

Workshop 6 – Standard Operating Procedures

Start-Up Procedure

The start-up procedure is intended as a guideline in making the initial start-up of the Distillation Unit. It should be used in conjunction with *Exercise – Start Advanced Distillation Steady State Simulation*

At this stage of the start-up, it is assumed that the unit is initialised with Nitrogen at ambient temperature and atmospheric pressure, valves are in closed position, pumps & fans are in stopped condition, no level in any holdup and Feed, utilities are readily available from battery limit.

Pressurising Debutanizer and Depropanizer

- Open HC44, PC15, and PC16, and back pressure the Debutanizer (PI14) to 110 psig with natural gas imported from the compressor interstage drum. PC16 should be more than 50% open because it is a split range controller.
- Open PC18 and PC19 and back pressure the Depropanizer (PI17) to 145 psig. PC19 should be more than 50% open because it is a split range controller.
- When both towers are pressurized, complete the following steps:
 - a) Set PC15 at 180 psig and PC16 at 170 psig in automatic.

- b) Set PC18 at 275 psig and PC19 at 265 psig in automatic.
 - c) Completely shut bypass HC44 to stop importing natural gas.
 - d) Commission cooling water 70% open to E-230 and E-240 with HC46 and HC72.
- Now both the Debutanizer and the Depropanizer are pressurized and ready to accept feed. First start-up the Debutanizer. After the Debutanizer is commissioned and operating at 60% of design conditions, start to commission the Depropanizer.

Feeding to Debutanizer

- Start the flow of heavy feed on FC01 to 10 MBPSD and light feed on FC02 to 1.4 MBPSD on automatic control.
- After the level appears on the tower bottom and LSD15 goes from the Shutdown to Normal state, reset HS39. To access the faceplate for HS39, select the shut-off valve. Commission the reboiler E-100 and aim for a minimum bottom temperature (TI20) of 330°F before storing any distillate. Keep the steam flow controller FC15 in manual and gradually increase the steam flow. Use FC18 to control the level by sending the bottoms flow to the off-specification tank until the Debutanizer reaches steady state conditions.
- As temperature increases, start fans on E-110 one at a time to maintain D-100 pressure at slightly above the set point of 170.0 psig and at a temperature of 130°F.

NOTE: Since the plant contains non-condensable at a cold start-up, ensure they are purged from the plant. Running the reflux drum slightly above the set point forces a constant purge to remove non-condensable. Control valve PV16B is open when the output of controller PC16 is between 50 and 100%.

- When the level appears in the reflux drum D-100, set the output of FC19 to 1%, and start the Debutanizer reflux pump (P-62 or P-63) to commission a small amount of reflux flow to the Debutanizer.

- Use FC01 to gradually increase the amount of heavy feed to the Debutanizer and simultaneously increase the steam flow in the reboiler. Watch the pressures in the tower and reflux drum and the temperature of the overhead condensed vapors.
- As the level increases in the D-100 reflux drum, send most of the overheads back to the Debutanizer. Do this to get the Debutanizer running at about 60% of its design rated value before commissioning the Depropanizer.
- Put AC12 in automatic with a set point of 1% and put the reflux flow FC19 in cascade.
- When TC10 reaches 340°F put the temperature controller in automatic and give it a set point of 325°F. Put FC15, the steam flow controller in cascade.
- Put LC14, the Debutanizer tower bottoms level controller, in automatic and FC17 in remote. Use FC18 to slowly stop the flow to the off-specification tank.

NOTE: At approximately 40 MBPSD of heavy feed to the Debutanizer, commission the Depropanizer and simultaneously watch the Debutanizer as you slowly steady it out.

Feeding to Depropanizer

- As the level on D-100 reaches 50%, put LC16 in automatic with a set point of 50%. Commission the Depropanizer feed pump, P-68 or P-69. Put the FC20 controller in cascade. Set a flow of 22.5 MBPSD on FC28 in automatic. This amount is the minimum flow spillback on P-68 or P-69.
- As the level increases on the Depropanizer bottom commission the reboiler by setting FC21 in automatic with a set point of 5 Mlb/h.
- Start at least one fan on E-210, the overhead condenser.

