

OWNER

Process Description and Operating Philosophy

Report



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TORUS

, County,

N O T I C E

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1. INTRODUCTION

1.1. PURPOSE

This report describes the process of the
 and how TORUS intends it to be operated. It sets out the process flow, the design cases, the control philosophy, and the operating steps for every mode the station will see, from commissioning to emergency shutdown. It is the process basis for the piping and instrumentation diagrams, the control narrative and cause-and-effect matrix, and the commissioning and start-up specification.

1.2. SCOPE

The report covers the station from the inlet insulating joint IJ-101 to the receiving pipeline operator's tap valve, including the outlet lateral. It covers normal operation between 10 and 120 MMSCFD, winter and summer operation of the line heater, pig receipt, maintenance of the filter separator, meter runs and control valves, overpressure protection, emergency shutdown, blowdown, liquids handling and the response to off-specification gas. Where a step depends on a calculated value, the value is taken from the
 PRO calculation named in the text.

1.3. EXCLUSIONS

The report does not cover the Owner's upstream lateral and treating facility, the hot tap and tap valve on the receiving pipeline (receiving pipeline operator's scope), custody measurement procedures and meter verification details (Volume 2), electrical and communications systems, or the detailed commissioning procedure (
 SPC-SPC-018). Instrument setpoints in this report are process values; the alarm and trip list in Volume 7 governs.

