GAS PLANT XYZ
PSV-1100
V-1100, INLET SEPARATOR

_____ P.E. STATE OF COLORADO #42086

Scenario Summary

Equipment Tag:	**V-1100**	**Relief Valve Tag:**	**PSV-1100**
Equipment Description:	Inlet Separator	Relief Valve Type/Size:	Conventional 4" x M x 6"
MAWP/MAWT/MDMT:	720 psig @ 120 / -20 F	Relief Valve Orifice Area:	4.08 in2
Drawing Number:	PID-1100	Relief Valve Set Pressure:	250 psig

Recommendations:

Notes:

Scenario / Credible	Description	Constraint	P1 / P2	Req. Rate / Area	In/Out/Total dP (Rated Capacity)
LCV-3400 Failure Open Basis Case	The After Separator sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event the level control valve were to fail open or bypass is inadvertently opened with subsequent gas blowby. Per field verification, LCV-3400 is a 2" Kimray 2200SMT PO with 1" linear trim. Flow coefficients were obtained from vendor literature. The upstream conditions were based on 1,250 psig and 120 F. This case represents what is currently present in the field. Note the liquid inventory in the After Scrubber is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	LCV-3400 2" Kimray 2200SMT PO, 1" Linear Trim Cv = 21.0, Xt = 0.77	1250 313.5	61,605.3 lb/hr 3.117 in2	2.9 psi 1.2 % Set 22.1 psi 8.8 % Set 22.1 psig 8.8 % Set
V-1100 External Fire HC Liquid Credible	The Inlet Separator may contain hydrocarbon liquids that condense out of the inlet stream. As such, overpressure could occur in the event of an external fire due to vaporization of the liquid. As the simulation predicts only water condensation, the hydrocarbon liquid composition was estimated by dropping the temperature to about 40 F and using the resulting hydrocarbon liquid composition at the relief pressure of 344.9 psig. The liquid level of 80% was based on the location of LSHH-1101 as estimated in the field.	LSHH-1101 Level = 80%		55,551.1 lb/hr 2.003 in2	2.5 psi 1.0 % Set 24.5 psi 9.8 % Set 24.5 psig 9.8 % Set

Scenario / Credible	Description	Constraint	P1 / P2	Req. Rate / Area	In/Out/Total dP (Rated Capacity)
V-4100/4200 Drain Valve Inadvertently Opened	The Contactor scrubber section also has a 1" ball valve that can drain liquid to the Inlet Separator. As described for the failure open of the LCV case, inadvertent opening of the drain valve could result in overpressure due to gas blowby. The required relief rate was evaluated using the same conditions as the control valves and 19.6 equivalent feet of 1" Sch 80 pipe as determined from the 3D model (1 entrance, 6.5' pipe, 1 ball valve, 1 swing check valve, 2 tee through runs). Note the liquid inventory in the contactors is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	V-4100/4200 Drain	1250	34,660.5 lb/hr	2.8 psi 1.1 % Set
Credible		1" Ball Valve	313.5	1.801 in2	21.3 psi 8.5 % Set
		ID = 0.957", Leq = 19.6'			21.3 psig 8.5 % Set
LCV-3300/3301/4100/4200 Bypass Open	In a similar manner as the control valves, inadvertent opening of the 1" globe valve bypass around LCV-3300, 3301 and 4100 could result in overpressure. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . The globe valve Cv was based on a regular port globe valve (Crane) and an Xt = 1.0 was assumed.	F-3300 and V-4100/4200 LCV Bypasses	1250	22,507.3 lb/hr	2.9 psi 1.2 % Set
Credible		1" RP Globe Valve	313.5	1.139 in2	22.1 psi 8.8 % Set
		Cv = 6.8, Xt = 1			22.1 psig 8.8 % Set
Gas Blowby from Compressor Scrubbers	The Inlet Separator receives liquids from the 2nd Stage and 3rd Stage Compressor Suction Scrubbers. The maximum pressures in the 2nd Stage Suction Scrubbers are limited to 200 psig (1st Stage Discharge PSHH set point), while the maximum pressure in the 3rd Stage Suction Scrubbers are limited to 500 psig (2nd Stage Discharge PSHH set point). As such, In the event that a liquid level control valve or manual bypass valve on one of the 3rd Stage Suction Scrubbers fails or is inadvertently opened overpressure of the Inlet Separator could occur due to gas blowby. All of the liquid level dump stations consist of a 1" LCV and a 1" manual bypass ball valve. As the 1" bypass represents the worst case, the required relief rate was conservatively based on the flow through 10' of 1" Sch 160 pipe (scrubbers are physically about 15' apart). The upstream conditions were taken as 500 psig at 120 F with the downstream relief pressure of 313.5 psig. Note the liquid inventory in the Scrubbers is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	3rd Scrubber LCV or Bypass	500	10,342.5 lb/hr	2.8 psi 1.1 % Set
Credible		1" Sch 160 Piping	313.5	0.565 in2	21.6 psi 8.6 % Set
		Leq = 10', ID = 0.815"			21.6 psig 8.6 % Set

Scenario / Credible	Description	Constraint	P1 / P2	Req. Rate / Area	In/Out/Total dP (Rated Capacity)
LCV-3400 Bypass Failure Open	The After Separator sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event the bypass is inadvertently opened with subsequent gas blowby. Per field verification, the relief requirement is limited by RO-3400 with 3/8" ID. The upstream conditions were based on 1,250 psig and 120 F. Note the liquid inventory in the After Scrubber is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	LCV-3400 or Bypass	1250	6,425.9 lb/hr	2.8 psi 1.1 % Set
Credible		RO-3400	313.5	0.334 in2	21.3 psi 8.5 % Set
		ID = 3/8"			21.3 psig 8.5 % Set
V-1100 External Fire Water	The Inlet Separator may contain water that condenses out of the inlet stream. As such, overpressure could occur in the event of an external fire due to vaporization of the water. The fluid properties were based on the properties of pure water at the relief pressure of 344.9 psig (trace dissolved hydrocarbons were conservatively removed). The liquid level of 80% was based on the location of LSHH-1101 as estimated in the field.	LSHH-1101		4,756.1 lb/hr	3.3 psi 1.3 % Set
Credible				0.306 in2	25.6 psi 10.2 % Set
		Level = 80%			25.6 psig 10.2 % Set
LCV-4100/4200 Failure Open	The Contactor scrubber section sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event any of the level control valves were to fail open with subsequent gas blowby. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . Per field verification, LCV-4100 is a 1" Kimray 1400SMT PO with 1/4" linear trim and flow coefficients were obtained from vendor literature. Note the liquid inventory in the 42" ID contactor is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	LCV-4100/4200	1250	4,824.9 lb/hr	2.8 psi 1.1 % Set
Credible		1" Kimray 1400SMT PO, 1/4" Linear Trim	313.5	0.255 in2	21.6 psi 8.6 % Set
		Cv = 2.17, Cf = 0.78			21.6 psig 8.6 % Set

Scenario / Credible	Description	Constraint	P1 / P2	Req. Rate / Area	In/Out/Total dP (Rated Capacity)
LCV-3300/1 Failure Open Credible	The Inlet Filter Coalescer sends liquids from both chambers to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event either of the level control valves were to fail open with subsequent gas blowby. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . Per field verification, LCV-3300 and 3301 are both 1" Kimray 1400SMT PO with 3/8" linear trim and flow coefficients were obtained from vendor literature. Note the liquid inventory in the Coalescer is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.	LCV-3300/3301 1" Kimray 1400SMT PO, 1/4" Linear Trim Cv = 2.17, Cf = 0.78	1250 313.5	4,886.9 lb/hr 0.248 in2	2.9 psi 1.2 % Set 22.1 psi 8.8 % Set 22.1 psig 8.8 % Set
VRU Drain Pump Not Credible	Liquids from the two VRU Compressors are pumped from the suction scrubber to the Inlet separator by a positive displacement pump with a rated flow of 5 gpm. Overfilling from this intermittent source is considered not credible, therefore the pumps do not present a potential source of overpressure.				
BPV-4130/4230 Failure Open Not Credible	Vapors from the TEG Flash Separators are routed to the Inlet Separator via BPV-4130 and BPV-4230. As the maximum pressure in the TEG Flash Separator is limited to 125 psig by the design pressure and associated relief valve, a failure open of this control valve is not a credible scenario.				
Blocked Outlet - Pipeline Inlet Not Credible	The maximum inlet pipeline pressure cannot exceed 215 psig. Therefore, overpressure of the Inlet Separator due to a blocked outlet is not an overpressure concern.				
External Fire Vapor Expansion Not Credible	The Inlet Separator may be free of liquids in which case overpressure could occur due to expansion of the vapor during an external fire. However, based on the maximum suction pressure of 60 psig (compressor 1st stage suction PSHH set point), the temperature would have to exceed the maximum wall temperature of 1,100 F to reach the relief pressure of 344.9 psig. As such, a thermal failure would be expected prior to overpressure and the relief valve does not provide protection against this scenario.				

Scenario / Credible	Description	Constraint	P1 / P2	Req. Rate / Area	In/Out/Total dP (Rated Capacity)
Instrument Air Failure Not Credible	In the event of an instrument air failure, the inlet from pipeline will be shutdown by the fail closed ESD-0100 as well as PCV-1000/1001. In addition, the main plant recycle control valve (PCV-2000) along with other high pressure dump valves that feed back to suction are all fail closed. Finally, the suction header, discharge header and fuel gas header will be depressured by fail open blowdown valves.				
Electric Power Failure Not Credible	An electric power failure does not represent an overpressure concern. The compressors are expected to shutdown and ultimately instrument air will be lost. See Instrument Air Failure.				
PCV-2000 Failure Open Not Credible	PSV-2000 which is present on the suction header and set at 215 psig provides protection for a failure open of PCV-2000 (Plant Recycle), therefore this scenario does not require consideration for this relief valve.				
PCV-1100 or PCV-1101 Failure Open Not Credible	Although the Inlet Separator (V-1100) has relief provided via PSV-1100 at 285 psig, the maximum inlet pipeline pressure cannot exceed 215 psig. Therefore, a failure open of either pipeline inlet pressure control valves does not represent a potential overpressure scenario.				

Vapor Control Valve Failure: LCV-3400

LCV-3400 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The After Separator sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event the level control valve were to fail open or bypass is inadvertently opened with subsequent gas blowby. Per field verification, LCV-3400 is a 2" Kimray 2200SMT PO with 1" linear trim. Flow coefficients were obtained from vendor literature. The upstream conditions were based on 1,250 psig and 120 F. This case represents what is currently present in the field.

