

Process Operating Window (POW)

CDU3 and NHGU Unit



**Bharat
Petroleum**

energising lives

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DESIGN CONDITIONS FOR NHGU

| | | Max | Min |
|-----------------------------|----------------------|-------|--------------------------|
| Hydrogen Production (T/D) | RMPRFI614.PV | 189 | 57 |
| FEED | | | |
| RLNG Feed T/D | rmprfi483td.pv | 526.5 | 8000 Nm3/hr = 146 TPD |
| ACTUAL H2/HC RATIO Nm3/Kg | rmprfx480a.pv | * | 0.08 |
| Process feed | | | |
| RLNG Pressure | kg/cm ² g | 38 | 36 |
| RLNG Temperature | Deg C | 40 | 12 |
| CCR PSA Tail Gas Pressure | kg/cm ² g | 25.5 | 22 |
| CCR PSA Tail Gas Temp | Deg C | 40 | 12 |
| CCR PSA inlet Gas Pressure | kg/cm ² g | 25 | 23 |
| CCR PSA inlet Gas Temp | Deg C | 40 | 12 |
| Product | | | |
| H2 Battery limit pressure | kg/cm ² g | 25.5 | 21 |
| H2 Battery limit temp | Deg C | 50 | 35 |
| Utilities | | | |
| <u>MP Steam</u> | | | |
| Pressure | kg/cm ² g | 17 | 13 |
| Temperature | Deg C | 340 | 290 |
| <u>LP Steam</u> | | | |
| Pressure | kg/cm ² g | 3.5 | 2.5 |
| Temperature | Deg C | 170 | 150 |
| <u>Instrument Air</u> | | | |
| Pressure | kg/cm ² g | 7 | 5 |
| Temperature | Deg C | 65 | 45 |
| <u>DM water</u> | | | |
| Pressure | kg/cm ² g | 5 | 3 |
| Temperature | Deg C | 35 | 35 |
| <u>SCW supply</u> | | | |
| Pressure | kg/cm ² g | 4.5 | 3.5 |
| Temperature | Deg C | 70 | 34 |
| Process Condition | | | |
| E-311 Process side temp | Deg C | 430 | NA |
| E-311 Process side Pressure | kg/cm ² g | 39 | NA |
| E-311 steam side temp | Deg C | 455 | NA |
| E-311 steam side Pressure | kg/cm ² g | 50 | NA |
| | | | |
| HDS | | | |
| R 301 Bed temp. RTI491 | rmprti491.pv | 400 | 300 |
| R 302 Bed temp | | 400 | 300 |
| HDS pressure | rmprpi487.pv | 50 | 15 |
| | | | |
| Feed / Steam mixing | | | |
| Steam to Ref. RFC 561 Kg/hr | rmprfc561.pv | 40003 | 19550 |
| S/C ratios | RMPSC_RATIO_A.PV | ** | 1.8 |
| | | | |