2. PROCESS DESCRIPTION

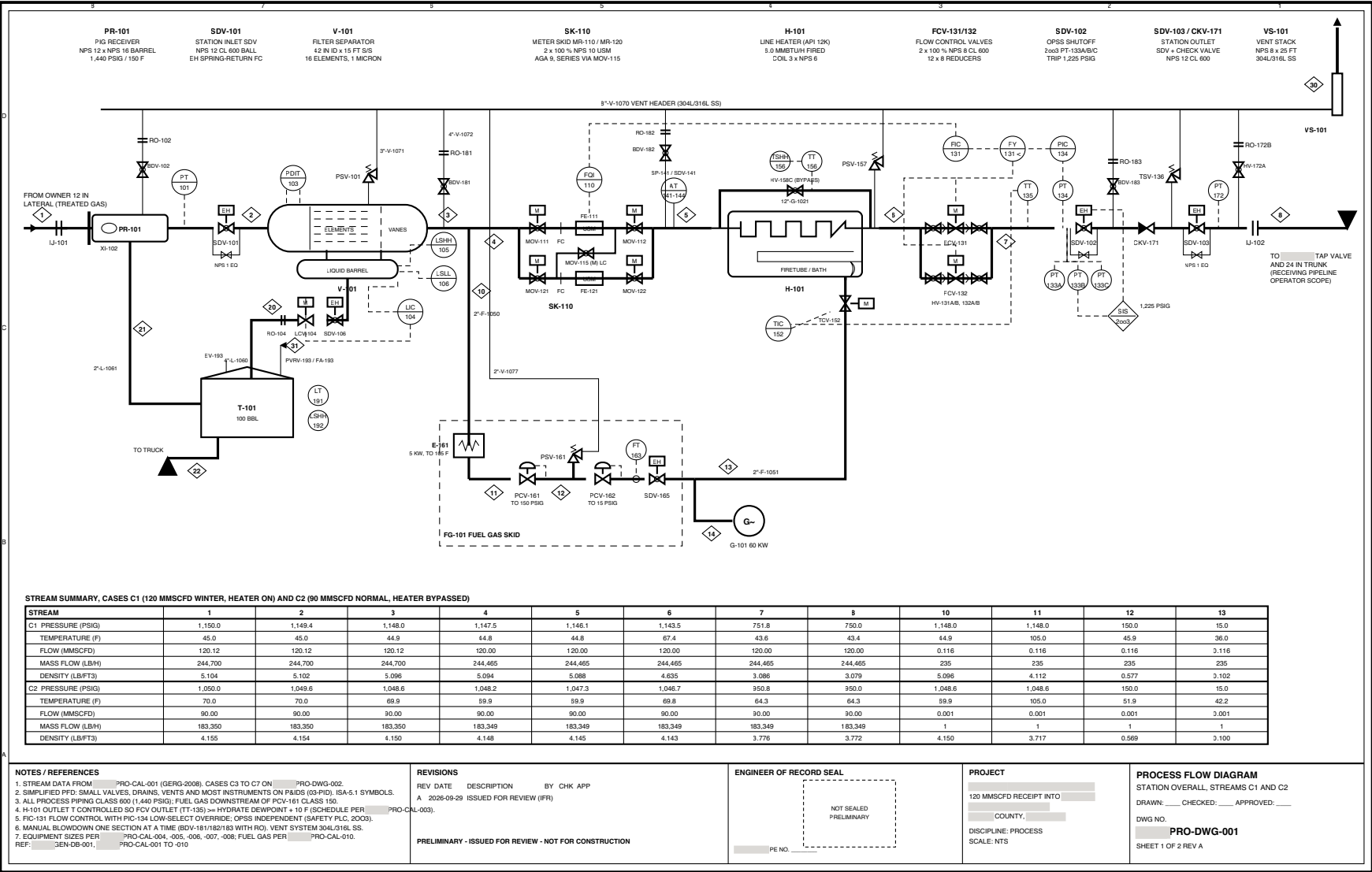
2.1. FLOW PATH

Treated and dehydrated residue gas arrives from the Owner's 12 in lateral at 900 to 1,150 psig. The gas passes insulating joint IJ-101, pig receiver PR-101 and inlet shutdown valve SDV-101, and enters filter separator V-101. V-101 is a two-stage horizontal filter separator, 42 in inside diameter by 15 ft seam to seam, with 16 coalescing elements rated at 1 micron and a vane pack. It removes solids and free liquids before the gas reaches the custody meters. Liquids collect in a two-compartment lower barrel (NPS 24 x 14 ft) and are dumped through SDV-106, LCV-104 and restriction orifice RO-104 to the 100 bbl atmospheric liquids tank T-101, which is emptied by vacuum truck.

Fuel gas is taken at the V-101 outlet, upstream of the meters, so that fuel never passes through the custody measurement and is not delivered. The custody gas is measured by one of two 100 % NPS 10 ultrasonic meter runs, MR-110 and MR-120. The standby run is kept pressurized with its outlet valve open, because a run isolated at both ends in the sun would reach about 1,570 psig and has no relief device (PRO-CAL-007). Gas quality is measured at sample point SP-141 downstream of the meters by a gas chromatograph and water, hydrogen sulfide and oxygen analyzers.

The gas then passes through indirect-fired water-bath line heater H-101, or around it through its bypass when heat is not needed. Duty control valve FCV-131 (FCV-132 is the standby) takes the pressure cut to the trunk pressure. Downstream, overpressure shutdown valve SDV-102, check valve CKV-171, outlet shutdown valve SDV-103 and insulating joint IJ-102 lead to the buried outlet lateral and the tap valve on the receiving pipeline operator's 24 in trunk. Figure 2-1 shows the flow path, the major control loops and the numbered streams, with the stream conditions for cases C1 and C2.

Figure 2-1. Process Flow Diagram



2.2. DESIGN CASES

TORUS designed the station for the seven operating cases of the Basis of Design, GEN-DB-001. Table 2-1 gives the station conditions in each case from the heat and material balance, PRO-CAL-001. Case C1 governs the heater, case C4 the control valve size, case C5 the meter velocity, and case C6 is the heater-out upset.

Table 2-1: Design Cases and Station Conditions

Case	Description	Flow, MMSCFD	Inlet, psig	Outlet, psig	Outlet, °F	H-101	FCV travel, %
C1	Design max, winter, max pressure cut	120	1,150	752	44	In service	58
C2	Normal operation	90	1,050	951	64	Bypassed	67
C3	Minimum flow (turndown)	10	1,000	950	57	Bypassed	19
C4	Summer max temperature	120	1,100	1,002	115	Bypassed	76
C5	Min metering pressure, max flow	120	900	752	51	In service	73
C6	Heater-out winter upset	120	1,150	752	18	Bypassed	57
C7	Rich gas, design max	120	1,100	852	52	In service	64

2.3. UTILITIES

Fuel gas for H-101 and standby generator G-101 is regulated in two cuts on skid FG-101: PCV-161 to 150 psig and PCV-162 to 15 psig. Electric preheater E-161 heats the fuel to 105 °F upstream of PCV-161, because the first cut would otherwise cool winter gas to about -36 °F, below the minimum design metal temperature (PRO-CAL-010). PSV-161 protects the low-pressure fuel system at 250 psig. Power is from the utility, with automatic transfer to G-101 and an 8 h uninterruptible supply for control and safety systems. There is no instrument air: every automated valve uses an electric or self-contained electro-hydraulic actuator, so the station has no gas-driven pneumatic devices. The vent system downstream of every restriction orifice and relief valve is stainless steel, because gas leaving the orifices during a winter blowdown reaches about -64 °F.

