCV-2001/2/3/4B PCV-2101/2/3/4C PCV-2901D PCV-3110	NIO-S6020-00-011-2001 NIO-S6020-00-011-2002 NIO-S6020-00-011-2003 NIO-S6020-00-011-2004 NIO-S6020-00-011-2901 NIO-S6020-00-011-3001 NIO-S6020-00-011-3100 NIO-S6020-00-011-3101 NIO-S6020-00-011-3102 NIO-S6020-00-011-7000		
3. Flash Gas / Vent Orange - ^^^^^	V-9301/02 DP/T = 125 psig / ?? T PSV-9301/02 @ 125 psig B-9401 Combuster DP/T = ??? Refractory Lined CS Vessel	1. FA-9401/02 FA-9410 PCV-3100 PCV-4101 SDV-9400A/B	NIO-S6020-00-011-3100 NIO-S6020-00-011-4001 NIO-S6020-00-011-4002 NIO-S6020-00-011-4101 NIO-S6020-00-011-9301 NIO-S6020-00-011-9401		
4. Oil to VRT Pink Diamonds	V-2901 Recycle Heater DP/T = 125 psig / 350 F PSV-2901 @ 125 psig vents to atms V-3001 DP/T = 125 psig / 200 F PSV-3001 @ 125 psig vents to atms	1. LCV-2101/2/3/4A LCV-2901A	NIO-S6020-00-011-2001 NIO-S6020-00-011-2002 NIO-S6020-00-011-2003 NIO-S6020-00-011-2004		

Nodes	Design Intent	Failures	Drawings	Session	Comment
	P-4201 Recycle Pump 2 hp Delta P = 100 psig		NIO-S6020-00-011-2901 NIO-S6020-00-011-3001 NIO-S6020-00-011-4000 NIO-S6020-00-011-4001 NIO-S6020-00-011-4002 NIO-S6020-00-011-4101		
5. Produced Water Blue Squares	P-3111/12 Condensate Removal Pump 1 HP - Disch Press ~ 100 psig P-9001 KO Drum Pump 2 HP P-9301/02 10 GPM Dead Head Pressure = ???? TK-4101/2 Atmos Storage Tanks PVRV-4101/2 @ 16 oz vent to atms	1. LCV-2901/2/3/4B LCV-2901B	NIO-S6020-00-011-2001 NIO-S6020-00-011-2002 NIO-S6020-00-011-2003 NIO-S6020-00-011-2004 NIO-S6020-00-011-2901 NIO-S6020-00-011-3101 NIO-S6020-00-011-3102 NIO-S6020-00-011-4100 NIO-S6020-00-011-4101 NIO-S6020-00-011-9001 NIO-S6020-00-011-9301		
6. Fuel Gas Green / / / / Flare Yellow Line	V-2201/2/3/4 Fuel Gas Scrubber DP/T = 125 psig / 200 F PSV-2201 @ 125 psig vents to atms V-2902 DP/T = 125 psig / 200 F PSV-2902 @ 125 psig vent to atms V-9001 DP/T = 125 psig / ?? F PSV-9001 @ 125 vents to atms	1. FA-9201 FCV-2101/2/3/4A FCV-2901A/B PCV-2201 PCV-2101/2/3/4A PCV-2101/2/3/4 PCV-2901A/B PCV-7100 PCV-9400 SDV-2101 SDV-2901 SDV-9420	NIO-S6020-00-011-2001 NIO-S6020-00-011-2002 NIO-S6020-00-011-2003 NIO-S6020-00-011-2004 NIO-S6020-00-011-2101 NIO-S6020-00-011-2102 NIO-S6020-00-011-2103 NIO-S6020-00-011-2104 NIO-S6020-00-011-2901 NIO-S6020-00-011-7000 NIO-S6020-00-011-9001 NIO-S6020-00-011-9201 NIO-S6020-00-011-9401		

Niobrara Quad Well Design Risk Assessment
Cyndee R. Clouse, Certified Facilitator / Michael H. Mead, Engineer of Record
January 29, 2018

Nodes	Design Intent	Failures	Drawings	Session	Comment
			NIO-S6020-00-011-9800		

Safety Analysis Function Evaluation Chart (SAFE)