NOTE: Depending on the flow rate of feed to the Depropanizer and steam flow in the E220 reboiler, you may need more than one fan to minimize the pressure overshoot on the Depropanizer.

- When level shows up in D-200, the reflux drum, commission the Depropanizer reflux pump P-66 or P-67 and set a reflux flow on FC23 in automatic.

- Gradually increase the pressure, temperature, and reflux flow to the Depropanizer by turning on more fans on the overhead condenser E-210 to hold the D-200 pressure at 265 psig and temperature at 131.0°F.

NOTE: Since T-200 was also initialized at cold start under a blanket of non-condensable it is essential to purge the non-condensable from the plant. Do not turn on all the fans. This will keep the pressure of D-200 slightly greater than the set point of PC19 (about 5 psi) until design conditions are approached. This action causes PC19 to force a constant purge of non-condensable.

- When the plant is operating close to design operating conditions, put all controllers into automatic or cascade, as appropriate. You may want to refer to the table below to view the design values.

Tag	Description	Value	Units
11AC12	T-100 Overheads Analyzer	1.0	%C ₅
11AC17	T-200 Overheads Analyzer	1.0	%C ₄
11AI16A	T-200 Bottoms Analyzer	2.9	%C ₃
11AI16B	T-200 Bottoms Analyzer	94.9	%C ₄
11ESD11	E-100 Steam Slam Trip	Normal	-
11ESD15	E-220 Steam Slam Trip	Normal	-
11FC01	Heavy Feed to Debutanizer	65.5	MBPSD
11FC02	Light Feed to Debutanizer	1.4	MBPSD
11FC15	E-100 Steam Flow	110.1	Mlb/hr
11FC17	T-100 Bottom to Storage Tank 1	46.9	MBPSD
11FC18	T-100 Bottom to Off Specs Tank 2	0.0	MBPSD
11FC19	Debutanizer Reflux	32.0	MBPSD
11FC20	Depropanizer Feed	20.1	MBPSD
11FC21	E-220 Reboiler Steam Flow	26.9	Mlb/hr
11FC22	Depropanizer C ₄ Product	10.1	MBPSD
11FC23	Depropanizer Reflux	20.2	MBPSD
11FC24	Depropanizer C ₃ Product	10.0	MBPSD
11FC28	P-68/69 Minimum Flow Spillback	5.0	MBPSD
11FC30	P-66/67 Minimum Flow Spillback	5.0	MBPSD
11HC41	D-100 Overhead to Flare	0.0	%

Tag	Description	Value	Units
11HC44	D-100 Byp from Comp Interstg Drum	0.0	%
11HC46	Cooling Water to E-230	70.0	%
11HC72	Cooling Water to E-240	70.0	%
11HS14A	E-110A Fan	Start	-
11HS14B	E-110B Fan	Start	-
11HS14C	E-110C Fan	Start	-
11HS14D	E-110D Fan	Start	-
11HS14E	E-110E Fan	Start	-
11HS14F	E-110F Fan	Start	-
11HS14G	E-110G Fan	Stop	-
11HS14H	E-110H Fan	Stop	-
11HS19A	E-210A Fan	Start	-
11HS19B	E-210B Fan	Start	-
11HS19C	E-210C Fan	Start	-
11HS19D	E-210D Fan	Start	-
11HS19E	E-210E Fan	Start	-
11HS19F	E-210F Fan	Stop	-
11HS39	T-100 Bottom Storage	Reset	-
11HS62	P-62 Debutanizer Reflux Pump	Start	-
11HS63	P-63 Debutanizer Reflux Pump Spare	Stop	-
11HS66	P-66 Depropanizer Reflux Pump	Start	-
11HS67	P-67 Depropanizer Reflux Pump Spare	Stop	-
11HS68	P-68 Depropanizer Feed Pump	Start	-
11HS69	P-69 Depropanizer Feed Pump Spare	Stop	-
11LC14	T-100, Debutanizer Bottoms Level	50.0	%
11LC16	D-100, Reflux Drum Level	50.0	-
11LC20	T-200, Depropanizer Bottoms Level	50.0	%
11LC21	D-200, Reflux Drum Level	50.0	%
11LSD15	Debutanizer Bottoms Low Level Trip	Normal	%
11PC15	T-100, Pressure Controller	180.0	psig
11PC16	D-100, Pressure Controller	170.0	psig
11PC18	T-200, Pressure Controller	275.0	psig