3. CONTROL PHILOSOPHY

3.1. FLOW AND PRESSURE

FIC-131 holds the nominated flow on the duty control valve, using the flow computer signal. PIC-134 overrides it through a low-select so that the outlet pressure never exceeds 1,150 psig (adjustable, never above 1,180 psig). The override is the first protection layer for the trunk. The control valves are NPS 8 Class 600 globe valves with three-stage low-noise trim, installed between 12 x 8 reducers in NPS 12 branch piping. Their predicted noise is about 86 dBA at 1 m, so both valve bodies and 10 ft of downstream pipe carry acoustic insulation (PRO-CAL-006).

3.2. TEMPERATURE

The gas must leave the control valve at least 10 °F above the hydrate formation temperature of tariff-quality gas, and never below the 40 °F tariff minimum. Because the hydrate temperature rises with pressure, the setpoint is pressure-compensated: a characterizer on PT-134 sets the TT-135 target, which cascades to heater outlet controller TIC-152. Table 3-1 gives the characterizer points from PRO-CAL-003. A fixed 40 °F setpoint was rejected because it gives only 6.5 °F of margin at 750 psig and falls below the 41.1 °F hydrate dewpoint at 1,150 psig. A fixed setpoint high enough for 1,150 psig was also rejected, because it would burn fuel needlessly at the lower outlet pressures.

Table 3-1: Control Valve Outlet Temperature Setpoint

Outlet pressure, psig	Hydrate dewpoint, 7 lb/MMscf, °F	Setpoint, design gas, °F	Setpoint, rich gas, °F
750	33.5	43.5	52.5
800	34.7	44.7	52.4
850	35.8	45.8	52.1
900	36.8	46.8	51.4
950	37.8	47.8	50.5
1,000	38.7	48.7	49.2
1,050	39.5	49.5	49.8
1,100	40.4	50.4	50.6
1,150	41.1	51.1	51.4

3.3. LEVEL, OVERPRESSURE AND SHUTDOWN

LIC-104 modulates LCV-104 on the V-101 barrel level. Low-low level LSLL-106 closes SDV-106 and LCV-104 through the safety controller, so gas cannot blow through to T-101 if the level is lost. SDV-106 is independent of LCV-104 because the dump valve cannot be both the device that fails and the device that protects. The overpressure protection system uses three pressure transmitters, PT-133A/B/C, voting two out of three on the safety controller. At 1,225 psig it closes SDV-102 and SDV-103. SDV-102

closes fully in 4 s or less, which holds the peak trunk pressure to about 1,260 psig, below the 1,290 psig limit under 49 CFR 192.201 (PRO-CAL-009). The trip was set at 1,225 psig rather than the 1,250 psig first proposed: at 1,250 psig the process safety time would be shorter than the response of the protection, while 1,225 psig still sits 45 psi above the highest PIC-134 setting of 1,180 psig, so spurious trips are not expected. Table 3-2 lists the principal process alarms and trips.

Table 3-2: Principal Process Alarms and Trips

Tag	Function	Setting
PT-133A/B/C, two out of three	Close SDV-102 and SDV-103 (overpressure protection)	1,225 psig
PIC-134	Outlet pressure override through low select	1,150 psig, adjustable to 1,180 psig
TT-135	Control valve outlet temperature low / low-low alarms	Schedule minus 3 °F / 40 °F
TT-156	Heater gas outlet high-high, burner trip	140 °F
TSHH-155	Bath high-high, burner trip	200 °F
PDIT-103	Filter differential high, element change	10 psid
LT-104	V-101 barrel level high / low alarms	70 % / 20 % of barrel diameter
LSHH-105	V-101 high-high level, closes SDV-101	85 % of barrel diameter
LSLL-106	V-101 low-low level, closes SDV-106 and LCV-104	10 % of barrel diameter
LSHH-192	T-101 high-high level, closes SDV-106 and LCV-104	90 %
PSV-101, PSV-157, TSV-136	Pressure relief	1,440 psig
PSV-161 / PSV-141B	Fuel gas relief / analyzer sample relief	250 psig / 50 psig

Note 1: The alarm and trip list in Volume 7 governs; the values here are the process basis.

4. OPERATING MODES

4.1. INITIAL PURGE AND GAS PACK

After hydrotest, dewatering and drying to a -40 °F water dewpoint, each section is purged of air with nitrogen. TORUS chose pressure-cycle purging, three cycles to 30 psig vented through the blowdown valves, because it needs no continuous flow path and gives a verifiable oxygen reading at the stack. The station needs about 8,590 scf of nitrogen, and is left at 5 to 10 psig of nitrogen.

Gas is then admitted through the NPS 1 equalizing bypass around SDV-101 and vented through the restriction orifices, one section at a time, until the vent gas is at least 95 % hydrocarbon. The station is then pressurized at no more than 50 psi per minute, with leak checks at 300 psig, 700 psig and line pressure. Throttling 1,150 psig gas into an empty station would cool it to about -52 °F from 45 °F supply gas (-14 °F from 70 °F), below the -20 °F minimum design metal temperature. For that reason the station shall be pre-pressurized with nitrogen before gas is admitted, or gas-in shall be limited to supply at 900 psig or less and 60 °F or warmer, with the skin temperature downstream of the bypass monitored. The initial pack uses about 93,800 scf of gas.