Facility Name:	**Nio Bulk Facility Standard (Design)**
Location:	**Watkins, CO**
Date Assessed:	**13-Jun-19**
Assessment Team:	**Daniel Paul; Shaun Gravois; John Kobert**
Facility Description	**Nio Bulk Facility**

PSH Pressure Sensor High
PSL Pressure Sensor Low
PSV Pressure Safety Valve
FSV Flow Safety Valve (Check Valve)
LSH Level Sensor High
LSL Level Sensor Low
TSH Temp Sensor High
TSL Temp. Sensor Low

BSL Flame Failure Indicator
MI Motor Interlock
FA Flame Arrestor
FD Fire Detection
SSDS Safety Shut Down System
MDSD Manual Shut Down System
CGDS Combustible Gas Detection System
TGDS Toxic Gas Detection System

US Utility Systems
SDV Shut Down Valve

Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed / Shutdown or Control Device I.D.
			PSL_Discharge	A.8.d.1		PSL installed (Discharge)	PIT XXXX (Vendor Package)			
			PSV_Suction	A.8.e.2		Each input source is protected by a PSV that will also protect the compressor.				
			PSV_Discharge	A.8.f.1		PSV installed (Discharge)	PSV XXX (Vendor Package)			
			FSV_Final_Discharge	A.8.g.1		FSV installed (Final Discharge)	PSV on VRT and Tanks			
			TSH	A.8.h.1		TSH installed - Compressor	TSH XXXX (Vendor Package)			
HT VRU		Compressors	PSH_Suction	A.8.a.1		PSH installed (Suction)	PIT XXXX (Vendor Package)			
VRU 720			PSH_Discharge	A.8.b.1		PSH installed (Discharge)	PIT XXXX (Vendor Package)			
VRU 721			PSL_Suction	A.8.c.2		Each input source is protected by a PSL that will also protect the compressor.		PSL on HT; VRU inlet is atmospheric vessel, desighed to operate at low suction pressures		
			PSL_Discharge	A.8.d.1		PSL installed (Discharge)	PIT XXXX (Vendor Package)			
			PSV_Suction	A.8.e.2		Each input source is protected by a PSV that will also protect the compressor.	PSV on Heater Treater			
			PSV_Discharge	A.8.f.1		PSV installed (Discharge)	PSV XXX (Vendor Package)			
			FSV_Final_Discharge	A.8.g.1		FSV installed (Final Discharge)				
			TSH	A.8.h.1		TSH installed - Compressor	TSH XXXX (Vendor Package)			
Gas Lift Compressor		Compressors	PSH_Suction	A.8.a.1		PSH installed (Suction)	PIT XXXX (Vendor Package)			
PK-900			PSH_Discharge	A.8.b.1		PSH installed (Discharge)	PIT XXXX (Vendor Package)			
			PSL_Suction	A.8.c.1		PSL installed (Suction)	PIT XXXX (Vendor Package)			
			PSL_Discharge	A.8.d.1		PSL installed (Discharge)	PIT XXXX (Vendor Package)			
			PSV_Suction	A.8.e.2		Each input source is protected by a PSV that will also protect the compressor.	PSV on Separators, and VRU Discharge			
			PSV_Discharge	A.8.f.1		PSV installed (Discharge)	PSV XXX (Vendor Package)			
			FSV_Final_Discharge	A.8.g.1		FSV installed (Final Discharge)				
			TSH	A.8.h.1		TSH installed - Compressor	TSH XXXX (Vendor Package)			
Vapor Recovery Tower		Pressure_Vessels	PSH	A.4.a.3		Each input source is protected by a PSH that protects the vessel.	PSH XXXX (on HT inlets)			
V-700			PSL	A.4.b.2		Minimum operating pressure is atmospheric pressure when in service.				
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.2		Liquid level is not automatically maintained in the vessel and the vessel does not have an immersed heating element subject to excess temperature.				
			FSV	A.4.f.4		Can document in comments that backflow is not possible or cannot create a consequence of concern - Pressure Vessel		Downstream equipment is atmospheric tanks		
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.				
Oil Stroage Tanks		Atmospheric_Vessels	Vent	A.5.a.1		Vent installed - Atmospheric Vessel	LP Vent Line			
T-2100/T-2200/T-2300/T-2400/T-2500			PSV	A.5.b.2		Vessel has second vent capable of handling maximum gas volume	Thief Hatch			
			LSH	A.5.c.1		LSH installed - Atmospheric Vessel	LSH XXXX / LSH XXXX / LSH XXXX LSH XXXX / LSH XXXX			
			LSL	A.5.d.4		Component is final vessel in a containment system designed to collect and direct hydrocarbon liquids to a safe location.				
			TSH	A.5.e.1		High temperature sensors are applicable only to vessels having a heat source.				