| | | | |
|----------------------------------|----------------------|--------|--------------------------|
| Prereformer (R 303) | | | |
| P.Gas at R303 I/LRTI565 | rmprti565.pv | 470 | 400 |
| Prereformer outlet RTI597 | rmprti597.pv | 505 | 400 |
| | | | |
| Reformer (133 - F - 301) | | | |
| P Gas E 301 O/L RTI581 | rmprti581.pv | 650 | 550 |
| | | | |
| HTER (133 - F - 302) | | | |
| Process gas to EW301 ex HTER | RMPRTZY412C.PV | 625 | 550 |
| | | | |
| MT Shift (R 304) | | | |
| P Gas at MT I/L RTI612 | rmprti612.pv | 210 | 15 deg C above dew point |
| | | | |
| MT Shift bed RTI621 | rmprti621.pv | 350 | 330 |
| | | | |
| LT Shift (R 305) | | | |
| | | | |
| P Gas at LT I/L RTI629 | rmprti629.pv | 200 | 15 deg C above dew point |
| LT Shift O/L RTI622 | rmprti622.pv | 275 | 200 |
| | | | |
| PSA data | | | |
| PSA inlet Flow Nm3/hr | RMPRfi613.pv | 130969 | 39290.7 |
| PSA outlet Flow TPD | RMPRfi614.pv | 189 | 56.7 |
| Offgas Flow Nm3/hr | RMPRft616.pv | 45583 | 13674.9 |
| | | | |
| Exchangers | | | |
| E-342 Process side temp | Deg C | 140 | NA |
| E-342 Process side Pressure | kg/cm ² g | 43 | NA |
| E-342 steam side temp | Deg C | 170 | NA |
| E-342 steam side Pressure | kg/cm ² g | 6.5 | NA |
| E-312 Process side temp | Deg C | 264 | NA |
| E-312 Process side Pressure | kg/cm ² g | 6 | NA |
| E-312 steam side temp | Deg C | 264 | NA |
| E-312 steam side Pressure | kg/cm ² g | 50 | NA |
| E-306 Process side temp | Deg C | 365 | NA |
| E-306 Process side Pressure | kg/cm ² g | 28.5 | NA |
| E-306 BFW side temp | Deg C | 260 | NA |
| E-306 BFW side Pressure | kg/cm ² g | 80 | NA |
| E-307 Process side temp | Deg C | 300 | NA |
| E-307 Process side Pressure | kg/cm ² g | 28.5 | NA |
| E-307 BFW side temp | Deg C | 200 | NA |
| E-307 BFW side Pressure | kg/cm ² g | 80 | NA |
| E-308 Process side temp | Deg C | 130 | NA |
| E-308 Process side Pressure | kg/cm ² g | 28.5 | NA |
| E-308 DM water side temp | Deg C | 200 | NA |
| E-308 DM water side Pressure | kg/cm ² g | 19 | NA |
| E-309 Process side temp | Deg C | 100 | NA |
| E-309 Process side Pressure | kg/cm ² g | 28.5 | NA |
| E-309 SCW water side temp | Deg C | 70 | NA |
| E-309 SCW water side Pressure | kg/cm ² g | 19 | NA |

| | | | |
|------------------------------|----------------------|-------|-------|
| EA-302 Process side temp | Deg C | 200 | NA |
| EA-302 Process side Pressure | kg/cm ² g | 28.5 | NA |
| | | | NA |
| K-304 Suction pressure | kg/cm ² g | 25.5 | NA |
| K-304 Suction temp | Deg C | 75 | NA |
| K-304 Discharge pressure | kg/cm ² g | 43 | NA |
| K-304 Discharge temp | Deg C | 170 | NA |
| | | | NA |
| FD Suction pressure | kg/cm ² a | 1.033 | NA |
| FD Suction temp | Deg C | 90 | NA |
| FD Discharge pressure | kg/cm ² a | 1.15 | NA |
| FD Discharge temp | Deg C | 90 | NA |
| | | | |
| ID Suction pressure | kg/cm ² a | NA | 0.9 |
| ID temp | Deg C | 181 | NA |
| ID Discharge pressure | kg/cm ² a | 1.15 | 1.033 |
| | | | |
| P-302 Flow | m ³ /hr | 164 | 98.4 |
| P-302 Temp | Deg C | 150 | NA |
| P-302 Suction Pressure | Kg/cm ² G | | 2.37 |
| P-302 Discharge Pressure | Kg/cm ² | 80 | |
| | | | |
| P-303 Flow | m ³ /hr | 13.4 | 8.04 |
| P-303 Temp | Deg C | 70 | NA |
| P-303 Suction Pressure | Kg/cm ² G | 70 | NA |
| P-303 Discharge Pressure | Kg/cm ² | 60 | |

* in case of CCR off gas H₂/HC ratio max limit is 0.45 (Design 0.12)