Note the liquid inventory in the After Scrubber is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Calculation Results:

Required Rate:	61,605.3	lb/hr	Device Choke Pressure:	167.9	psig
Actual Capacity:	80,613.7	lb/hr	Outlet Temperature:	22.3	F
Required Area:	3.117	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.062	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.249	
Relief Temperature:	56.1	F	Outlet Viscosity:	0.009	cP
Relief MW:	21.56		Inlet Non-Recoverble dP:	2.9	psi
Relief Mass Quality:	0.987		Inlet dP % Set:	1.0	% Set
Relief Density:	1.422	lb/ft3	Built-Up Back Pressure:	22.1	psig
Relief SG:	0.743		Built-Up Back P % Set:	7.8	% Set
Relief Z:	0.899		Total Back Pressure:	22.1	psig
Relief Ideal Cp/Cv:	1.242		Total Back P % Set:	7.8	% Set
Relief Viscosity:	0.010	cP	Reaction Force:	1393	lbf

Vapor Control Valve Failure: LCV-3400

LCV-3400 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Control Valve Tag:	LCV-3400	
Gas Type:	Inlet Gas	
Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Upstream Temperature:	120	F
Dewpoint Vapor:	☐	
Set Pressure:	285	psig
Allowable Overpressure:	10.0%	
Constant Back Pressure:	0	psig
Required Relief Rate Units:	lb/hr	
Sizing Method	IEC	
Cv:	21	
Xt (Cf for Kimray):	0.77	
C1:		
Cg:		
Control Valve ID:	1.939	in
Inlet Pipe ID:	1.939	in
Outlet Pipe ID:	1.939	in
Additional Flow:	0.0	lb/hr
Use Thermo	☑	
Thermo Package:	Advanced_Peng-Robinson	
Relief Device Kd:	0.818	
Nozzle Sizing:	API 520 Vapor	
Outlet Pipe Sizing:	Adiabatic	

Scenario Output Data:

Fk:	0.88	
K1 Inlet Piping Resistance:	0	
K2 Outlet Piping Resistance:	0	
K1 Inlet Piping Bernoulli:	0	
K2 Outlet Piping Bernoulli:	0	
Fp:	1	
dP/P1 Actual:	0.740	
dP/P1 Critical:	0.674	
Y:	0.667	
Upstream Density:	5.673	lb/ft3
Upstream Z:	0.772	
Upstream Ideal Cp/Cv:	1.226	
Control Valve Flow:	61,605.3	lb/hr
Required Mass Rate:	61,605.3	lb/hr
Required Rate Std Vol:	26.0	MMSCFD
Required Air Rate:	931,447.0	scfh air
Relief Mass Flux:	790.5	lb/sec/ft2

Notes:

Vapor Control Valve Failure: LCV-3400

LCV-3400 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma Dry Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7553
ethane	0.1281
propane	0.0624
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
nonane	0.0000
decane	0.0000
methanol	0.0000
water	0.0000
triethylene glycol	0.0000

LCV-3400

KIMRAY INC.®
OKLAHOMA CITY, OK

ITEM NO.	
	2200 SMT
SHELL	WCB SIZE 2
CLASS / W.P.	2000 PSI
SERVICE LIMIT	-20-250F NBR
ACTUATOR	4-20 PSI PO
TRIM MAT'L	303-CR28-D2
TRIM SIZE	1 LIN
SERIAL NO.	2220770366

7547

External Fire Boiling Liquid API STD 521

V-1100 External Fire HC Liquid

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Inlet Separator may contain hydrocarbon liquids that condense out of the inlet stream. As such, overpressure could occur in the event of an external fire due to vaporization of the liquid. As the simulation predicts only water condensation, the hydrocarbon liquid composition was estimated by dropping the temperature to about 40 F and using the resulting hydrocarbon liquid composition at the relief pressure of 344.9 psig. The liquid level of 80% was based on the location of LSHH-1101 as estimated in the field.

Scenario Calculation Results:

Required Rate:	55551.1	lb/hr	Device Choke Pressure:	172.4	psig
Actual Capacity:	113181.6	lb/hr	Outlet Temperature:	319.1	F
Required Area:	2.003	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.080	in2	Outlet Density:	0.107	lb/ft3
Relief Pressure:	344.9	psig	Outlet Ideal Cp/Cv:	1.065	
Relief Temperature:	355.9	F	Outlet Viscosity:	0.010	cP
Relief MW:	59.94		Inlet Non-Recoverble dP:	2.5	psi
Relief Mass Quality:	1.000		Inlet dP % Set:	0.9	% Set
Relief Density:	3.24	lb/ft3	Built-Up Back Pressure:	24.5	psig
Relief SG:	2.067		Built-Up Back P % Set:	8.6	% Set
Relief Z:	0.76		Total Back Pressure:	24.5	psig
Relief Ideal Cp/Cv:	1.06		Total Back P % Set:	8.6	% Set
Relief Viscosity:	0.011	cP			

External Fire Boiling Liquid API STD 521

V-1100 External Fire HC Liquid

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Length:	20	ft
Diameter:	66	in
Orientation:	Horizontal	
Head Type:	2:1 Ellipsoidal	
Level Basis:	LSHH-1101	
Additional Wetted Area:	9.8	ft2
Level:	80%	
Bottom Elevation:	4	ft
Area Exponent:	0.82	
Adequate Drainage	☐	
Insulation Factor:	1	
Start Mass % Vapor:	0.00%	
Finish Mass % Vapor:	5.00%	
Remove Sensible Heat:	☑ Correct for Densities: ☐	
Set Pressure:	285	psig
Allowable Overpressure:	21.0%	
Constant Back Pressure:	0	psig
Use Thermodynamics:	☑	
Thermo Package:	Advanced_Peng-Robinson	
Relief Device Kd:	0.818	
Nozzle Sizing:	API Numerical Integration Vapor	
Outlet Pipe Sizing:	Adiabatic	

Scenario Output Data:

Wetted Area:	305.8	ft2
Fire Heat Input:	3.77	MMBtu/hr
Total Heat/lb Vaporized:	600.0	Btu/lb
Sensible Heat/lb Vaporized:	532.2	Btu/lb
Latent Heat:	67.8	Btu/lb
Initial Relief Temperature:	320.6	F
Temp. at Start Quality:	320.7	F
Cp at Start Quality:	0.737	Btu/lb/F
Cp at Final Quality:	0.773	Btu/lb/F
Liquid Density:	32.10	lb/ft3
Required Mass Rate:	55551.1	lb/hr
Required Std. Vol. Rate:	8.44	MMSCFD
Required Air Rate:	633378.9	scfh air
Relief Mass Flux:	1109.6	lb/sec/ft2

Notes: Additional area accounts for boot which was estimated to be 18" OD x 2' S/S.

External Fire Boiling Liquid API STD 521

V-1100 External Fire HC Liquid

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Liquid Stream Description: **Theta Inlet Liquids**

Relief Stream Description: **V-1100 Fire HC Vapor**

Component	Liquid Stream Mole Fraction	Relief Stream Mole Fraction
carbon dioxide	0.0006	0.0024
nitrogen	0.0001	0.0009
methane	0.0271	0.1388
ethane	0.0356	0.1172
propane	0.0727	0.1662
isobutane	0.0178	0.0299
butane	0.0950	0.1442
isopentane	0.0461	0.0508
pentane	0.0829	0.0853
hexane	0.1178	0.0799
heptane	0.1659	0.0768
octane	0.3383	0.1067
water	0.0002	0.0008

Pipe Flow Numerical Integration

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Contactor scrubber section also has a 1" ball valve that can drain liquid to the Inlet Separator. As described for the failure open of the LCV case, inadvertent opening of the drain valve could result in overpressure due to gas blowby. The required relief rate was evaluated using the same conditions as the control valves and 19.6 equivalent feet of 1" Sch 80 pipe as determined from the 3D model (1 entrance, 6.5' pipe, 1 ball valve, 1 swing check valve, 2 tee through runs).

Note the liquid inventory in the contactors is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Results Summary:

Required Rate:	34660.5	lb/hr	Device Choke Pressure:	125.4	psig
Actual Capacity:	78893	lb/hr	Outlet Temperature:	22.3	F
Required Area:	1.801	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.062	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.249	
Relief Temperature:	56.1	F	Outlet Viscosity:	0.010	cP
Relief Mass Quality:	0.987		Inlet Non-Recoverble dP:	2.8	psi
Relief Density:	1.42	lb/ft3	Inlet dP % Set:	1.0	% Set
Relief MW:	21.56		Built-Up Back Pressure:	21.3	psig
Relief Viscosity:	0.010	cP	Built-Up Back P % Set:	7.5	% Set
			Total Back Pressure:	21.3	psig
			Total Back P % Set:	7.5	% Set
			Reaction Force:	1052	lbf

Pipe Flow Numerical Integration

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Calculations:

Input Data:

Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Flash Type:	PT	
Upstream Mass Quality:	1.000	
Upstream Temperature:	120.0	F
Set Pressure:	285	psig
Allowable Overpressure:	10.00%	
Constant Back Pressure:	0	psig
Pipe Nominal Pipe Size:	1"	
Pipe Nominal Pipe Schedule:	80	
Pipe Inner Diameter:	0.957	in
Pipe Equiv. Length:	19.6	ft
Pipe Roughness:	0.0018	in
Number of Increments:	10	
Relief Device Liquid Kd:	0.707	
Relief Device Vapor Kd:	0.818	
Thermo Package:	Advanced_Peng-Robinson	
Nozzle Sizing:	API Numerical Integration	
Outlet Pipe Sizing:	Isothermal	

Output Data:

Upstream Density:	5.67	lb/ft3
Upstream Z:	0.772	
Upstream Ideal Cp/Cv:	1.226	
Upstream Viscosity:	0.011	cP
Choked:	Yes	
Exit Pressure:	379.6	psig
Relief Device Kd:	0.817	
Relief Mass Flux:	769.8	lb/sec/ft2
Fanning Friction Factor:	0.006	

Notes:

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma Dry Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7553
ethane	0.1281
propane	0.0624
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
nonane	0.0000
decane	0.0000
methanol	0.0000
water	0.0000
triethylene glycol	0.0000

Vapor Control Valve Failure: LCV-3300/01/4100/200

LCV-3300/3301/4100/4200 Bypass Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

In a similar manner as the control valves, inadvertent opening of the 1" globe valve bypass around LCV-3300, 3301 and 4100 could result in overpressure. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . The globe valve Cv was based on a regular port globe valve (Crane) and an Xt = 1.0 was assumed.

Scenario Calculation Results:

Required Rate:	22,507.3	lb/hr	Device Choke Pressure:	167.9	psig
Actual Capacity:	80,613.7	lb/hr	Outlet Temperature:	22.3	F
Required Area:	1.139	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.062	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.249	
Relief Temperature:	56.1	F	Outlet Viscosity:	0.009	cP
Relief MW:	21.56		Inlet Non-Recoverble dP:	2.9	psi
Relief Mass Quality:	0.987		Inlet dP % Set:	1.0	% Set
Relief Density:	1.422	lb/ft3	Built-Up Back Pressure:	22.1	psig
Relief SG:	0.743		Built-Up Back P % Set:	7.8	% Set
Relief Z:	0.899		Total Back Pressure:	22.1	psig
Relief Ideal Cp/Cv:	1.242		Total Back P % Set:	7.8	% Set
Relief Viscosity:	0.010	cP	Reaction Force:	1393	lbf

Vapor Control Valve Failure: LCV-3300/01/4100/200

LCV-3300/3301/4100/4200 Bypass Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Control Valve Tag:	LCV-3300/01/4100/200 Bypass	
Gas Type:	Inlet Gas	
Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Upstream Temperature:	120	F
Dewpoint Vapor:	☐	
Set Pressure:	285	psig
Allowable Overpressure:	10.0%	
Constant Back Pressure:	0	psig
Required Relief Rate Units:	lb/hr	
Sizing Method	IEC	
Cv:	6.8	
Xt (Cf for Kimray):	1	
C1:		
Cg:		
Control Valve ID:	0.957	in
Inlet Pipe ID:	0.957	in
Outlet Pipe ID:	0.957	in
Additional Flow:	0.0	lb/hr
Use Thermo	☑	
Thermo Package:	Advanced_Peng-Robinson	
Relief Device Kd:	0.818	
Nozzle Sizing:	API 520 Vapor	
Outlet Pipe Sizing:	Adiabatic	

Scenario Output Data:

Fk:	0.88	
K1 Inlet Piping Resistance:	0	
K2 Outlet Piping Resistance:	0	
K1 Inlet Piping Bernoulli:	0	
K2 Outlet Piping Bernoulli:	0	
Fp:	1	
dP/P1 Actual:	0.740	
dP/P1 Critical:	0.876	
Y:	0.718	
Upstream Density:	5.673	lb/ft3
Upstream Z:	0.772	
Upstream Ideal Cp/Cv:	1.226	
Control Valve Flow:	22,507.3	lb/hr
Required Mass Rate:	22,507.3	lb/hr
Required Rate Std Vol:	9.5	MMSCFD
Required Air Rate:	340,301.2	scfh air
Relief Mass Flux:	790.5	lb/sec/ft2

Notes:

Vapor Control Valve Failure: LCV-3300/01/4100/200

LCV-3300/3301/4100/4200 Bypass Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma Dry Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7553
ethane	0.1281
propane	0.0624
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
nonane	0.0000
decane	0.0000
methanol	0.0000
water	0.0000
triethylene glycol	0.0000

Pipe Flow Numerical Integration

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Inlet Separator receives liquids from the 2nd Stage and 3rd Stage Compressor Suction Scrubbers. The maximum pressures in the 2nd Stage Suction Scrubbers are limited to 200 psig (1st Stage Discharge PSHH set point), while the maximum pressure in the 3rd Stage Suction Scrubbers are limited to 500 psig (2nd Stage Discharge PSHH set point). As such, In the event that a liquid level control valve or manual bypass valve on one of the 3rd Stage Suction Scrubbers fails or is inadvertently opened overpressure of the Inlet Separator could occur due to gas blowby. All of the liquid level dump stations consist of a 1" LCV and a 1" manual bypass ball valve. As the 1" bypass represents the worst case, the required relief rate was conservatively based on the flow through 10' of 1" Sch 160 pipe (scrubbers are physically about 15' apart). The upstream conditions were taken as 500 psig at 120 F with the downstream relief pressure of 313.5 psig.