4.2. START-UP

The operator first confirms with the receiving pipeline operator that the tap valve is open, the nomination is set and the data link is live. V-101 level control is placed in automatic, the duty meter run is selected, and the analyzers are placed in service. The heater mode is chosen from Figure 4-1: if the station inlet temperature is below the bypass limit for the expected pressure cut, H-101 is lit and its bath brought to temperature before flow, and E-161 is energized first so the fuel gas is preheated. SDV-102 and SDV-103 are equalized through their NPS 1 bypasses, which take about 20 minutes from a depressured outlet section, and then opened. With FCV-131 in manual at zero travel, FIC-131 is set to a low rate of about 10 MMSCFD and transferred to automatic, and the flow is raised to the nomination at no more than about 20 MMSCFD per 10 minutes while TT-135 and PIC-134 are watched.

4.3. NORMAL OPERATION

In normal operation (case C2) the station receives 1,050 psig gas and delivers it at 951 psig, with FCV-131 at about 67 % travel. One meter run is in service, the heater is set by season, LCV-104 dumps the small normal liquid flow to T-101, and E-161 preheats the fuel. The operator watches the filter differential (element change at 10 psid), the meter diagnostics, gas quality, the T-101 level and the heater bath.

4.4. WINTER HEATER OPERATION

In winter the heater is in line and TIC-152 holds the scheduled control valve outlet temperature. At the design winter condition (case C1) the heater absorbs 3.96 MMBtu/h, 5.29 MMBtu/h fired against its 6.0 MMBtu/h rating, and the gas leaves the coil at 67 °F. A normal winter day at 90 MMSCFD needs about

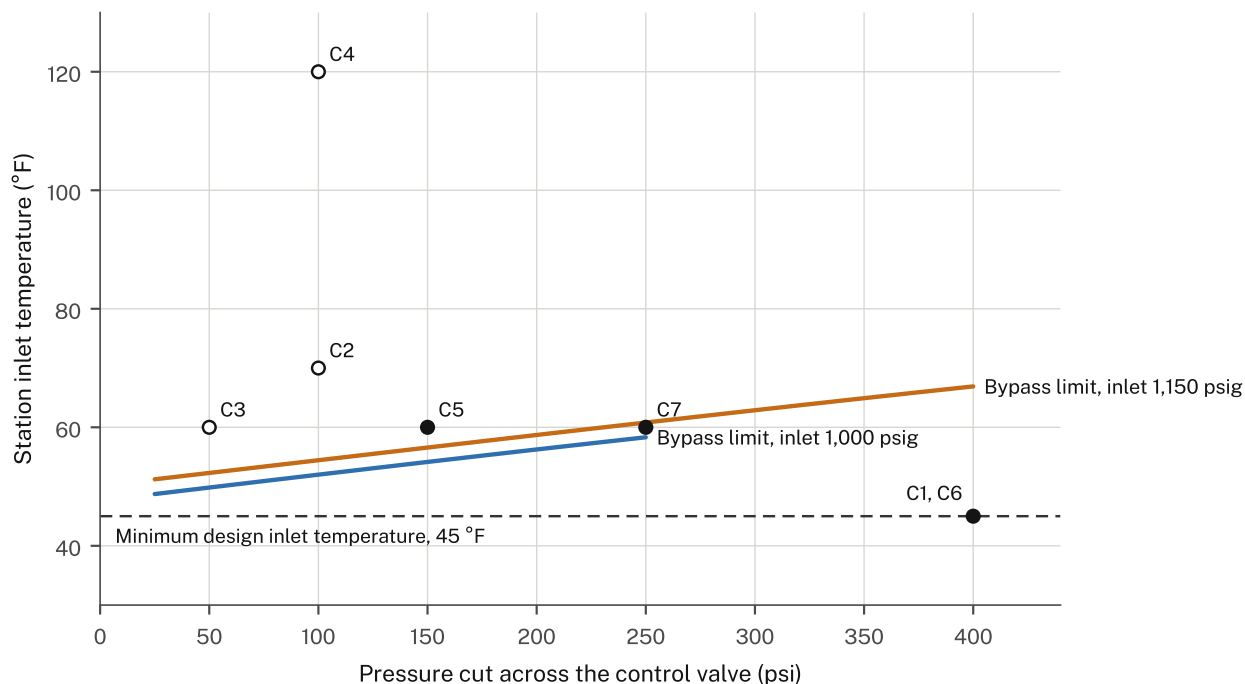
1.1 MMBtu/h. The heater's burner management system uses two diverse flame detectors, BE-153A and BE-153B, and a high-high gas outlet temperature trip on TT-156 at 140 °F protects the downstream piping, whose design temperature is 150 °F.