Safety Analysis Function Evaluation Chart (SAFE)

Facility Name:	**Nio Bulk Facility Standard (Design)**
Location:	**Watkins, CO**
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Assessment Team:	**Daniel Paul; Shaun Gravois; John Kobert**
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Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed / Shutdown or Control Device I.D.
Water Storage Tanks		Atmospheric Vessels	Vent	A.5.a.1		Vent installed - Atmospheric Vessel	LP Vent Line			
T-2000/T-2010			PSV	A.5.b.2		Vessel has second vent capable of handling maximum gas volume	Thief Hatch			
			LSH	A.5.c.1		LSH installed - Atmospheric Vessel	LSH XXXX / LSH XXXX			
			LSL	A.5.d.4		Component is final vessel in a containment system designed to collect and direct hydrocarbon liquids to a safe location.				
			TSH	A.5.e.1		High temperature sensors are applicable only to vessels having a heat source.				
Tank Containment		Tank_Containment_Systems_and_Sumps	Containment	A.13.1		Containment installed equal to 1.1 x largest tank capacity plus 100 year rainfall				
Recycle Pump		Pumps	PSH_Pipeline_Pumps		N/A					
PD-430			PSH_Other_Pumps	A.7.b.3		Pump is manually operated and continuously attended - PSH				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.2		Pump is manually operated and continuously attended - PSL				
			PSV_Pipeline_Pumps		N/A					
			PSV_Other_Pumps	A.7.f.2		Maximum pump discharge pressure is less than the maximum allowable working pressure of the discharge piping.				
			FSV	A.7.g.1		Check valve installed - All Pumps				
LACT Pump		Pumps	PSH_Pipeline_Pumps		N/A					
LACT-1000 / P-1502			PSH_Other_Pumps	A.7.b.2		Maximum pump discharge pressure does not exceed 70 percent of the Maximum allowable working pressure of the discharge piping.				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.2		Pump is manually operated and continuously attended - PSL	PIT XXX (Vendor Drawings)			
			PSV_Pipeline_Pumps		N/A					
			PSV_Other_Pumps	A.7.f.3		Pump has internal pressure relief capacity.	PSV XXX (Vendor Drawings)			
			FSV	A.7.g.1		Check valve installed - All Pumps				

Safety Analysis Function Evaluation Chart (SAFE)

Facility Name:	**Nio Bulk Facility Standard (Design)**
Location:	**Watkins, CO**
Date Assessed:	**13-Jun-19**
Assessment Team:	**Daniel Paul; Shaun Gravois; John Kobert**
Facility Description	**Nio Bulk Facility**

PSH Pressure Sensor High
PSL Pressure Sensor Low
PSV Pressure Safety Valve
FSV Flow Safety Valve (Check Valve)
LSH Level Sensor High
LSL Level Sensor Low
TSH Temp Sensor High
TSL Temp. Sensor Low
BSL Flame Failure Indicator
MI Motor Interlock
FA Flame Arrestor
FD Fire Detection
SSDS Safety Shut Down System
MDSD Manual Shut Down System
CGDS Combustible Gas Detection System
TGDS Toxic Gas Detection System
US Utility Systems
SDV Shut Down Valve

Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed / Shutdown or Control Device I.D.
LACT Sample Receiver		Pressure Vessels	PSH	A.4.a.6		Vessel operates at atmospheric pressure and has an adequate vent system.				
LACT-1000 / V-1501			PSL	A.4.b.5		Operates <250 psi and the line is monitored weekly.				
			PSV	A.4.c.1		PSV installed on Vessel				
			LSH	A.4.d.5		Vessel is a small trap from which liquids are manually drained.				
			LSL	A.4.e.2		Liquid level is not automatically maintained in the vessel and the vessel does not have an immersed heating element subject to excess temperature.				
			FSV	A.4.f.1		FSV installed on each outlet of Vessel				
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.				
LACT Sample Circulation Pump		Pumps	PSH_Pipeline_Pumps		N/A					
LACT-1000 / P-1503			PSH_Other_Pumps	A.7.b.2		Maximum pump discharge pressure does not exceed 70 percent of the Maximum allowable working pressure of the discharge piping.				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.3		Adequate containment is provided.				
			PSV_Pipeline_Pumps		N/A					
			PSV_Other_Pumps	A.7.f.1		PSV installed - Other Pumps				
			FSV	A.7.g.1		Check valve installed - All Pumps				
LACT Sump Pump		Pumps	PSH_Pipeline_Pumps		N/A					
P-1504			PSH_Other_Pumps	A.7.b.5		Pump discharges to an atmospheric vessel - PSH				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.3		Adequate containment is provided.				
			PSV_Pipeline_Pumps		N/A					
			PSV_Other_Pumps			PSV installed - Other Pumps				
			FSV			Check valve installed - All Pumps				
Flash Gas Combustor KO Drum		Pressure Vessels	PSH	A.4.a.5		Vessels is final scrubber in a flare, relief, or vent system and is designed to withstand maximum built up back pressure - Header				
PV-740			PSL	A.4.b.5		Operates <250 psi and the line is monitored weekly.				
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.3		Downstream equipment safely handle gas rates. Vessel doesn't have an immersed heating element. Economic consequences of gas blowby are acceptable.No environmental concerns from venting gas.		no consequence (Low level is desired)		
			FSV	A.4.f.4		Can document in comments that backflow is not possible or cannot create a consequence of concern - Pressure Vessel	Pump prevents liquid backflow; gas will have insignificant backflow			
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.				
Flash Gas Combustor KO Drum Pump		Pumps	PSH_Pipeline_Pumps		N/A					
PD-740			PSH_Other_Pumps	A.7.b.5		Pump discharges to an atmospheric vessel - PSH				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.3		Adequate containment is provided.				
			PSV_Pipeline_Pumps		N/A					

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			PSV_Other_Pumps	ATTENTION!		PSV Not Installed - Other Pumps		NEED TO VALIDATE DESIGN		
			FSV	A.7.g.1		Check valve installed - All Pumps				
LP Gas Combustor KO Drum		Pressure_Vessels	PSH	A.4.a.5		Vessels is final scrubber in a flare, relief, or vent system and is designed to withstand maximum built up back pressure - Header				
PV-750			PSL	A.4.b.5		Operates <250 psi and the line is monitored weekly.				
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.3		Downstream equipment safely handle gas rates. Vessel doesn't have an immersed heating element. Economic consequences of gas blowby are acceptable.No environmental concerns from venting gas.		no consequence (Low level is desired)		
			FSV	A.4.f.4		Can document in comments that backflow is not possible or cannot create a consequence of concern - Pressure Vessel	Pump prevents liquid backflow; gas will have insignificant backflow			
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.				
LP Gas Combustor KO Drum Pump		Pumps	PSH_Pipeline_Pumps		N/A					
PD-750			PSH_Other_Pumps	A.7.b.5		Pump discharges to an atmospheric vessel - PSH				
			PSL_Pipeline_Pumps		N/A					
			PSL_Other_Pumps	A.7.d.3		Adequate containment is provided.				
			PSV_Pipeline_Pumps		N/A					
			PSV_Other_Pumps	ATTENTION!		PSV Not Installed - Other Pumps		NEED TO VALIDATE DESIGN		
			FSV	A.7.g.1		Check valve installed - All Pumps				
Combustor		Fired_or_Exhaust_Heated_Equipment	TSH_Fluid				N/A			
FL-760			TSH_Stack	A.6.b.1		TSH installed - Fired and Exhaust Heated Components				
			PSL_Air	A.6.d.2		Component is equipped with a natural draft burner - Air - PSL				
			PSH	A.6.e.3		Fuel line contains two (2) pressure controlling devices upstream of fuel flow control valve (temperature control valve)	PCV XXXX (fuel gas) PCV XXXX (burner)			
			PSL_Fuel	A.6.f.2		Component is equipped with a natural draft burner - Fuel - PSL				
			BSL	A.6.g.1		BSL installed - Fired and Exhaust Heated Components	BSLL XXXX			
			FSL	A.6.h.2		Component is not a closed heat transfer type in which a combustible medium flows through tubes located in the firing or exhaust heated chamber.				
			MI	A.6.i.2		Component is equipped with a natural draft burner - Fired and Exhaust Heated Components - MI				
			FA_Intake	A.6.j.1		Flame arrestor installed - Fired and Exhaust Heated Components	FA XXXX			
			SA	A.6.k.2		Bird/Bat Cone installed				
			PSV	A.6.l.2		Component is not a tube type heater.				
			FSV	A.6.l.2		Component is not a tube type heater.				
Fuel Gas Scrubber		Pressure_Vessels	PSH	A.4.a.1		PSH installed on Vessel	PIT XXXX			
PV-4000			PSL	A.4.b.5		Operates <250 psi and the line is monitored weekly.				
			PSV	A.4.c.1		PSV installed on Vessel	PSV XXXX			
			LSH	A.4.d.1		LSH installed on Vessel	LSHH XXXX			
			LSL	A.4.e.1		LSL installed to protect each liquid outlet on Vessel	LSL XXXX	may depend on actual standard design is selected		
			FSV	A.4.f.4		Can document in comments that backflow is not possible or cannot create a consequence of concern - Pressure Vessel	Check valve on liquid outlet, flow meter and regulators on gas outlet will prevent backflow			
			TSH							