Note the liquid inventory in the Scrubbers is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Results Summary:

Required Rate:	10342.5	lb/hr	Device Choke Pressure:	125.4	psig
Actual Capacity:	74921.7	lb/hr	Outlet Temperature:	82.5	F
Required Area:	0.565	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.055	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.235	
Relief Temperature:	106.9	F	Outlet Viscosity:	0.011	cP
Relief Mass Quality:	1.000		Inlet Non-Recoverble dP:	2.8	psi
Relief Density:	1.26	lb/ft3	Inlet dP % Set:	1.0	% Set
Relief MW:	21.56		Built-Up Back Pressure:	21.6	psig
Relief Viscosity:	0.011	cP	Built-Up Back P % Set:	7.6	% Set
			Total Back Pressure:	21.6	psig
			Total Back P % Set:	7.6	% Set
			Reaction Force:	1061	lbf

Pipe Flow Numerical Integration

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Calculations:

Input Data:

Upstream Pressure:	500	psig
Upstream Pressure Basis:	2nd Stage Discharge PSHH	
Flash Type:	PT	
Upstream Mass Quality:	1.000	
Upstream Temperature:	120.0	F
Set Pressure:	285	psig
Allowable Overpressure:	10.00%	
Constant Back Pressure:	0	psig
Pipe Nominal Pipe Size:	1"	
Pipe Nominal Pipe Schedule:	160	
Pipe Inner Diameter:	0.815	in
Pipe Equiv. Length:	10	ft
Pipe Roughness:	0.0018	in
Number of Increments:	10	
Relief Device Liquid Kd:	0.707	
Relief Device Vapor Kd:	0.818	
Thermo Package:	Advanced_Peng-Robinson	
Nozzle Sizing:	API Numerical Integration	
Outlet Pipe Sizing:	Isothermal	

Output Data:

Upstream Density:	1.99	lb/ft3
Upstream Z:	0.896	
Upstream Ideal Cp/Cv:	1.226	
Upstream Viscosity:	0.011	cP
Choked:	No	
Exit Pressure:	313.5	psig
Relief Device Kd:	0.818	
Relief Mass Flux:	732.2	lb/sec/ft2
Fanning Friction Factor:	0.006	

Notes:

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma HP Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7540
ethane	0.1279
propane	0.0623
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
water	0.0015

Orifice Flow - Numerical Integration

LCV-3400 Bypass Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The After Separator sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event the bypass is inadvertently opened with subsequent gas blowby. Per field verification, the relief requirement is limited by RO-3400 with 3/8" ID. The upstream conditions were based on 1,250 psig and 120 F.

Note the liquid inventory in the After Scrubber is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Results Summary:

Required Rate:	6425.9	lb/hr	Device Choke Pressure:	125.4	psig
Actual Capacity:	78914.2	lb/hr	Outlet Temperature:	22.3	F
Required Area:	0.334	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.062	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.249	
Relief Temperature:	56.1	F	Outlet Viscosity:	0.010	cP
Relief Mass Quality:	0.987		Inlet Non-Recoverble dP:	2.8	psi
Relief Density:	1.42	lb/ft3	Inlet dP % Set:	1.0	% Set
Relief MW:	21.56		Built-Up Back Pressure:	21.3	psig
Relief Viscosity:	0.010	cP	Built-Up Back P % Set:	7.5	% Set
			Total Back Pressure:	21.3	psig
			Total Back P % Set:	7.5	% Set
			Reaction Force:	1052	lbf

Orifice Flow - Numerical Integration

LCV-3400 Bypass Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Input Data:

RO Tag:	RO-3400	
Gas Type:	Dry Gas	
Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Flash Type:	PT	
Upstream Mass Quality:	1.000	
Upstream Temperature:	120.0	F
Set Pressure:	285	psig
Allowable Overpressure:	10.00%	
Constant Back Pressure:	0	psig
Pressure Increment:	10	
Pipe ID:	1.939	in
Orifice ID:	0.375	in
Relief Device Liquid Kd:	0.707	
Relief Device Vapor Kd:	0.818	
Thermodynamic Package:	Advanced_Peng-Robinson	
Nozzle Sizing:	API Numerical Integration Vapor	
Outlet Pipe Sizing:	Isothermal	
Notes:		

Output Data:

Beta:	0.193	
Orifice Flow C:	0.620	
Discharge Cd:	0.620	
Upstream Density:	5.67	lb/ft3
Upstream Z:	0.77	
Upstream Ideal Cp/Cv:	1.23	
Upstream Viscosity:	0.011	cP
Choked:	Yes	
Exit Pressure (P2 for Sizing):	594.4	psig
Orifice Mass Flux:	2327.2	lb/sec/ft2
Required Mass Rate:	6,425.9	lb/hr
Relief Kd:	0.817	
Relief Mass Flux:	769.6	lb/sec/ft2

Orifice Flow - Numerical Integration

LCV-3400 Bypass Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma Dry Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7553
ethane	0.1281
propane	0.0624
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
nonane	0.0000
decane	0.0000
methanol	0.0000
water	0.0000
triethylene glycol	0.0000
	0.0000
	0.0000
	0.0000
	0.0000
	0.0000

External Fire Boiling Liquid API STD 521

V-1100 External Fire Water

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Inlet Separator may contain water that condenses out of the inlet stream. As such, overpressure could occur in the event of an external fire due to vaporization of the water. The fluid properties were based on the properties of pure water at the relief pressure of 344.9 psig (trace dissolved hydrocarbons were conservatively removed). The liquid level of 80% was based on the location of LSHH-1101 as estimated in the field.

Scenario Calculation Results:

Required Rate:	4756.1	lb/hr	Device Choke Pressure:	181.3	psig
Actual Capacity:	63360.7	lb/hr	Outlet Temperature:	325.0	F
Required Area:	0.306	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.080	in2	Outlet Density:	0.032	lb/ft3
Relief Pressure:	344.9	psig	Outlet Ideal Cp/Cv:	1.304	
Relief Temperature:	434.3	F	Outlet Viscosity:	0.017	cP
Relief MW:	18.02		Inlet Non-Recoverble dP:	3.3	psi
Relief Mass Quality:	1.000		Inlet dP % Set:	1.2	% Set
Relief Density:	0.78	lb/ft3	Built-Up Back Pressure:	25.6	psig
Relief SG:	0.621		Built-Up Back P % Set:	9.0	% Set
Relief Z:	0.87		Total Back Pressure:	25.6	psig
Relief Ideal Cp/Cv:	1.30		Total Back P % Set:	9.0	% Set
Relief Viscosity:	0.016	cP			

External Fire Boiling Liquid API STD 521

V-1100 External Fire Water

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Length:	20	ft
Diameter:	66	in
Orientation:	Horizontal	
Head Type:	2:1 Ellipsoidal	
Level Basis:	LSHH-1101	
Additional Wetted Area:	9.8	ft2
Level:	80%	
Bottom Elevation:	3	ft
Area Exponent:	0.82	
Adequate Drainage	☐	
Insulation Factor:	1	
Start Mass % Vapor:	0.00%	
Finish Mass % Vapor:	5.00%	
Remove Sensible Heat:	☑	
Correct for Densities:	☐	
Set Pressure:	285	psig
Allowable Overpressure:	21.0%	
Constant Back Pressure:	0	psig
Use Thermodynamics:	☑	
Thermo Package:	REFPROP 10.0	
Relief Device Kd:	0.818	
Nozzle Sizing:	API 520 Vapor	
Outlet Pipe Sizing:	Isothermal	

Scenario Output Data:

Wetted Area:	305.8	ft2
Fire Heat Input:	3.77	MMBtu/hr
Total Heat/lb Vaporized:	791.9	Btu/lb
Sensible Heat/lb Vaporized:	0.0	Btu/lb
Latent Heat:	791.9	Btu/lb
Initial Relief Temperature:	434.3	F
Temp. at Start Quality:	434.3	F
Cp at Start Quality:	1.108	Btu/lb/F
Cp at Final Quality:	1.093	Btu/lb/F
Liquid Density:	52.17	lb/ft3
Required Mass Rate:	4756.1	lb/hr
Required Std. Vol. Rate:	2.40	MMSCFD
Required Air Rate:	103544.7	scfh air
Relief Mass Flux:	621.2	lb/sec/ft2

Notes: Additional area accounts for boot which was estimated to be 18" OD x 2' S/S.

External Fire Boiling Liquid API STD 521

V-1100 External Fire Water

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Liquid Stream Description: **Water**

Relief Stream Description: **V-1100 Fire Water Vapor**

Component	Liquid Stream Mole Fraction	Relief Stream Mole Fraction
hydrogen sulfide	0.0000	
nitrogen	0.0000	
methane	0.0000	
carbon dioxide	0.0000	
ethane	0.0000	
propane	0.0000	
butane	0.0000	
isobutane	0.0000	
pentane	0.0000	
isopentane	0.0000	
hexane	0.0000	
cyclohexane	0.0000	
heptane	0.0000	
octane	0.0000	
benzene	0.0000	
ethylbenzene	0.0000	
water	1.0000	1.0000

Vapor Control Valve Failure: LCV-4100/4200

LCV-4100/4200 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Contactor scrubber section sends liquids to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event any of the level control valves were to fail open with subsequent gas blowby. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . Per field verification, LCV-4100 is a 1" Kimray 1400SMT PO with 1/4" linear trim and flow coefficients were obtained from vendor literature.