If the heater trips, the station keeps flowing and TT-135 falls toward the case C6 value of 18 °F at the maximum pressure cut. That is below the hydrate dewpoint and the tariff minimum but above the -20 °F minimum design metal temperature, so it is an operating upset rather than a metal hazard. On the TT-135 low alarm the operator reduces the pressure cut or the rate; at the low-low alarm the rate is reduced until the bypassed outlet holds 40 °F, and the receiving pipeline operator is notified. The heater is then restarted through its burner management sequence.

4.5. SUMMER HEATER BYPASS

Figure 4-1 shows, for two inlet pressures, the lowest station inlet temperature at which the control valve outlet still meets the setpoint with the heater bypassed. For the largest cut, 1,150 to 750 psig, the inlet must be at least 67 °F; for a 1,100 to 950 psig cut it must be at least 56 °F. When the inlet temperature is above the limit, the operator opens bypass valve HV-158C and then closes the heater inlet and outlet valves. The heater remains in hot standby on its pilot, so it can return to service without a cold start, and PSV-157 protects the isolated coil. The heater is returned to service before the inlet temperature falls below the limit, with a seasonal check each October.

Figure 4-1. Heater Bypass Limit and Basis Operating Cases



In Figure 4-1 the filled markers are the basis cases run with the heater in service and the open markers are those run with it bypassed. Cases C1 and C6 share a point: the same winter condition with the heater in service and out of service. The limit lines are for the design gas composition; rich gas (case C7) needs 6 to 9 °F more because of its higher hydrocarbon dewpoint.

4.6. PIG RECEIPT

The Owner advises the launch time and expected liquids. Before the pig arrives the operator confirms that V-101 is at or below normal level with LCV-104 in automatic, that T-101 has room for at least the 5 bbl design slug (HOLD H-16), and that the receiver closure is secured and the barrel aligned to receive. Liquids pushed ahead of the pig reach V-101 first. The barrel holds the design slug below the high-high trip while LCV-104 dumps at up to 30 gpm, so a high-level alarm is expected but no trip. When pig signaler XI-102 shows arrival, the barrel is isolated and vented through BDV-102 and restriction orifice RO-102, which brings it to 50 psig in about 11 minutes. After zero pressure is confirmed on PI-102, the barrel is drained to T-101, purged with nitrogen if pyrophoric iron sulfide is suspected, and opened.

4.7. FILTER ELEMENT CHANGE-OUT

The elements are changed when the differential reaches 10 psid, or on schedule. The V-101 bypass is locked closed and is used only with the receiving pipeline operator's approval, because unfiltered gas would reach the custody meters. The normal method is therefore a planned shut-in: flow is ramped to zero, SDV-103 and SDV-101 are closed, and the inlet section is blown down through BDV-181 and RO-181, which takes about 24 minutes to reach 50 psig. The vessel is purged with nitrogen, the elements and gaskets are replaced, and the section is purged, repressurized as for initial pack, and returned to service.

4.8. METER RUN SWITCHING AND SERIES VERIFICATION

To switch meter runs, the operator opens the standby run's inlet valve (its outlet valve is already open), confirms that flow shares, then closes the inlet valve of the run being taken out. For meter-to-meter verification, at least quarterly and in the presence of the receiving pipeline operator's witness, the rate is reduced to case C2 flow or lower, crossover valve MOV-115 is opened, and the valves are aligned so the gas passes through both meters in series. This adds only about 3.2 psi at 120 MMSCFD. Agreement within 0.3 % is required. The procedure is detailed in Volume 2.

4.9. CONTROL VALVE SWITCHOVER

If the duty valve's position deviates from its demand, the control system ramps FCV-132 open in flow control while driving FCV-131 closed, without a bump in flow. For maintenance the switchover is made manually and the out-of-service valve is isolated by its block valves and depressured. Both control valves fail as-is on loss of power and have handwheels, so flow can be held manually.

4.10. OPSS TRIP AND RESET

When two of the three pressure transmitters reach 1,225 psig, the safety controller closes SDV-102 and SDV-103 and flow stops. The inlet stays open, so the station remains packed. Thermal relief valve TSV-136 protects the section trapped between SDV-102 and SDV-103. Reset is local and deliberate: the operator finds and corrects the cause, confirms the trunk pressure is below 1,150 psig and both control valves are closed in manual, resets the trip at the valve, equalizes and reopens the shutdown valves, and restarts as for start-up. Overpressure events are reported as 49 CFR 191 requires.