** S/C ratio to be adjusted to maintain TST 968 deg C (Design 2.1)

DESIGN CONDITIONS FOR CDU/VDU 3

| DESCRIPTION | UNITS | Normal AM | Max | Min | Comments |
|---------------------------------|------------|--------------|--------|-------|---|
| Crude Intake | TPD | 18210 | 22000 | 11220 | |
| Crude inlet temp | Deg C | 35 | 90 | Amb | |
| PREHEAT 1 | DEGC | 134 | 144 | 125 | |
| DESALTER -1 PR | KG/CM2G | 8.5 | 31 | 7 | |
| PREFLASH DRUM PR | KG/CM2G | 3.03 | 6 | NA | |
| PREFLASH DRUM Temp | Deg C | 129 | 150 | 115 | |
| CDU HEATER AND COLUMN | | | | | |
| F-101 HOT | Deg C | 360 | 373 | NA | Depending on the crude it varies |
| F-101 Preheated crude Pressure | KG/CM2G | 19.41 | 25.2 | NA | |
| F-101 heat Release/Duty | MM Kcal/hr | 65 | 73.6 | NA | |
| F-101 Arch Temp | Deg C | 835 | 850 | NA | |
| F-101 Cell temp | Deg C | 835 | 850 | NA | |
| Convection outlet Skin temp | Deg C | 525 | 630 | NA | |
| Convection outlet Flue Gas temp | Deg C | 380 | 500 | NA | |
| Max fuel per burner | T/D | 6.8 | 8.5 | NA | |
| C-101 TOP PR | KG/CM2G | 2.5 | 5.4 | Atm | |
| C-101 TOP TEMP | DEGC | 135 | 150 | 128 | |
| HN DRAW | Deg C | 171 | 212 | 165 | |
| LK DRAW | Deg C | 189 | 247 | 175 | |
| HK DRAW | Deg C | 220 | 274 | 200 | |
| LGO DRAW | Deg C | 278 | 288 | 240 | |
| HGO DRAW | Deg C | 325.7 | 350 | 280 | |
| STRIPPING STEAM | TPD | 100 | 135 | NA | Depending on the crude and throughput it varies |
| RCO TEMP | Deg C | 350 | 363 | 330 | Depending on the crude it varies |
| STABILISER | | | | | |
| STABILISER FEED | TPD | 3000 | 3822.8 | | |
| UBSTABILISED FEED TEMP | DEGC | 45 | 65 | Amb | |

| | | | | | |
|---------------------------------|------------|-------|------------|------|----------------------------------|
| STABILISER TOP PR | KG/CM2G | 10 | 14.5 | Amb | |
| VACCUM HEATER AND COLUMN | | | | | |
| F-102 Coil Outlet Temp | Deg C | 418 | 432 | | Depending on the crude it varies |
| F-102 heat Release/Duty | MM Kcal/hr | 25 | 37.7 | NA | |
| F-102 Arch Temp | Deg C | 830 | 855 | | |
| F-102 Cell temp | Deg C | 830 | 855 | | |
| F-102 Skin temp | Deg C | 490 | 625 | | |
| Convection outlet Flue Gas temp | Deg C | 460 | 550 | | |
| Max fuel per burner | T/D | 1.5 | 2 | NA | |
| COIL STEAM TO F-102 | TPD | 32 | 48 | | |
| C-110 TOP VACUUM | MMHGA | 12 | 3.5 Kg/cm2 | | |
| PRODUCT DRAW OFF TEMP | | | | | |
| VD DRAW TEMP | Deg C | 135 | 145 | | |
| LLVGO DRAW TEMP | Deg C | 199 | 226 | | |
| LVGO DRAW TEMP | Deg C | 247.7 | 267 | | |
| HVGO DRAW TEMP | Deg C | 325 | 335 | | |
| SLOPS DRAW TEMP | Deg C | 380 | 388 | | |
| VR DRAW TEMP | Deg C | 345 | 350 | | |
| SCW RTN TEMP | | | 45 | | |
| Vessels | | | | | |
| V-102 Reflux drum temp | Deg C | 105 | 125 | 96.5 | |
| V-102 Reflux drum press | Kg/cm2 | 2 | 5.4 | | |
| Overhead Nap Accumulator | | | | | |
| V-103 Pressure | Kg/cm2 | 1.5 | 5.4 | 1 | |
| V-103 Temp | Deg C | 45 | 65 | Amb | |
| Nap Stabilizer reflux drum | | | | | |
| V-104 Pressure | Kg/cm2 | 9.3 | 14.5 | | |
| V-104 Temp | Deg C | 40 | 65 | Amb | |
| V-111 Flushing oil drum | | | | | |
| V-111 Pressure | Kg/cm2 | ATM | 3.5 | Atm | |
| V-111 Temp | Deg C | 80 | 95 | | |
| V-107 Steam drum | | | | | |
| V-107 Pressure | Kg/cm2 | 7.5 | 9.5 | | |