Note the liquid inventory in the 42" ID contactor is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Calculation Results:

Required Rate:	4,824.9	lb/hr	Device Choke Pressure:	125.4	psig
Actual Capacity:	77,426.1	lb/hr	Outlet Temperature:	44.3	F
Required Area:	0.255	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.059	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.244	
Relief Temperature:	75.2	F	Outlet Viscosity:	0.010	cP
Relief MW:	21.56		Inlet Non-Recoverble dP:	2.8	psi
Relief Mass Quality:	0.997		Inlet dP % Set:	1.0	% Set
Relief Density:	1.359	lb/ft3	Built-Up Back Pressure:	21.6	psig
Relief SG:	0.743		Built-Up Back P % Set:	7.6	% Set
Relief Z:	0.910		Total Back Pressure:	21.6	psig
Relief Ideal Cp/Cv:	1.237		Total Back P % Set:	7.6	% Set
Relief Viscosity:	0.010	cP	Reaction Force:	1058	lbf

Vapor Control Valve Failure: LCV-4100/4200

LCV-4100/4200 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Control Valve Tag:	LCV-4100/4200	
Gas Type:	Inlet Gas	
Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Upstream Temperature:	135	F
Dewpoint Vapor:	☐	
Set Pressure:	285	psig
Allowable Overpressure:	10.0%	
Constant Back Pressure:	0	psig
Required Relief Rate Units:	lb/hr	
Sizing Method	Kimray	
Cv:	2.17	
Xt (Cf for Kimray):	0.78	
C1:		
Cg:		
Control Valve ID:	0.957	in
Inlet Pipe ID:	0.957	in
Outlet Pipe ID:	0.957	in
Additional Flow:	0.0	lb/hr
Use Thermo	☑	
Thermo Package:	Advanced_Peng-Robinson	
Relief Device Kd:	0.818	
Nozzle Sizing:	Numerical Integration	
Outlet Pipe Sizing:	Adiabatic	

Scenario Output Data:

Fk:	0.82	
K1 Inlet Piping Resistance:	0	
K2 Outlet Piping Resistance:	0	
K1 Inlet Piping Bernoulli:	0	
K2 Outlet Piping Bernoulli:	0	
Fp:	1	
dP/P1 Actual:	0.740	
dP/P1 Critical:	0.515	
Y:	1.5	
Upstream Density:	5.378	lb/ft3
Upstream Z:	0.794	
Upstream Ideal Cp/Cv:	1.223	
Control Valve Flow:	4,824.9	lb/hr
Required Mass Rate:	4,824.9	lb/hr
Required Rate Std Vol:	2.0	MMSCFD
Required Air Rate:	74,290.5	scfh air
Relief Mass Flux:	756.8	lb/sec/ft2

Notes:

Vapor Control Valve Failure: LCV-4100/4200

LCV-4100/4200 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma Dry Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7553
ethane	0.1281
propane	0.0624
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
nonane	0.0000
decane	0.0000
methanol	0.0000
water	0.0000
triethylene glycol	0.0000

LCV-4100

Vapor Control Valve Failure: LCV-3300/3301

LCV-3300/1 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Description:

The Inlet Filter Coalescer sends liquids from both chambers to the Inlet Separator and has a design pressure of 1,440 psig and the maximum pressure is limited to 1,250 psig by the compressor 3rd stage discharge PSHH set points. As such, overpressure could occur in the event either of the level control valves were to fail open with subsequent gas blowby. The required relief rate was based on the normal gas composition at 1,250 psig and 120 F . Per field verification, LCV-3300 and 3301 are both 1" Kimray 1400SMT PO with 3/8" linear trim and flow coefficients were obtained from vendor literature.

Note the liquid inventory in the Coalescer is minimal compared to the surge volume available in the Inlet Separator therefore no concerns are present with overfilling prior to gas blowby.

Scenario Calculation Results:

Required Rate:	4,886.9	lb/hr	Device Choke Pressure:	167.9	psig
Actual Capacity:	80,528.0	lb/hr	Outlet Temperature:	22.3	F
Required Area:	0.248	in2	Outlet Mass Quality:	1.000	
Actual Area:	4.08	in2	Outlet Density:	0.062	lb/ft3
Relief Pressure:	313.5	psig	Outlet Ideal Cp/Cv:	1.249	
Relief Temperature:	57.2	F	Outlet Viscosity:	0.009	cP
Relief MW:	21.56		Inlet Non-Recoverble dP:	2.9	psi
Relief Mass Quality:	0.987		Inlet dP % Set:	1.0	% Set
Relief Density:	1.419	lb/ft3	Built-Up Back Pressure:	22.1	psig
Relief SG:	0.743		Built-Up Back P % Set:	7.7	% Set
Relief Z:	0.899		Total Back Pressure:	22.1	psig
Relief Ideal Cp/Cv:	1.242		Total Back P % Set:	7.7	% Set
Relief Viscosity:	0.010	cP	Reaction Force:	1389	lbf

Vapor Control Valve Failure: LCV-3300/3301

LCV-3300/1 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Scenario Input Data:

Control Valve Tag:	LCV-3300/3301	
Gas Type:	Inlet Gas	
Upstream Pressure:	1250	psig
Upstream Pressure Basis:	3rd Stage Discharge PSHH	
Upstream Temperature:	120	F
Dewpoint Vapor:	☐	
Set Pressure:	285	psig
Allowable Overpressure:	10.0%	
Constant Back Pressure:	0	psig
Required Relief Rate Units:	lb/hr	
Sizing Method	Kimray	
Cv:	2.17	
Xt (Cf for Kimray):	0.78	
C1:		
Cg:		
Control Valve ID:	0.957	in
Inlet Pipe ID:	0.957	in
Outlet Pipe ID:	0.957	in
Additional Flow:	0.0	lb/hr
Use Thermo	☑	
Thermo Package:	Advanced_Peng-Robinson	
Relief Device Kd:	0.818	
Nozzle Sizing:	API 520 Vapor	
Outlet Pipe Sizing:	Adiabatic	

Scenario Output Data:

Fk:	0.82	
K1 Inlet Piping Resistance:	0	
K2 Outlet Piping Resistance:	0	
K1 Inlet Piping Bernoulli:	0	
K2 Outlet Piping Bernoulli:	0	
Fp:	1	
dP/P1 Actual:	0.740	
dP/P1 Critical:	0.515	
Y:	1.5	
Upstream Density:	5.674	lb/ft3
Upstream Z:	0.772	
Upstream Ideal Cp/Cv:	1.226	
Control Valve Flow:	4,886.9	lb/hr
Required Mass Rate:	4,886.9	lb/hr
Required Rate Std Vol:	2.1	MMSCFD
Required Air Rate:	73,966.6	scfh air
Relief Mass Flux:	789.5	lb/sec/ft2

Notes:

Vapor Control Valve Failure: LCV-3300/3301

LCV-3300/1 Failure Open

Equipment Data:

Equipment Tag:	**V-1100**	Type:	Pressure Vessel
Drawing:	PID-1100	MAWP:	720 psig
Description:	Inlet Separator	MAWT:	120 F

Relief Stream Composition:

Stream Description: Sigma HP Gas

Component	Mole Fraction
carbon dioxide	0.0048
nitrogen	0.0155
methane	0.7540
ethane	0.1279
propane	0.0623
isobutane	0.0053
butane	0.0184
isopentane	0.0031
pentane	0.0042
hexane	0.0015
heptane	0.0007
octane	0.0007
water	0.0015

LCV-3301


2220450243
MAX W.P 4000 PSI
1400 SMT PO 1/4IV CS NBR
KUNKLE VALVE COMPANY

Detailed Sizing: API 520 Vapor
PSV Tag Number: PSV-1100
Drawing: PID-1100
Sizing Scenario: LCV-3400 Failure Open

PSV Data:

Device Type:	Conventional		Orifice Designation:	M	
Inlet NPS:	4"		Orifice Area:	4.08	in2
Inlet Schedule:	40		Set Pressure:	250.0	psig
Inlet Equivalent Length:	12.3	ft	Allowable Overpressure:	25%	
Outlet NPS:	6"		Constant Backpressure:	0.0	psig
Outlet Schedule:	40		Kd 0.818 Kb 1.000 Kc 1.000		
Outlet Equivalent Length:	12.1	ft	Device Sizing:	API 520 Vapor	
			Outlet Pipe Sizing:	Adiabatic	
			Thermo Package:	Advanced_Peng-Robinson	

Scenario Data:

Required Rate:	61605.3	lb/hr	Relief Density:	1.422	lb/ft
Relief Mass Flux:	790.5	lb/ft2/sec	Relief Specific Gravity:	0.743	
Relief Pressure:	313.5	psig	Relief Viscosity:	0.010	cP
Relief Temperature:	56.1	F	Outlet Temperature:	22.3	F
Relief MW:	21.56		Outlet Mass Quality:	1.000	
Relief Z:	0.899		Outlet Density:	0.062	lb/ft
Relief Ideal Cp/Cv:	1.242		Outlet Viscosity:	0.009	cP
Relief Mass Quality:	0.987		Outlet Ideal Cp/Cv:	1.249	

PSV Sizing Results:

Actual Capacity:	80613.7	lb/hr	Built-Up Back Pressure:	22.1	psi
Required Area:	3.118	in2	Built-Up Back P % of Set:	8.8%	
Device Choke Pressure:	167.9	psig	Total Back Pressure:	22.1	psig
Inlet Pressure Drop:	2.9	psi	Total Back P % of Set:	8.8%	
Inlet dP % of Set:	1.2%		Tail Pipe Exit Pressure:	10.7	psig
			Tail Pipe Exit Area:	28.890	in2
			Reaction Force:	1392.8	lbf

Detailed Sizing: API 520 Vapor
PSV Tag Number: PSV-1100
Drawing: PID-1100
Sizing Scenario: LCV-3400 Failure Open

Inlet Piping Pressure Drop Details

NPS	Sch	Fitting Type	Qty. or Length (ft)	Beta	EqL Actual NPS (ft)	EqL PSV Inlet NPS (ft)	Seg. dP (psi)	Exit P (psig)	Exit Vel. (fps)	Exit Mach
4"	40	Sharp Edged Entranc	1	0	10.25	10.25	2.44	311.1	178.1	0.15
4"	40	Ball Valve	1	0	1.01	1.01	0.24	310.8	178.1	0.15
4"	40	Pipe	1	0	1.00	1.00	0.24	310.6	178.1	0.15

Outlet Piping Pressure Drop Details

NPS	Sch	Fitting Type	Qty. or Length (ft)	Beta	EqL Actual NPS (ft)	EqL PSV Inlet NPS (ft)	Seg. dP (psi)	Exit P (psig)	Exit T (F)	Exit Vel. (fps)	Exit Mach
6"	40	Std. 90	1	0	7.08	7.08	4.2	17.9	24.8	917	0.78
6"	40	Pipe	5	0	5.00	5.00	17.9	10.7	24.1	1175	1

PSV-1100

1	Client:	RKR Engineering and Consulting	38	Manufacturer:	Mercer
2	Plant:	Gas Plant XYZ	39	Model Number:	91-71M11T1MNX1
3	Project:	Pressio 2024 Help Benchmarks	40	Project Number:	2024-1000
4	Service:	Inlet Separator	41	Serial Number:	1045480
5	P&ID Number:	PID-1100	42	Equipment Tag:	V-1100
	GENERAL			**PILOT**	
6	Inlet:	4" Sch. 40 ANSI 300# RFWN	43	Pilot Type:	N/A
7	Outlet:	6" Sch. 40 ANSI 150# RFWN	44	Pilot Body:	N/A
8	Type:	Conventional	45	Pilot Trim:	N/A
9	BonnetType:	Closed	46	Pilot Seat:	N/A
10	NozzleType:	Semi	47	Pilot Tube:	N/A
	MAIN BODY		48	Back Flow Preventer:	☐
11	Body:	Carbon Steel	49	Supply Filter:	☐
12	Nozzle:	Stainless Steel		**SIZING BASIS**	
13	Bonnet:	Carbon Steel	50	Code:	ASME VIII
14	Disc:	Stainless Steel	51	Stamp Required:	☑
15	Trim:	Stainless Steel	52	Sizing Basis:	LCV-3400 Failure Open
16	Seat:	Viton	53	Relieves To:	Atmosphere
17	Spring:	Chrome Alloy	54	Certified Test	☑ ☑ NB-18 Area and Kd
18	Bellows:	N/A		**ACCESSORIES**	
19			55	Cap:	Closed
20			56	Lifting Lever:	None
21			57	Test Ring	☐