4.11. EMERGENCY SHUTDOWN

Any station shutdown push-button, confirmed gas detection, a fire at the heater, loss of control power, or a remote shutdown from the receiving pipeline operator closes SDV-101, SDV-102, SDV-103, SDV-106, fuel shutoff SDV-165 and analyzer sample shutoff SDV-141, trips the heater and de-energizes E-161. The motor-operated valves and control valves fail as-is. There is no automatic blowdown: after the station is made safe, the operator decides whether to blow down.

4.12. MANUAL BLOWDOWN BY SECTION

The station is divided into the sections in Table 4-1. Each is blown down to the vent stack through a manual full-bore valve and a restriction orifice that sets the rate (PRO-CAL-008). Sections are blown down one at a time: the 25 ft vent stack meets the radiation criteria for a single section if the release ignites, and simultaneous blowdown would need a 43 ft stack. Blowdown valves are opened fully. Personnel stay upwind, and hot work and vehicles are kept at least 50 ft from the stack.

Table 4-1: Blowdown Sections

Section	Boundary	Volume, ft ³	Valve and orifice	Time to 50 psig, min	Coldest gas after orifice, °F
S1, inlet	IJ-101 to the meter run inlet valves, including PR-101 and V-101	428	BDV-181, RO-181 (9/16 in)	24	-64
S2, meter and heater	Meter run inlet valves to SDV-102, including H-101 and the control valves	367	BDV-182, RO-182 (9/16 in)	20	-61
S3, outlet	SDV-102 to SDV-103	24	BDV-183, RO-183 (3/16 in)	12	-70
S4, outlet lateral	SDV-103 to the tap valve, lines 1041 and 1042	138	HV-172A, RO-172B (3/8 in)	17	-69
PR-101 barrel	Barrel isolated for pig removal	22	BDV-102, RO-102 (3/16 in)	11	-71

Note 1: The section 3 time and temperature are for a trip from normal operation. After a heater-out upset, the section should be allowed to warm before blowdown, because the gas leaving RO-183 would otherwise reach about -126 °F.

Section 3 shall not be blown down after a heater-out upset trip until its skin temperature is at or above 40 °F. Trapped at up to 1,290 psig and 18 °F, it would otherwise cool its wall below the -20 °F minimum design metal temperature during blowdown (PRO-CAL-008). The P&ID carries this rule at BDV-183.

4.13. LIQUIDS HANDLING AND TRUCK-OUT

V-101 liquids flash as they pass LCV-104 and RO-104 into T-101. The normal liquid rate is small (a design allowance of 2 bbl/d, HOLD H-20). Flash gas and tank breathing vent through PVRV-193 and flame arrestor FA-193; emergency vent EV-193 protects the tank in fire and in the case of gas blow-by. High level on LT-191 schedules a truck, and high-high level LSHH-192 closes SDV-106 and LCV-104. Trucks load inside the tank containment, grounded and bonded, with no open hatches and a spill kit present. The tank throughput is limited to 350 bbl/yr (about 350,000 scf/yr of flash gas) so that its emissions stay below the regulatory storage vessel threshold.

4.14. OFF-SPECIFICATION GAS RESPONSE

The analyzers alarm to the Owner and the receiving pipeline operator when heating value, carbon dioxide, inerts, water, hydrogen sulfide or oxygen leave the delivery specification (HOLD H-13). If the condition lasts for the agreed delay, 15 minutes by default, the control system ramps FIC-131 to zero and closes SDV-103. While the delay runs, two process actions apply. High water raises the hydrate dewpoint, so the operator raises the TT-135 setpoint by 5 °F on the water alarm. Rich gas has a hydrocarbon dewpoint of about 42 °F at the outlet, so the setpoint schedule carries the rich-gas column, with a 10 °F margin over that dewpoint, while the heating-value alarm is active. Free liquids arriving from upstream appear as rising V-101 level and dump frequency, and are handled as a pig slug with the Owner notified.

5. SUMMARY AND CONCLUSIONS

The station can be operated safely across all seven design cases with the equipment and controls described in this report. TORUS draws the following conclusions:

1. The line heater is needed in winter for the larger pressure cuts, and can be bypassed in summer when the inlet temperature is above the limit in Figure 4-1.
2. The control valve outlet temperature setpoint shall be pressure-compensated as in Table 3-1, because a fixed 40 °F setpoint does not keep the required margin over the hydrate dewpoint at higher outlet pressures.
3. Fuel gas shall be preheated by E-161 to 105 °F before PCV-161.
4. The OPSS trips at 1,225 psig and SDV-102 shall close fully in 4 s or less, which keeps the trunk below 1,290 psig with a peak of about 1,260 psig.
5. The standby meter run shall be kept with its outlet valve open, and sections shall be blown down one at a time.
6. Initial gas-in shall follow a nitrogen pre-pressurization, or be limited to warm supply gas at 900 psig or less, to keep piping above its minimum design metal temperature.