| | | | | | |
|------------------------------------|----------|-------|------------|-----|--|
| V-107 Temp | Deg C | 172.5 | 205 | | |
| Flow | TPD | 634 | 681 | 312 | |
| V-109 Desalter water vessel | | | | | |
| V-109 Pressure | Kg/cm2 | ATM | 3.5 | ATM | |
| V-109 Temp | Deg C | 40-70 | 100 | Amb | |
| V-115 Fuel Gas KOD | | | | | |
| V-115 Pressure | Kg/cm2 G | 3 | 8 | 3 | |
| V-115 Temp | Deg C | 40 | 75 | Amb | |
| V-119 Hotwell | | | | | |
| V-119 Pressure | Kg/cm2 G | 0.4 | 3.5 | ATM | |
| V-119 Temp | Deg C | 45 | 65 | Amb | |
| V-122 Slop Drum | | | | | |
| V-122 Pressure | mm hg A | 29 | 4 Kg/cm2 G | | |
| V-122 Temp | Deg C | 388 | 410 | | |
| V-123 Tempered Water | | | | | |
| V-123 Pressure | Kg/Cm2 G | 1 | 3.5 | ATM | |
| V-123 Temp | Deg C | 60 | 100 | Amb | |
| V-140 De-aerator | | | | | |
| V-140 Pressure | Kg/Cm2 G | 0.1 | 3.5 | ATM | |
| V-140 Temp | Deg C | 100 | 170 | Amb | |
| Overhead AFC's | | | | | |
| Atm column Overhead delta pressure | Kg/Cm2 | 0.37 | 0.5 | | |
| EA101 pressure | Kg/Cm2 G | 2.2 | 5.4 | ATM | |
| EA101 temp | Deg C | 106.5 | 140 | Amb | |
| EA102 pressure | Kg/Cm2 G | 2 | 5.4 | ATM | |
| EA102 temp | Deg C | 102.1 | 121 | Amb | |
| EA103 pressure | Kg/Cm2 G | 7.9 | 15 | ATM | |
| EA103 temp | Deg C | 97 | 220 | Amb | |
| EA104 pressure | Kg/Cm2 G | 13.7 | 21 | ATM | |
| EA104 temp | Deg C | 147 | 211 | Amb | |
| EA105 pressure | Kg/Cm2 G | 9.4 | 18.7 | ATM | |
| EA105 temp | Deg C | 97.1 | 247 | Amb | |
| EA106 pressure | Kg/Cm2 G | 10.9 | 25.7 | ATM | |

| | | | | | |
|----------------|-------------------------|-------|-------|------|--|
| EA106 temp | Deg C | 122.8 | 195 | Amb | |
| EA107 pressure | Kg/Cm2 G | 11.2 | 32.6 | ATM | |
| EA107 temp | Deg C | 99.9 | 162 | Amb | |
| EA108 pressure | Kg/Cm2 G | 11.8 | 21.9 | ATM | |
| EA108 temp | Deg C | 147 | 332 | Amb | |
| EA109 pressure | Kg/Cm2 G | 10.2 | 28.5 | ATM | |
| EA109 temp | Deg C | 100 | 127 | Amb | |
| EA110 pressure | Kg/Cm2 G | 5 | 9.5 | ATM | |
| EA110 temp | Deg C | 80 | 100 | Amb | |
| Flow in TPD | | | | | |
| P 102 A/B/C | PF CRUDE | 9450 | 10400 | 4465 | |
| P 103 A/B | I ST DESALT | 1080 | 1432 | 540 | |
| P 104 A/B | II ND DESALT | 1152 | 2121 | 577 | |
| P 105 A/B/C | ATM.COL.REFLX | 5106 | 6800 | 1190 | |
| P 106 A/B | STAB FEED | 3474 | 3823 | 1911 | |
| P 107 A/B | HK CR | 9465 | 10412 | 2738 | |
| P 108 A/B | LGO CR | 6067 | 9683 | | |
| P 109 A/B | HGO CR | 7919 | 8711 | 3248 | |
| P 110 A/B/C | RCO PUMP | 4374 | 4811 | 1600 | |
| P 111 A/B | HN PDT | 954 | 1050 | 601 | |
| P 112 A/B | LK PDT | 1278 | 1406 | 639 | |
| P 113 A/B | HK PDT | 2785 | 3062 | 2238 | |
| P 114 A/B/C | LGO PDT | 2141 | 2356 | 967 | |
| P 115 A/B | HGO PDT | 635 | 699 | 504 | |
| P 116 A/B | STAB REFLX | 951 | 1045 | 379 | |
| P 117 A/B | LPG PDT | 396 | 436 | 156 | |
| P 132 A/B | VD | 4648 | 6740 | 2324 | |
| P 133 A/B | LVGO | 11700 | 14498 | 5850 | |
| P 134 A/B/C | HVGO | 13284 | 14188 | 6650 | |
| P 136 A/B | SLOP | 2065 | 2272 | 609 | |
| P 137 A/B/C | VR | 2512 | 3081 | 1061 | |
| P 138 A/B | LLVGO | 2230 | 2453 | 1094 | |