	SELECTION				
22	Actual Capacity:	80,613.7 lb/hr	58	Orifice Designation (letter):	M
23	Required Capacity:	61,605.3 lb/hr	59	Discharge Coefficients, KdV/KdL:	0.818 / 0.650
24	Selected Orifice Area - in²:	4.08	60	Backpressure Correction Kb:	1
25	Calculated Orifice Area - in²:	3.118	61	Combination Capacity Factor (Kc):	1
	FLUID DATA				
26	Operating Pressure:	146 psig	62	Operating Fluid:	Natural Gas
27	Installed Set Pressure:	250 psig	63	Operating Phase:	Vapor
28	Cold Differential Set Pressure:	250 psig	64	Relief Fluid:	Natural Gas
29	Allowable Overpressure:	25%	65	Relief Phase:	Vapor
30	Relief Pressure:	313.5 psig	66	Relief Mass Quality:	0.987
31	Operating Temperature:	267 F	67	Relief MW:	21.56
32	Relief Temperature:	56.1 F	68	Relief Z:	0.899
33	Outlet Temperature:	22.3 F	69	Relief Density:	1.422 lb/ft3
34	Inlet Pressure Drop:	2.9 psi 1.2 % of Set	70	Relief Viscosity:	0.010 cP
35	Constant Backpressure:	0.0 psig 0.0 % of Set	71	Relief cP/(Cp-R):	1.242
36	BuiltUp Backpressure:	22.1 psi 8.8 % of Set	72	Relief SG:	0.743
37	Total Backpressure:	22.1 psig 8.8 % of Set			

NOTES

REVISIONS

Rev.	Date	Description	By
A	12/1/2024	Issued for Review	RAK

MERCER VALVE COMPANY INC

6218 LONG DRIVE HOUSTON, TX. (713) 242-6960

VALVE REPAIR / TEST REPORT

JOB ORDER NUMBER:

COMPANY:
ADDRESS:

CUSTOMER CONTACT:
PO NUMBER:

DATE VALVE REPAIRED / TESTED: 6/10/2020

PLANT / BOOSTER			
UNIT #:			
LOCATION	1ST STAGE		
P.S.V. #:	1100		
MANUFACURER:	MERCER	**CAP/BONNET**	CLOSED
MFG. SERIAL NO.:	1045480	**OUTLET SIZE/RATING:**	6" 150RF
ORIFICE SIZE:	M	**SEAT:**	SOFT
INLET SIZE:	4" 300RF	**CAPACITY**	17723 SCFM
SET PRESSURE:	250	**U.V. STAMPED:**	YES
MODEL #:	91-71M11T1MNX1		

PRETEST INFORMATION

1ST POP: 252 **2ND POP:** 251

REMARKS: TEST ONLY - SEAL # FGS-218

INSPECTION INFORMATION

		ADJUSTMENT:	N/A
CAP:	OK	**SCREW:**	N/A
BONNET:	OK	**JAM NUT:**	N/A
BODY:	OK	**BLOWDOWN RING:**	N/A
NOZZLE:	N/A	**SPRING:**	N/A
DISK:	N/A	**SPRING WASHERS:**	N/A

SPRING DATA

SPRING #:		**COILS:**	N/A
WIRE SIZE:	N/A	**CONDITION:**	N/A

PARTS REPLACED:

NONE

VALVE REPAIR AND TEST DATA

SET PRESSURE:	250	**TEST GUAGE:**	100501
LEAK RATE:	LEAKAGE TIGHT @ 90% OF SET	**MAINT SCHEDULE:**	June - 20
TEST MEDIA:	NITROGEN	**MENT MAINT. DATE:**	June - 21
B.D.R.lower:	N/A	**B.D.R. upper:**	N/A

REPAIR TAG DATA

SET PRESSURE:	250	**QUALITY CONTROL INSP:**	
REPAIR SERIAL #:	1304192	**REPAIR TAG:**	OK
DATE TESTED:	6/10/2020	**SEAL WIRE:**	OK
V.R. STAMPED:	NO	**NAT GAS CAP:**	
		CAPACITY	17723 SCFM

Office Number
1-800-833-6402

Webpage
www.mercervalve.net

Fax Number
405-495-8728

Email
sales@ mercervalve.net

MERCER VALVE CO., INC.®

AUTO SEAT TECHNOLOGY®

PSV-1100

CERTIFICATE OF COMPLIANCE

Customer Name:

Customer PO Number: 5733299

Item Description: **Qty:** (1) 91-71M11T1MNX1 4" 300 RF X 6" 150 RF
Series 9100 Serial Number(s) 1095043
Set @ 250 psi Customer PN
Capacity SCFM Air 17723
Repair Kit Number: 6M1T1NX4

Mercer Valve Sales Order Number: BS300
Mercer Valve Job Order Number: BS300-4
Valve Setting Instructions:
Set Pressure: 250 psi
Set Pressure Tolerance: 3%
Test Medium: Air

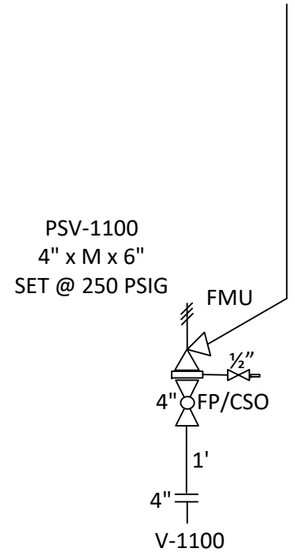
Leakage tight at 10% below set pressure

This certifies that the valves purchased on the above sales order number were built per section VIII, Division 1 of ASME boiler and pressure vessel code as indicated by the UV on the nameplate.

11/13/2014

Certified Individual
Quality Control

N



REFERENCE DRAWINGS							
NO.	TITLE						
		A	ISSUED FOR REVIEW	RAK			12/02/24
		NO.	REVISION	BY	CHK	APVD	DATE

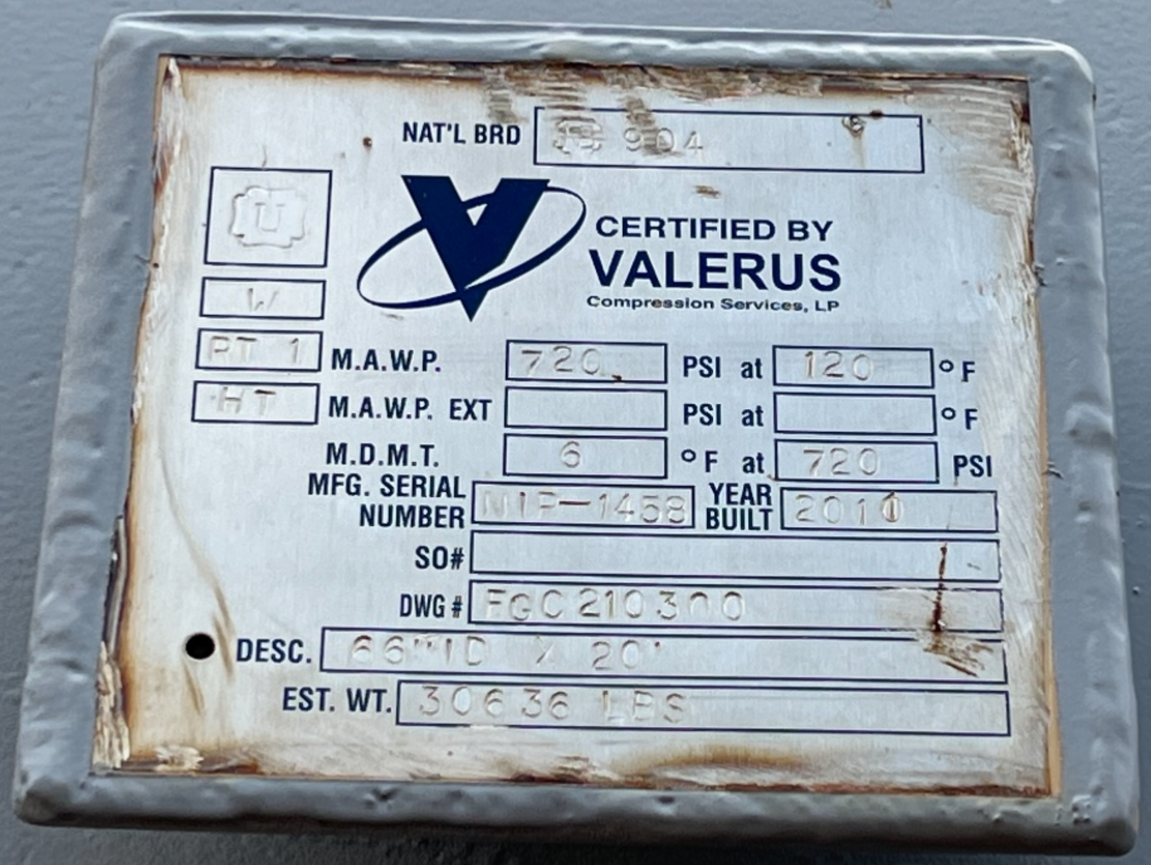
ENG. RECORD		DATE
DRAWN BY	RAK	12/02/24
CHECKED		
APPROVED		
APPROVED		
SCALE		

GAS PLANT XYZ

JOB NO.

DRAWING NO. PSV-1100 REV. A

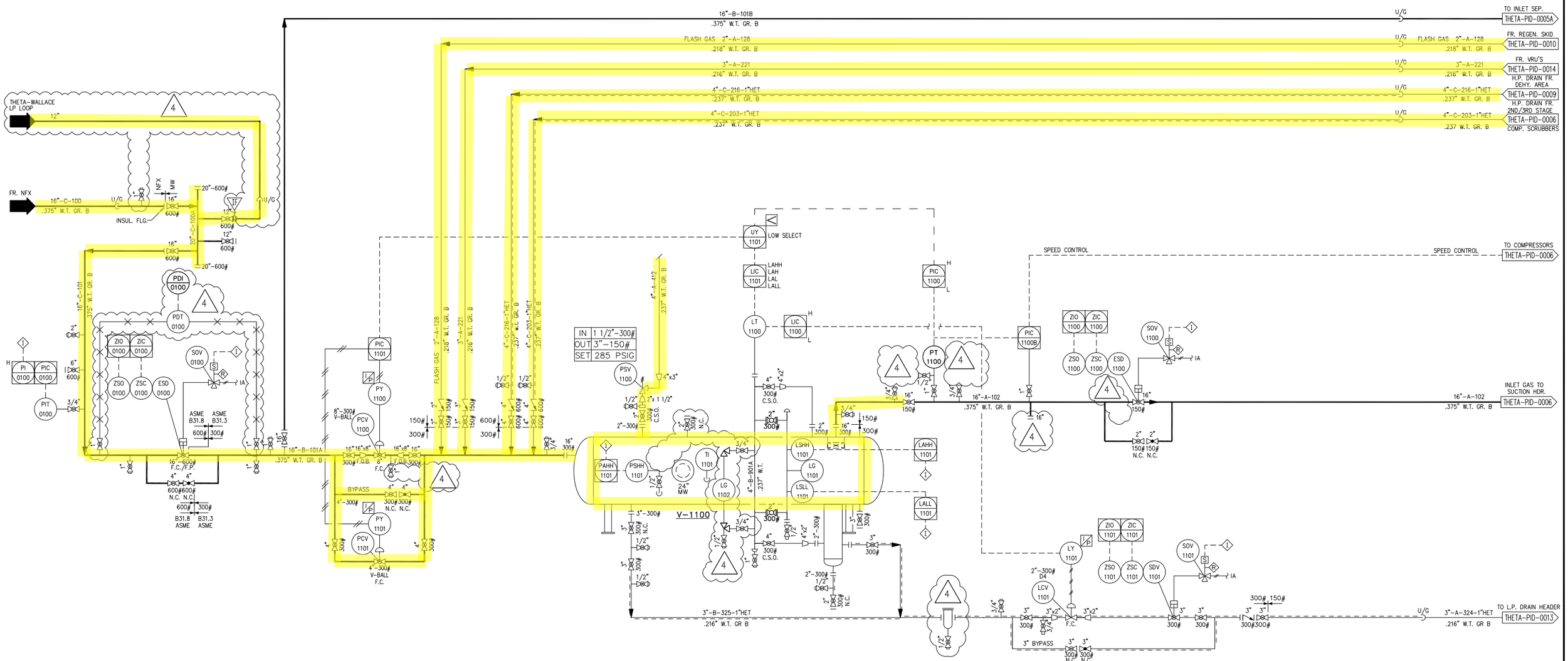
V-1100


NAT'L BRD
CERTIFIED BY
VALERUS
Compression Services, LP
W
PT 1
M.A.W.P.
720
PSI at
120
°F
HT
M.A.W.P. EXT
PSI at
°F
M.D.M.T.
6
°F at
720
PSI
MFG. SERIAL NUMBER
NIP-1458
YEAR BUILT
2010
SO#
DWG #
FGC210300
DESC.
66"ID x 20'
EST. WT.
30636 LBS