The open items that affect operation are listed in Table 5-1.

Table 5-1: Open Items Affecting Operation

Hold	Item	Responsible party
H-01	Interconnect and operating agreement: witness rights, verification frequency	Owner and receiving pipeline operator
H-04	Trunkline data, valve spacing and whether the trunk can be blocked in at the tap	Receiving pipeline operator
H-12	Extended gas and liquid composition	Owner
H-13	Gas quality specification at delivery	Receiving pipeline operator
H-15	Vendor data for the heater, filter separator, valves, regulators and relief valves	Vendors after award
H-16	Upstream lateral MAOP and pigging program	Owner
H-20	Liquids production rate at V-101	Owner

The next step is for the Owner and the receiving pipeline operator to review this report with the control narrative and cause-and-effect matrix, resolve the holds above, and confirm the operating steps before the commissioning procedure is written.

APPENDIX A. STREAM SUMMARY, CASES C3 TO C7



STREAM SUMMARY, CASES C3 TO C7 (STREAM 2 = STREAM 1 LESS PR-101/SDV-101 LOSSES; SEE PRO-CAL-001)

STREAM	1	3	4	5	6	7	8	10	11	12	13
C3 PRESSURE (PSIG)	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	950.0	950.0	1,000.0	1,000.0	150.0	15.0
TEMPERATURE (F)	60.0	60.0	60.0	60.0	60.0	57.0	57.0	60.0	105.0	54.8	45.3
FLOW (MMSCFD)	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.001	0.001	0.001	0.001
MASS FLOW (LB/H)	20,373	20,373	20,372	20,372	20,372	20,372	20,372	1	1	1	1
C4 PRESSURE (PSIG)	1,100.0	1,097.3	1,096.5	1,094.7	1,093.6	1,001.6	1,000.0	1,097.3	1,097.3	150.0	15.0
TEMPERATURE (F)	120.0	119.9	119.8	119.8	119.7	115.5	115.4	119.9	119.9	67.6	58.6
FLOW (MMSCFD)	120.00	120.00	120.00	120.00	120.00	120.00	120.00	0.001	0.001	0.001	0.001
MASS FLOW (LB/H)	244,466	244,466	244,465	244,465	244,465	244,465	244,465	1	1	1	1
C5 PRESSURE (PSIG)	900.0	897.2	896.4	894.5	890.9	751.8	750.0	897.2	897.2	150.0	15.0
TEMPERATURE (F)	60.0	59.8	59.8	59.7	59.6	50.8	50.7	59.8	105.0	61.1	51.8
FLOW (MMSCFD)	120.00	120.00	120.00	120.00	120.00	120.00	120.00	0.001	0.001	0.001	0.001
MASS FLOW (LB/H)	244,468	244,468	244,465	244,465	244,465	244,465	244,465	3	3	3	3
C6 PRESSURE (PSIG)	1,150.0	1,148.0	1,147.5	1,146.1	1,145.3	751.6	750.0	1,148.0	1,148.0	150.0	15.0
TEMPERATURE (F)	45.0	44.9	44.8	44.8	44.7	18.2	18.1	44.9	105.0	45.9	36.0
FLOW (MMSCFD)	120.00	120.00	120.00	120.00	120.00	120.00	120.00	0.001	0.001	0.001	0.001
MASS FLOW (LB/H)	244,466	244,466	244,465	244,465	244,465	244,465	244,465	1	1	1	1
C7 PRESSURE (PSIG)	1,100.0	1,097.7	1,097.1	1,095.6	1,092.7	851.6	850.0	1,097.7	1,097.7	150.0	15.0
TEMPERATURE (F)	60.0	59.9	59.8	59.7	67.8	52.1	51.9	59.9	105.0	42.5	31.5
FLOW (MMSCFD)	120.04	120.04	120.00	120.00	120.00	120.00	120.00	0.042	0.042	0.042	0.042
MASS FLOW (LB/H)	260,863	260,863	260,771	260,771	260,771	260,771	260,771	92	92	92	92

BASIS CASES (GEN-DB-001 SECTION 6)