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Component Identification No.	Service	Equipment type	Device Type	Alternate Protection: SAC Ref. Number	Alternate Protection: Alternate Device If Applicable	SAC Text	Unique Device TAG / ID	Comments	Recommendations	Function Performed	Shutdown or Control Device I.D.
Chemical Pump		Pumps	PSH_Pipeline_Pumps		N/A						
PD-900			PSH_Other_Pumps	A.7.b.4		Small, low volume pumps, e.g. chemical injection pumps - PSH					
PD-901			PSL_Pipeline_Pumps		N/A						
			PSL_Other_Pumps	A.7.d.4		Small, low volume pumps, e.g. chemical injection pumps - PSL					
			PSV_Pipeline_Pumps		N/A						
			PSV_Other_Pumps	A.7.f.1		PSV installed - Other Pumps	PSV XXXX				
			FSV	A.7.g.1		Check valve installed - All Pumps					
Chemical Storage Tank		Atmospheric_Vessels	Vent	A.5.a.1		Vent installed - Atmospheric Vessel					
T-900			PSV	A.5.b.4		Vessel has no pressure sources (except blanket gas and/or manual drains) and is equipped with an adequately sized vent.					
			LSH	A.5.c.2		Fill operations are continually attended.					
			LSL	A.5.d.2		Adequate containment system is provided.					
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.					
Environmental Tank		Atmospheric_Vessels	Vent	A.5.a.1		Vent installed - Atmospheric Vessel					
T-5000			PSV	A.5.b.4		Vessel has no pressure sources (except blanket gas and/or manual drains) and is equipped with an adequately sized vent.					
			LSH	A.5.c.4		Tank volume is sized to contain the volume produced in 3 times the normal route check rate (i.e. tank volume > 3 times avg daily production x number of days between operator visits)					
			LSL	A.5.d.2		Adequate containment system is provided.					
			TSH	A.4.g.2		Heat source is incapable of causing excess temperature.					
Drain Pump		Pumps	PSH_Pipeline_Pumps		N/A						
PD-5000			PSH_Other_Pumps	A.7.b.5		Pump discharges to an atmospheric vessel - PSH					
			PSL_Pipeline_Pumps		N/A						
			PSL_Other_Pumps	A.7.d.5		Pump discharges to an atmospheric vessel - PSL					
			PSV_Pipeline_Pumps		N/A						
			PSV_Other_Pumps	A.7.f.2		Maximum pump discharge pressure is less than the maximum allowable working pressure of the discharge piping.					
			FSV	A.7.g.1		Check valve installed - All Pumps					