V-1100

INLET SEPARATOR

66" I.D. x 20'-0" S/S
MAOP: 720 PSIG. @ 120°F
MFG: VALERUS



CM-2100
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3606
DRIVER HP: 2370 HP
FRAME MODEL: WH-64

CM-2100 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	300 PSIG
2nd STAGE	635 PSIG
3rd STAGE	1650 PSIG

CM-2100 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-5203	2 1/2" X 3"	300 PSIG
PSV-5204	2" X 2"	635 PSIG
PSV-5205	1" X 1 1/2"	1440 PSIG
–	–	–

CM-2100 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-5030	1"	–
LCV-5030	1"	–
LCV-5030	1"	–

CM-2200
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3606
DRIVER HP: 2370 HP
FRAME MODEL: WH-64

CM-2200 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	300 PSIG
2nd STAGE	635 PSIG
3rd STAGE	1650 PSIG

CM-2200 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-5203	2" X 2"	300 PSIG
PSV-5204	2" X 2"	635 PSIG
PSV-5205	2" X 2"	1440 PSIG
–	–	–

CM-2200 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-5030	1"	–
LCV-5030	1"	–
LCV-5030	1"	–

PIC-1100B SPEED CONTROL THETA-PID-0005
PIC-1150B SPEED CONTROL THETA-PID-0005A

RUN COM XS 2100 VAHH 2100 RUNNING XI 2101
ESD PERMISSIVE
XY 2100 VSHH 2100 SY 2100 XS 2101 XE 2100
CM-2100
IN 2"-150# OUT 3"-150# SET 215 PSIG
FR. FUEL FILTER
PSV 2100
BI 2100 HH H BT 2100
GI 2100 HH H GT 2100 GE 2100 LEL
14"-300# 150# 300# 14"x10" 2" FNPT 2" FNPT 1" FNPT
START AIR FUEL GAS DISCHARGE
6"x4" 4"-900# 900# 600#
2"x1" 1/2" 2" 150# C.S.O./F.P.
3/4" 6" 600# 4"x3" 3"
SP 2100 10" SUCTION 10"-A-109C .365" W.T. GR. B
4"-A-401C VENT .237" W.T. GR. B
2"-A-605C 2"-A-503C .218" W.T. GR. B
2"-A-305C-1"HET 2"-A-301C-1"HET L.P. DRAIN .218" W.T. GR. B
2"-C-201C-1"HET H.P. DRAIN .218" W.T. GR. B
4"-C-110C .337" W.T. GR. B
NOTE 2
U/G

IN 4"-150# OUT 6"-150# SET 285 PSIG
PSV 2000
6"x4" 150# C.S.O./F.P.
IN 2"-600# OUT 3"-150# SET 1440 PSIG
PSV 2010
4"x3" 3"x2" 1/2" 600# C.S.O./F.P.
4"-A-406 .237" W.T. GR. B

CM-2200
IN 2"-150# OUT 3"-150# SET 215 PSIG
PSV 2200
RUN COM XS 2200 VAHH 2200 RUNNING XI 2201
ESD PERMISSIVE
XY 2200 VSHH 2200 SY 2200 XS 2201 XE 2200
FR. FUEL FILTER
14"-300# 150# 300# 14"x10" 2" FNPT 1" FNPT
START AIR FUEL GAS DISCHARGE
6"x4" 4"-900# 900# 600#
2"x1" 1/2" 2" 150# C.S.O./F.P.
3/4" 6" 600# 4"x3" 3"
SP 2200 10" SUCTION VENT
2"-A-305D-1"HET 2"-A-301D-1"HET L.P. DRAIN .218" W.T. GR. B
2"-C-201D-1"HET H.P. DRAIN .216" W.T. GR. B
4"-C-1100 .337" W.T. GR. B
6"-A-410 .322" W.T. GR. B
NOTE 2
U/G
BI 2200 HH H BT 2200
GI 2200 HH H GT 2200 GE 2200 LEL

ZIO 2000 ZIC 2000 ZSO 2000 ZSC 2000 ESD 2000
SOV 2000 S IA
PZ 2000 P PCV 2000 ED
FC 1 1/2"-600# F.C.
3"x1 1/2" 1/2" 3" 600# 3"-C-120 (RECYCLE) .216" W.T. GR. B
FUTURE HEADER
SUCTION RECYCLE THETA-PID-0009 FR. DEHYDRATION
3"-A-121 .216" W.T. GR. B

INLET GAS THETA-PID-0005
16"-A-102 .375" W.T. GR. B
16"-A-107 .375" W.T. GR. B
8"-C-111 .500" W.T. GR. B
8"-A-403 .322" W.T. GR. B
3"-A-502B .216" W.T. GR. B
3"-A-302-1"HET .216" W.T. GR. B
4"-C-202-1"HET .237" W.T. GR. B
3"-A-603 .216" W.T. GR. B
2"-A-604 .218" W.T. GR. B
INLET GAS – 150#
SUCTION HDR. – 150#
DISCHARGE HDR. – 600#
VENT HDR. – 150#
FUEL GAS HDR. – 150#
L.P. DRAIN–150#
H.P. DRAIN–600#
START AIR HDR.–150#
INSTRUMENT AIR HDR.–150#
TO USERS
SKID DRAIN

TO COMPRESSORS THETA-PID-0007
PIC-1100B THETA-PID-0005
2"-A-306-1"HET .218" W.T. GR. B
TO DRAIN SUMP V-6910 THETA-PID-0016
PT 5100 TO PIC-5100 THETA-PID-0017
TO COMPRESSORS THETA-PID-0007
FR. COMPRESSORS THETA-PID-0007
TO COMPRESSORS THETA-PID-0007
TO COMPRESSORS THETA-PID-0007
FR. COMPRESSORS THETA-PID-0007
FR. COMPRESSORS THETA-PID-0007
TO COMPRESSORS THETA-PID-0007
TO COMPRESSORS THETA-PID-0007
FR. AIR COMP. THETA-PID-0018
2"-A-602 .218" W.T. GR. B
FR. AIR COMP. THETA-PID-0018
3"-A-601 .216" W.T. GR. B
TO FILTER SEPARATOR THETA-PID-0009
8"-C-112 .500" W.T. GR. B
TO TK-6100 THETA-PID-0013
3"-A-303-1"HET .216" W.T. GR. B
FR. FG. SCRUBBER THETA-PID-0017
3"-A-502A .216" W.T. GR. B
600# C.S.O.
START AIR INST. AIR

GEN-SET PRIMARY FUEL SUPPLY
2" 150# 2"-A-521A .218" W.T. GR. B U/G
LG 2000 LSH 2000 LC 2000 LCV 2000 N.C.
1"-A-312-1"HET .179" W.T. GR. B
3"x2" 2"x1"

TO INLET SEPARATOR THETA-PID-0005
4"-C-203-1"HET .237" W.T. GR. B U/G
FR. V-6910 SUMP THETA-PID-0016
2"-A-319-1"HET .216" W.T. GR. B

METHANOL
3/8" TUBING

CM-2300
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3608
DRIVER HP: 2370 HP
FRAME MODEL: JGC-4

CM-2300 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	–
2nd STAGE	–
3rd STAGE	–

CM-2300 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-2001	–	–
PSV-2002	–	–
PSV-2003	–	–
PSV-2004	–	–

CM-2300 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-001	–	–
LCV-002	–	–
LCV-003	–	–

CM-2400
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3608
DRIVER HP: 2370 HP
FRAME MODEL: JGC-4

CM-2400 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	–
2nd STAGE	–
3rd STAGE	–

CM-2400 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-2001	–	–
PSV-2002	–	–
PSV-2003	–	–
PSV-2004	–	–

CM-2400 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-001	–	–
LCV-002	–	–
LCV-003	–	–

FR. COMPRESSORS THETA-PID-0006
TO COMPRESSORS THETA-PID-0008
RUN COM XS 2300 VAHH 2300 RUNNING XI 2301
RUN COM XS 2400 VAHH 2400 RUNNING XI 2401
ESD PERMISSIVE
XY 2300 VSHH 2300 SY 2300 XS 2301 XE 2300
XY 2400 VSHH 2400 SY 2400 XS 2401 XE 2400
IN 2"–150#
OUT 3"–150#
SET 215 PSIG
BI 2300 HH H BT 2300 GI 2300 HH H GT 2300 GE 2300 LEL
BI 2400 HH H BT 2400 GI 2400 HH H GT 2400 GE 2400 LEL
PSV 2300 PSV 2400
FR. FUEL FILTER
DISCHARGE
START AIR
FUEL GAS
NOTE 1
SP 2300 SP 2400
L.P. DRAIN
H.P. DRAIN
SKID DRAIN
U/G
TO DRAIN SUMP V-6910 THETA-PID-0016 2"–A–308–1"HET .218" W.T. GR. B
FR. INLET SEPARATOR THETA-PID-0006 16"–A–107 .375" W.T. GR. B
TO FILTER SEPARATOR THETA-PID-0006 8"–C–111 .500" W.T. GR. B
FR. COMPRESSORS THETA-PID-0006 8"–A–403 .322" W.T. GR. B
FR. FG. SCRUBBER THETA-PID-0006 3"–A–502B .216" W.T. GR. B
TO STORAGE TK–6100 THETA-PID-0006 3"–A–302–1"HET .216" W.T. GR. B
TO INLET SEPARATOR THETA-PID-0006 4"–C–202–1"HET .237" W.T. GR. B
FR. AIR COMP. THETA-PID-0006 3"–A–603 .216" W.T. GR. B
FR. AIR COMP. THETA-PID-0006 2"–A–604 .218" W.T. GR. B
TO USERS
SUCTION HDR. – 150#
DISCHARGE HDR. – 600#
VENT HDR. – 150#
FUEL GAS HDR. – 150#
L.P. DRAIN –150#
H.P. DRAIN – 600#
START AIR HDR.–150#
INSTRUMENT AIR HDR.–150#
4"–C–LT–402 .237" W.T. A–333 GR. 6
0.500" BORE 0.375" THICK
0.875" BORE 0.375" THICK
SOV 2010 ZSO 2010 ESD 2010 ZSC 2010 ZIO 2010 ZIC 2010 RO 2010
SOV 2020 ZSO 2020 ESD 2020 ZSC 2020 ZIO 2020 ZIC 2020 RO 2020
SOV 2030 ZSO 2030 ESD 2030 ZSC 2030 ZIO 2030 ZIC 2030 RO 2030
TO VENT SEP. V–9210 THETA-PID-0016
8"–A–414 .322" W.T. GR. B
16"–A–107 .375" W.T. GR. B
8"–C–111 .500" W.T. GR. B
8"–A–403 .322" W.T. GR. B
3"–A–502B .216" W.T. GR. B
3"–A–302–1"HET .216" W.T. GR. B
4"–C–202–1"HET .237" W.T. GR. B
3"–A–603 .216" W.T. GR. B
2"–A–604 .218" W.T. GR. B
2"–A–609 .218" W.T. GR. B
2"–A–323–1"HET .218" W.T. GR. B
FR. VENT SEP. V–9210 THETA-PID-0016