C1: DESIGN MAX, WINTER, MAX PRESSURE CUT, 120 MMSCFD, DESIGN GAS, INLET 1,150 PSIG / 45 F, TRUNK 750 PSIG, HEATER ON
C2: NORMAL OPERATION, 90 MMSCFD, DESIGN GAS, INLET 1,050 PSIG / 70 F, TRUNK 950 PSIG, HEATER BYPASSED
C3: MINIMUM FLOW (TURNDOWN), 10 MMSCFD, DESIGN GAS, INLET 1,000 PSIG / 60 F, TRUNK 950 PSIG, HEATER BYPASSED
C4: SUMMER MAX TEMPERATURE, 120 MMSCFD, DESIGN GAS, INLET 1,100 PSIG / 120 F, TRUNK 1,000 PSIG, HEATER BYPASSED
C5: MIN METERING PRESSURE, MAX FLOW, 120 MMSCFD, DESIGN GAS, INLET 900 PSIG / 60 F, TRUNK 750 PSIG, HEATER ON
C6: HEATER-OUT WINTER UPSET, 120 MMSCFD, DESIGN GAS, INLET 1,150 PSIG / 45 F, TRUNK 750 PSIG, HEATER BYPASSED
C7: RICH GAS, DESIGN MAX, 120 MMSCFD, RICH GAS, INLET 1,100 PSIG / 60 F, TRUNK 850 PSIG, HEATER ON

LIQUID, VENT AND STANDBY STREAMS (ALL CASES)

14	G-101 FUEL (STANDBY)	0 NORMAL; 680 SCF/H AT 15 PSIG DURING UTILITY OUTAGE
20	V-101 LIQUIDS TO T-101	2 BBL/D AVERAGE (HOLD H-20); 30 GPM WHILE DUMPING; SG ABOUT 0.85; FLASHES ACROSS LCV-104 (ABOUT 750 SCF/BBL DUMPED, HOLD H-12)
21	PR-101 DRAIN TO T-101	BATCH AFTER PIG RECEIPT, DESIGN 5 BBL, GRAVITY FROM DEPRESSURED BARREL
22	T-101 TRUCK-OUT	BATCH BY VACUUM TRUCK, UP TO 400 GPM
30	VENT HEADER TO VS-101	INTERMITTENT: S1 BLOWDOWN PEAK 16,859 LB/H, MIN -64 F; PSV-101 FIRE 15,793 LB/H
31	T-101 VENT (PVRV-193/FA-193)	UP TO 30,863 SCFH AIR EQUIVALENT DURING A SLUG DUMP; EMERGENCY VENT EV-193

KEY DUTIES AND SETTINGS

H-101: C1 ABSORBED 3.96 MMBTU/H; C7 1.52; FIREBOX 6.0 MMBTU/H; EFFICIENCY 75 % HHV
FCV-131/132: CV REQUIRED 23 TO 228; RATED ABOUT 550; PREDICTED NOISE 85.6 DBA AT 1 M, ACOUSTIC INSULATION ON BODY AND 10 FT DOWNSTREAM
E-161: 4.0 KW DESIGN, 5 KW RATED; PCV-161 150 PSIG, PCV-162 15 PSIG
RELIEF: PSV-101 'E' 1,440 PSIG; PSV-157 'D' 1,440 PSIG; PSV-161 'D' 250 PSIG; TSV-136 1,440 PSIG
BLOWDOWN: RO-181 0.5625 IN, RO-182 0.5625 IN, RO-183 0.1875 IN; ABOUT 20 MIN TO 50 PSIG (S1, S2)
OPSS: PT-133A/B/C 2003 TRIP 1,225 PSIG CLOSES SDV-102 (FULL STROKE 4 S MAX); 192.201 LIMIT 1,290 PSIG (75 % SMYS OF ASSUMED TRUNK, HOLD H-04)

NOTES / REFERENCES
1. STREAM NUMBERS AS SHOWN ON PRO-DWG-001.
2. DATA FROM PRO-CAL-001 (GERG-2008), CLEAN FILTER.
3. FUEL DRAW = HEATER FIRED DUTY / HHV + PILOT; G-101 STANDBY.
REF: PRO-DWG-001, PRO-CAL-001

REVISIONS			
REV	DATE	DESCRIPTION	BY CHK APP
A	2026-09-29	ISSUED FOR REVIEW (IFR)	
PRELIMINARY - ISSUED FOR REVIEW - NOT FOR CONSTRUCTION			

ENGINEER OF RECORD SEAL

NOT SEALED
PRELIMINARY

PE NO. _____

PROJECT
120 MMSCFD RECEIPT INTO
COUNTY,
DISCIPLINE: PROCESS
SCALE: NTS

PROCESS FLOW DIAGRAM
STREAM SUMMARY CASES C3 TO C7
DRAWN: ____ CHECKED: ____ APPROVED: ____
DWG NO.
PRO-DWG-002
SHEET 2 OF 2 REV A