Tag	Description	Value	Units
11PC19	D-200, Pressure Controller	265.0	psig
11PI14	T-100, Bottoms Pressure	183.2	psig
11PI17	T-200, Bottoms Pressure	278.0	psig
11TC10	T-100, Tray 2, Reboiler	325.0	°F
11TC11	T-200, Tray 3, Reboiler	228.0	°F
11TI20	T-100, Bottoms	390.6	°F
11TI21	E-100, Reboiler Outlet	409.1	°F
11TI22	E-100, Reboiler Inlet	390.6	°F
11TI23	T-100, Tray 4	308.2	°F
11TI24	T-100, Tray 23	244.3	°F
11TI25	T-100, Overheads	159.6	°F
11TI26	T-100, Reflux	131.0	°F
11TI30	E-250, Shell Side Inlet	135.2	°F
11TI31	T-200, Depropanizer Splitter Bottoms	235.6	°F
11TI32	E-220, Reboiler Outlet	237.5	°F
11TI33	T-200, Depropanizer Tray 1	233.9	°F
11TI34	E-250, Tube Out	162.6	°F
11TI35	T-200, Depropanizer Overheads	134.3	°F
11TI36	T-200, Depropanizer Reflux	128.3	°F
11TI37	E-230, Shell side Outlet, C ₃	101.7	°F
11TI38	E-250, Shell side Outlet	174.7	°F
11TI39	E-240, Shell side Outlet, C ₄	124.5	°F
11TI40	Heavy Feed Temperature	244.0	°F

Shut-Down Procedure

The shutdown procedure is intended as a guideline in making the initial shutdown of the Distillation Unit. It should be used in conjunction with *Exercise – Start Advanced Distillation Steady State Simulation*

At this stage of the shut-down, it is assumed that the unit is at full load steady state operation and controller is in Auto or Cascade mode as appropriate.

Reducing feed of Debutanizer and Depropaniser

- To reduce the feed to the Debutanizer and the Depropanizer, slowly reduce the setpoint of FC01 to 50% of normal.
- TC10, the reboiler temperature controller, reduces the steam input as the feed rate falls.
- Once the plant has stabilized, put FC01 and FC02 in manual. Gradually reduce the output of both controllers to zero.
- To reduce the reboiler temperature of the Debutanizer, put FC15 in manual and gradually reduce its output to zero.
- To stop C3 product flow, put FC24 in manual with zero output.
- To send reflux hydrocarbon from D-100, the overhead drum, into the Debutanizer tower, put FC19 in manual with an output of 60%.
- To stop feed to the Depropanizer, put FC20 in manual with zero output.
- To reduce the reboiler temperature of the Depropanizer, put FC21 in manual and gradually reduce its output to zero.
- To send reflux from D-200, the overhead drum, into the Depropanizer tower, put FC23 in manual with an output of 60%.
- To drain the Debutanizer bottoms to the off-spec tank, put FC17 in manual with zero output and put FC18 in manual with an output of 100%.

- To drain the Depropanizer bottoms, put FC22 in manual with an output of 100%.
- To close all valves, put all controllers except PC16 and PC19, in manual with zero output. PC16 and PC19 should have an output of 50%.
- Stop all rotating equipment.