CM-2500
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3608
DRIVER HP: 2370 HP
FRAME MODEL: JGD/4

CM-2500 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	–
2nd STAGE	–
3rd STAGE	–

CM-2500 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-2001	–	–
PSV-2002	–	–
PSV-2003	–	–
PSV-2004	–	–

CM-2500 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-001	–	–
LCV-002	–	–
LCV-003	–	–

CM-2600
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3608
DRIVER HP: 2370 HP
FRAME MODEL: JGD/4

CM-2600 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	–
2nd STAGE	–
3rd STAGE	–

CM-2600 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-2001	–	–
PSV-2002	–	–
PSV-2003	–	–
PSV-2004	–	–

CM-2600 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-001	–	–
LCV-002	–	–
LCV-003	–	–

CM-2700
COMPRESSOR
MAKE: CATERPILLAR
ENGINE MODEL: 3608
DRIVER HP: 2370 HP
FRAME MODEL: JGD/4

CM-2700 CYLINDER SIZE DATA	
TAG	SIZE
1st STAGE	–
2nd STAGE	–
3rd STAGE	–

CM-2700 RELIEF VALVE DATA		
TAG	SIZE	SET PRESSURE
PSV-2001	–	–
PSV-2002	–	–
PSV-2003	–	–
PSV-2004	–	–

CM-2700 DUMP VALVE DATA		
TAG	VALVE SIZE	TRIM SIZE
LCV-001	–	–
LCV-002	–	–
LCV-003	–	–

FR. COMPRESSORS THETA-PID-0007

RUN COM XS 2500 · VAHH 2500 · RUNNING XI 2501 · XY 2500 · VSHH 2500 · SY 2500 · XS 2501 · XE 2500 · CM-2500

IN 2"–150# | OUT 3"–150# | SET 215 PSIG

BI 2500 HH H · GI 2500 HH H · BT 2500 · GT 2500 · GE 2500 LEL · PSV 2500

FR. FUEL FILTER · 14"–300# · 14"x10" · 2" FNPT · 1" FNPT · 3/4" · 1/2" · 2"x1" · 2" C.S.O./F.P. 150# · 6"x4" · 4"–600# · 6" 600# · 2" · 4" · 6" · 3/4" 150# 600#

DISCHARGE · NOTE 1 · U/G

BI 2600 HH H · GI 2600 HH H · BT 2600 · GT 2600 · GE 2600 LEL · PSV 2600

RUN COM XS 2600 · VAHH 2600 · RUNNING XI 2601 · XY 2600 · VSHH 2600 · SY 2600 · XS 2601 · XE 2600 · CM-2600

IN 2"–150# | OUT 3"–150# | SET 215 PSIG

FR. FUEL FILTER · 14"–300# · 14"x10" · 2" FNPT · 1" FNPT · 3/4" · 1/2" · 2"x1" · 2" C.S.O./F.P. 150# · 6"x4" · 4"–600# · 6" 600# · 2" · 4" · 6" · 3/4" 150# 600#

DISCHARGE · NOTE 1 · U/G

BI 2700 HH H · GI 2700 HH H · BT 2700 · GT 2700 · GE 2700 LEL · PSV 2700

RUN COM XS 2700 · VAHH 2700 · RUNNING XI 2701 · XY 2700 · VSHH 2700 · SY 2700 · XS 2701 · XE 2700 · CM-2700

IN 2"–150# | OUT 3"–150# | SET 215 PSIG

FR. FUEL FILTER · 12"–150# · 12"x10" · 2"–150# · 2" · 1-1/2" · 1-1/2"x1" · 1-1/2"x1-1/4" · 1-1/2" 600# · 3"–900# · 6"x3" · 900# 600# · 1/2" · 2" C.S.O./F.P. 150# · 6"x4" · 6" 600# · 3/4" 150# 600#

DISCHARGE · NOTE 1 · U/G

L.P. DRAIN · 2"–A–301G–1"HET .218" W.T. GR. B · 2"–A–305G–1"HET .218" W.T. GR. B · 10"–A–109G SUCTION .365" W.T. GR. B · 4"–A–401G VENT .237" W.T. GR. B · 2"–A–605G .218" W.T. GR. B · 2"–A–503G .218" W.T. GR. B · 2"–A–305G–1"HET .218" W.T. GR. B · H.P. DRAIN 2"–C–201G–1"HET .218" W.T. GR. B · 4"–C–110G .337" W.T. GR. B

L.P. DRAIN · 2"–A–301H–1"HET .218" W.T. GR. B · 2"–A–305H–1"HET .218" W.T. GR. B · 10"–A–109H SUCTION .365" W.T. GR. B · 4"–A–401H VENT .237" W.T. GR. B · 2"–A–605H .218" W.T. GR. B · 2"–A–503H .218" W.T. GR. B · 2"–A–305H–1"HET .218" W.T. GR. B · H.P. DRAIN 2"–C–201H–1"HET .218" W.T. GR. B · 4"–C–110H .337" W.T. GR. B

L.P. DRAIN · 2"–A–301J–1"HET .218" W.T. GR. B · 2"–A–305J–1"HET .218" W.T. GR. B · 10"–A–109J SUCTION .365" W.T. GR. B · 4"–A–401J VENT .237" W.T. GR. B · 2"–A–605J .218" W.T. GR. B · 2"–A–503J .218" W.T. GR. B · 2"–A–305J–1"HET .218" W.T. GR. B · H.P. DRAIN 2"–C–201J–1"HET .218" W.T. GR. B · 4"–C–110J .337" W.T. GR. B

SP 2500 · SP 2600 · SP 2700 · START AIR · FUEL GAS · SKID DRAIN

TO DRAIN SUMP V–6930 THETA-PID-0016 — 2"–A–306–1"HET .218" W.T. GR. B

FR. INLET SEPARATOR THETA-PID-0007 — 16"–A–107 .375" W.T. GR. B — SUCTION HDR. – 150#

TO FILTER SEPARATOR THETA-PID-0007 — 8"–C–111 .500" W.T. GR. B — DISCHARGE HDR. – 600#

FR. COMPRESSORS THETA-PID-0007 — 8"–A–403 .322" W.T. GR. B — VENT HDR. – 150#

FR. FG. SCRUBBER THETA-PID-0007 — 3"–A–502B .216" W.T. GR. B — FUEL GAS HDR. – 150#

TO STORAGE TK–6100 THETA-PID-0007 — 3"–A–302–1"HET .216" W.T. GR. B — L.P. DRAIN –150#

TO INLET SEPARATOR THETA-PID-0007 — 4"–C–202–1"HET .237" W.T. GR. B — H.P. DRAIN – 600#

FR. AIR COMP. THETA-PID-0007 — 3"–A–603 .216" W.T. GR. B — START AIR HDR.–150#

FR. AIR COMP. THETA-PID-0007 — 2"–A–604 .218" W.T. GR. B — TO USERS — INSTRUMENT AIR HDR.–150#

TO V–1150 THETA-PID-0005A — 2"–A–606 .218" W.T. GR. B

FR. INLET SEP. THETA-PID-0005A — 16"–A–102A .375" W.T. GR. B

FR. INLET SEP. THETA-PID-0005A — 3"–A–324A–1"HET .216" W.T. GR. B

16"–A–107A .375" W.T. GR. B · 8"–C–111A .500" W.T. GR. B · 8"–A–403A .322" W.T. GR. B · 3"–A–502C .216" W.T. GR. B · 3"–A–302A–1"HET .216" W.T. GR. B · 4"–C–202A–1"HET .237" W.T. GR. B · 3"–A–603A .216" W.T. GR. B · 2"–A–604A .218" W.T. GR. B

16"–150# · 8"–600# · 3"–150# · 2"–150# · 8" CSO · 4" · 3" · 2" · 16" 150#

1"–A–313–1"HET · LSH 2010 · LG 2010 · LC 2010 · LCV 2010 · 3"x2" · N.C. · 2"x1"

AC-3100
TRIM COOLER
DUTY: 2.57 MMBTU/HR
MAWP: 1440 PSIG @ 175'F
MOTOR: 50 HP, 1800 RPM, 230/460-3-60

F-3300
FILTER SEPARATOR
SIZE: 30" O.D. x 12' S/S
MAWP: 1440 PSIG @ 120'F
(EXTERRAN)

AC-3200
TRIM COOLER
DUTY: 2.57 MMBTU/HR
MAWP: 1440 PSIG @ 175'F
MOTOR: 50 HP, 1800 RPM, 230/460-3-60

V-4100
GLYCOL CONTACTOR
SIZE: 48" I.D. x 25'-0" S/S
MAWP: 1440PSIG. @ 120'F
(VALERUS)

V-4200
GLYCOL CONTACTOR
SIZE: 42" I.D. x 25'-0" S/S
MAWP: 1440PSIG. @ 120'F
(VALERUS)

V-3400
AFTER SEPARATOR
SIZE: 36" O.D. x 10'-0" S/S
MAOP: 1440 PSIG. @ 120'F
(EXTERRAN)

AC-3100
AC-3200
F-3300
V-4100
V-4200
V-3400
V-3400
8"-C-112 CONTACTOR BYPASS .500" W.T. GR B
8"-C-112 FILTER SEPARATOR BYPASS .500" W.T. GR B
2"-C-608 .218" W.T. GR B
2" RICH GLYCOL
2"-C-608 .218" W.T. GR B
TO REGEN SKID THETA-PID-0010
2"-C-607 .218" W.T. GR B
2" LEAN GLYCOL
2"-C-607 .218" W.T. GR B
FR. REGEN SKID THETA-PID-0010
IN 1" NPT
OUT 1" NPT
SET 1440 PSIG
AFTER SEPARATOR BYPASS .500" W.T. GR B
8"-C-118 .500" W.T. GR B
TO FACILITY OUTLET THETA-PID-0012
2"-C-607A .218" W.T. GR B
FR. REGEN SKID THETA-PID-0010A
3"-C-122 .216" W.T. GR B
TO FG. SCRUBBER THETA-PID-0017
2"-C-608A .218" W.T. GR B
TO REGEN SKID THETA-PID-0010A
4"-C-216-1"HET .237" W.T. GR. B
3"-C-120 .216" W.T. GR. B DEHY FUEL GAS
8"-C-117 .500" W.T. GR B
8"-C-116 .500" W.T. GR B
8"-C-115 .500" W.T. GR B
8"-C-114A .500" W.T. GR B
8"-C-114 .500" W.T. GR B
8"-C-113B .500" W.T. GR B
8"-C-113A .500" W.T. GR B
8"-C-112 .500" W.T. GR B
8"-C-131 .500" W.T. GR B
8"-C-130 .500" W.T. GR B
1"-A-408 .179" W.T.
2"-C-215 .216" W.T. GR B
2"-C-214 .216" W.T. GR B
1"-C-214A-1HET .179" W.T. GR B
4"x2"
2" RICH GLYCOL
2" LEAN GLYCOL
FR. DISCHARGE HDR. THETA-PID-0006
TO INLET SEPARATOR THETA-PID-0005
TO SUCTION HDR. THETA-PID-0006
4"-C-216-1"HET .237" W.T. GR. B
3"-C-120 .216" W.T. GR. B
RECYCLE
3/8" TUBING
METHANOL
U/G
N.C.
N.O.
NC
1" NPT NORRISEAL
2" 1/4" PORT

SK-4100
GLYCOL REGEN SKID
12'-2" x 29'-0"
1.0 MMBTU/HR
(VALERUS)

F-4100
HP GLYCOL FILTER

H-4110
1MM REBOILER
INTERNAL: ATMOS. @ –
EXTERNAL: – @ –
42" OD X 17'-0" LG
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

V-4120
FUEL GAS K.O. POT
INTERNAL: ATMOS. @ –
EXTERNAL: – @ –
XX" OD XX" LG
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

V-4130
PUMP GAS SEPARATOR
INTERNAL: 125 @ 250
EXTERNAL: – @ –
30" OD X 10'-0" LG
ASME SECTION VIII, DIV 1
C.A.: NONE
N.D.E. TESTING: RT-4

E-4160
GLYCOL/GYCOL
EXCHANGER
EXTERNAL: – @ –
2" PIPE IN 4" PIPE
10 PASS, SPLIT 8/2

V-4140
CHARCOAL FILTER
INTERNAL: 15 @ 120
EXTERNAL: – @ –
12 3/4" OD X 4'-3" OAL
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

P-4171
GLYCOL PUMP
45015 PV
KIMRAY

P-4172
GLYCOL PUMP
45015 PV
KIMRAY

V-4150
GLYCOL SOCK FILTER
INTERNAL: 15 @ 120
EXTERNAL: – @ –
8 5/8" OD X 3'-9" S/S
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

CONNECTION SCHEDULE					
MK	QTY.	SIZE	RATING	TYPE	SERVICE
A	1	3"	3000#	NPT	VAPOR OUTLET
B	1	2"	S/80	NPT	REBOILER FILL
C	1	1 1/2"	3000#	NPT	GLYCOL INLET FROM ABSORBER
D	1	1 1/2"	3000#	NPT	GLYCOL OUTLET FROM ABSORBER
E	1	1"	3000#	NPT	REBOILER DRAIN
F	1	1"	3000#	NPT	GLYCOL DRAIN
G	1	1"	3000#	NPT	PGS DISTALLATE OUTLET
H	1	1"	3000#	NPT	PGS BACK PRESSURE OUTLET
J	1	1"	3000#	NPT	PGS DRAIN
K	1	3/4"	3000#	NPT	SUPPLY GAS INLET
L	1	1/2"	3000#	NPT	REBOILER SKIMMER
M	1	1/2"	3000#	NPT	FUEL GAS KO POT DRAIN
N	2	1/2"	3000#	NPT	SOCK FILTER DRAINS
P	1	1/2"	3000#	NPT	CHARCOAL FILTER DRAIN
Q	1	1"	3000#	NPT	GLYCOL RECOVERY

DETAIL "A"
SEE THETA-PID-0011

1 1/2" CERAMIC SADDLES

1 1/2" FIBERGLASS W/ ALUMINUM JACKET

TEG

FUEL GAS

2"-A-504
.218" W.T. GR. B

3"-A-415
.216" W.T. GR. B

1 1/2"-G-050

1 1/2"-G-080

1 1/2"-G-070

1 1/2"-G-020

1 1/2"-G-030

1 1/2"-G-040

1 1/2"-G-010

1 1/2"-G-090

1"-FG-020

1"-FG-010

1"-R-010

1"-R-020

1"-R-030

1"-R-040

1"-PIL-010

2"-A-504A
.218" W.T. GR. B
TO SK-4200
THETA-PID-0010A

2"-A-504
.218" W.T. GR. B
FR. F.G. SCRUBBER
THETA-PID-0017

2"-A-505
.218" W.T. GR. B
TO B-TEX COND.
THETA-PID-0011

3"-A-415
.216" W.T. GR. B
TO B-TEX COND.
THETA-PID-0011

FROM SK-4200
THETA-PID-0010A
2"-A-128A
.218" W.T. GR. B

TO INLET SEP.
V-1100
THETA-PID-0005
2"-A-128
.218" W.T. GR. B
FLASH GAS

TO V-4100
GLYCOL CONTACTOR
THETA-PID-0009
2"-C-607
.218" W.T. GR. B
LEAN GLYCOL

FR. V-4100
GLYCOL CONTACTOR
THETA-PID-0009
2"-C-608
.218" W.T. GR. B
RICH GLYCOL

THETA-PID-0011
1"-A-XXX

2"-A-311-1"HET
.218" W.T. GR. B
FROM SK-4500
THETA-PID-0011

2"-A-304A-1"HET
.218" W.T. GR. B
FROM SK-4200
THETA-PID-0010A

2"-A-304-1"HET
.218" W.T. GR. B
TO TK-6100
THETA-PID-0013

2"-A-304-1"HET
.218" W.T. GR. B
L.P. DRAIN

LEAN GLYCOL
2"-C-607
.218" W.T. GR. B

RICH GLYCOL
2"-C-608
.218" W.T. GR. B

F-4200
HP GLYCOL FILTER

H-4210
1MM REBOILER
INTERNAL: ATMOS. @ –
EXTERNAL: – @ –
42" OD X 17'-0" LG
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

V-4220
FUEL GAS K.O. POT
INTERNAL: ATMOS. @ –
EXTERNAL: – @ –
XX" OD XX" LG
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

SK-4200
GLYCOL REGEN SKID
12'-2" x 29'-0"
1.0 MMBTU/HR
(VALERUS)

V-4230
PUMP GAS SEPARATOR
INTERNAL: 125 @ 250
EXTERNAL: – @ –
30" OD X 10'-0" LG
ASME SECTION VIII, DIV 1
C.A.: NONE
N.D.E. TESTING: RT-4

E-4260
GLYCOL/GYCOL
EXCHANGER
EXTERNAL: – @ –
2" PIPE IN 4" PIPE
10 PASS, SPLIT 8/2

V-4240
CHARCOAL FILTER
INTERNAL: 15 @ 120
EXTERNAL: – @ –
12 3/4" OD X 4'-3" OAL
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

P-4271
GLYCOL PUMP
45015 PV
KIMRAY

P-4272
GLYCOL PUMP
45015 PV
KIMRAY

V-4250
GLYCOL SOCK FILTER
INTERNAL: 15 @ 120
EXTERNAL: – @ –
8 5/8" OD X 3'-9" S/S
NON CODE
C.A.: NONE
N.D.E. TESTING: N/A

CONNECTION SCHEDULE					
MK	QTY.	SIZE	RATING	TYPE	SERVICE
A	1	3"	3000#	NPT	VAPOR OUTLET
B	1	2"	S/80	NPT	REBOILER FILL
C	1	1 1/2"	3000#	NPT	GLYCOL INLET FROM ABSORBER
D	1	1 1/2"	3000#	NPT	GLYCOL OUTLET FROM ABSORBER
E	1	1"	3000#	NPT	REBOILER DRAIN
F	1	1"	3000#	NPT	GLYCOL DRAIN
G	1	1"	3000#	NPT	PGS DISTALLATE OUTLET
H	1	1"	3000#	NPT	PGS BACK PRESSURE OUTLET
J	1	1"	3000#	NPT	PGS DRAIN
K	1	3/4"	3000#	NPT	SUPPLY GAS INLET
L	1	1/2"	3000#	NPT	REBOILER SKIMMER
M	1	1/2"	3000#	NPT	FUEL GAS KO POT DRAIN
N	2	1/2"	3000#	NPT	SOCK FILTER DRAINS
P	1	1/2"	3000#	NPT	CHARCOAL FILTER DRAIN
Q	1	1"	3000#	NPT	GLYCOL RECOVERY

DETAIL "A"
SEE THETA-PID-0011

TO INLET SEP. V-1100
THETA-PID-0010
2"-A-128A .218" W.T. GR. B
FLASH GAS

TO V-4200 GLYCOL CONTACTOR
THETA-PID-0009
2"-C-607A .218" W.T. GR. B
LEAN GLYCOL

FR. V-4200 GLYCOL CONTACTOR
THETA-PID-0009
2"-C-608A .218" W.T. GR. B
RICH GLYCOL

2"-A-504A .218" W.T. GR. B
FUEL GAS

FR. FG SCRUBBER
THETA-PID-0010
2"-A-504A .218" W.T. GR. B

TO SK-4500
THETA-PID-0011
3"-A-415A .216" W.T. GR. B

2"-A-304A-1"HET .218" W.T. GR B
L.P. DRAIN

TO TK-6100
THETA-PID-0010
2"-A-304A-1"HET .218" W.T. GR B

P-120/M-120
LIQUID DRAIN PUMP
MODEL: MTH T51
MWPSI: 350 PSIG
HP/RPM: 3/4 HP, 1800 RPM

V-110
VESSELS
SIZE: 14" x X'-X" C.S
DESIGN PRESS: 250@230°F.
CAPACITY: XXX BBLS

GHE-150/OHE-150
COOLERS
MODEL: XXX
MWPSI: 250 PSI @ 250°F

C-130
COMPRESSOR
MODEL: SCG14G
GEAR RATIO: 1.43

M-130
COMPRESSOR MOTOR
MODEL: CL1 DIV 2
FRAME: 405TCZ
HP/RPM: 100 HP, 3550 RPM

V-140
VESSELS
SIZE: 14" x X'-X" C.S
DESIGN PRESS: 250@250°F.
CAPACITY: XXX BBLS

HOLD

CUSTOMER ELECTRICAL SERVICE
480 VAC. 60 HZ, 3 OMS.
CONTROL PANEL OFF-SKID
PLC 3750
VFD 3750

SUCTION PRESSURE PI 3751 HH H
RUN IND. XI 3750
COMM. FAULT XA 3751
E-STOP XE 3750

SK-375

SET @ XX PSIG
PCV 3750
TO VOC ENCLOSED FLARE
THETA-PID-0015
6"-A-422
.280" W.T. GR. B
6" 150#
PI 3750
0-15 PSIG SEE NOTE 6
PT 3750
FR. STORAGE TANKS
THETA-PID-0013
6"-A-421
.280" W.T. GR. B
4
6"
6"x4"
A
TO TK-6100
THETA-PID-0013
1"-A-371-1"HET
.179" W.T. GR. B
C
1"
FR. PT-7000
THETA-PID-0013

B
4

SK-385

4
6"
6"x4"
A
TO TK-6100
THETA-PID-0013
1"-A-372-1"HET
.179" W.T. GR. B
C
1"

PI 3761 HH H SUCTION PRESSURE
XI 3760 RUN IND.
XA 3761 COMM. FAULT
XE 3760 E-STOP

B
4
2"
4
2"
4

AIC 3750 HH
AE 3750
02
SOV 3751
I.A.
PCV 3751
ZSO 3751
ZCV 3751
XV 3751
1/2"
3"x2"
TO INLET SEPARATOR
THETA-PID-0005
3"-A-221
.216" W.T. GR. B
3" NC
3" 150# FC
4
FI 3760
FIT 3760
1/2"
1/2"
2"
2"
2"
FE 3760