RESUMEN DE QUÍMICOS Y CATALIZADORES P/ LA PLANTA DE AMONIACO

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RESUMEN DE REVISION DEL DOCUMENTO

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CATALYST & CHEMICAL SPECIFICATIONS

To achieve the ammonia plant performance, catalyst performance specifications have been summarized in the following pages. All the catalyst shall be supplied only by a "KBR Approved Vendor". The performance shall conform to the attached specifications and parameters. The required performance shall be guaranteed by the supplier/vendor. The given catalyst volumes are the effective loaded numbers. Extra volume shall be added for handling, breakage and spillage (as noted in each case) after verifying the total actual loaded volume from the final equipment drawings.

The CO2 Removal System is based on BASF 2-Stage OASE CO2 Removal Technology.

I. List of KBR Approved Vendors/Suppliers:

- **Catalyst**

1. Clariant (previously Sud-Chemie) [all catalyst]
2. Johnson Matthey [all catalyst]
3. Haldor Topsoe [all catalyst, primary reformer catalyst to be proven in steaming operation]

- **Mercury Guard**

1. Calgon
2. Norit

- **Molecular Sieve**

1. UOP
2. Zeochem

- **CO2 Removal Technology**

1. BASF

II. Catalyst Summary

VESSEL	DESCRIPTION	CATALYST TYPE	EFFECTIVE VOL m^3	INSTALLED VOL m^3 (Note 1)	CATALYST EXPECTED LIFE (years)
101-B	Primary Reformer	Nickel Reforming	18.75	19.28	5 - 10
102-D	Mercury Guard	Activated Carbon	3.6	3.62	10
103-D	Secondary Reformer	Nickel Reforming	20	20	10 - 15
104-D1	High Temp Shift	Iron/Chrome/Copper	39.6	39.6	8
104-D2	Low Temp Shift	Copper/Alumina/Zinc	63.8	63.8	3
105-D	Ammonia Synthesis Converter	Promoted Iron	72.4	72.44	10 - 20
		Pre-reduced		11.54	
		Non-reduced		60.9	
106-D	Methanator	Nickel Oxide	24.5	24.53	10 - 20
108-DA	Hydrotreater	Co-Mo	9.5	9.5	5 - 10
108-DB/DC	Desulfurizers	Zinc Oxide	49.2(each)	49.23(each)	1(lead bed)
109-DA/DB	Molecular Sieve Dryers	Zeolite	23.8(each)	23.81(each)	3 - 5

Notes:

(1) Volumes do not include allowance for breakage and spillage. Add 5% extra volume to cover breakage and spillage.

III. Chemical Summary

CO2 Removal System

The CO2 Removal System is based on BASF's 2 Stage OASE CO2 Removal Technology. This system uses a 40 wt% OASE Solution.

Items	Initial Charge	1-Day Consumption	2-Year Consumption	Remark
OASE premix	270 MT of OASE Premix.	-	27 MT of OASE Premix to makeup for annual losses	This solution is diluted to 40 wt% in the system
Anti-Foaming Agent (Amerel 1500)	32 liters. (To give 50 ppm initial concentration)	200 –250 ml/day	182.5 liters	

Other Chemicals

Items	Initial Charge	1-Day Consumption	2-Year Consumption	Remark
Phosphate	4.7 m3	2.1 ton	102.1 ton (Density : 1040 ~ 1080 kg/m3)	Chemical concentration 8 wt%
Detergents	0.23 m3	-	0.46 m3	Intermittent Cleaning Chemical for Gas Turbine

NOTE

1) Please note that above quantities do not include allowance for spillage or unusual losses.
2) ~~Final charged volume to be confirmed by DEC after piping layout.~~
3) BASF will supply and confirm above OASE quantity.

IV. Catalyst Specification

CATALYST SPECIFICATION
101-B PRIMARY REFORMER

Catalyst Type:	Nickel Reforming (Note 1)
Specification:	Top: 40% ReforMax 210 LDP or equivalent Bottom: 60% ReforMax 330 LDP or equivalent
Size (mm):	Top: 19 X 12 LDP or equivalent, vendor to confirm Bottom: 19 X 16 LDP or equivalent, vendor to confirm
Density (kg/m^3):	By Vendor
Special Requirement:	SiO2 content 0.2 wt% (max.)
Performance Requirements:	See operating conditions below. Vendor to guarantee a methane leakage of not more than 29.2 mol% (dry basis) for End of Run (EOR) conditions in Normal case.
Expected Catalyst Life:	>5 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop:	≤2.2 kg/cm^2

The information on the primary reformer is as follows:

No. of Tubes:	144		
ID:	127	mm	
Length:	10280	mm	Effective
	10572	mm	Overall
Catalyst Effective Vol.:	18.75	m^3	
Total Vol.:	19.28	m^3	

Primary Reformer Operating Conditions (End-of run)

	Normal Case			
	Inlet		Outlet	
Components	kmol/hr	Dry mol%	kmol/hr	Dry mol%
H2	31.2	1.95	1983.7	54.22
N2	19.6	1.22	19.6	0.54
CH4	1420.4	88.56	1068.9	29.22
AR	2.2	0.14	2.2	0.06
NH3	0.0	0.00	0.0	0.00
CO	0.0	0.00	165.3	4.52
CO2	29.0	1.81	418.6	11.44
O2	0.0	0.00	0.0	0.00
C2H6	101.1	6.30	0.0	0.00
C3H8	0.5	0.03	0.0	0.00
IC4	0.0	0.00	0.0	0.00
NC4	0.0	0.00	0.0	0.00
IC5	0.0	0.00	0.0	0.00
NC5	0.0	0.00	0.0	0.00
C6	0.0	0.00	0.0	0.00
H2O	4384.5		3439.9	
Total Flow KMOL/HR	5988.5		7098.4	
Total Flow KG/HR	106811		106811	
Temperature, Deg. C	539.8		712.7	
Pressure, KG/SQCM (A)	44.8		41.5	

Notes:

1) Vendor to only specify catalyst which has been in commercial use for at least 2 years.
2) Allow for +5% catalyst (minimum) for handling loss.
3) Catalyst shall have proven ability to withstand steaming at high temperature as process steam is not cut-off at start-up & shutdown.
4) No hydrogen is present at start-up and during shutdowns. Vendor to recommend layer of prereduced catalyst if applicable.

CATALYST SPECIFICATION
102-D MERCURY GUARD

Type:	Sulfur Impregnated Activitated Carbon, Vendor to confirm
Specification:	(Note 2) HGR 4X10, Vendor to confirm (Note 2)
Size (mm):	By Vendor
Installed Volume (m^3):	3.62 (Note 3)
Vessel ID (mm)	1600
Bed height (mm):	By Vendor
Density (kg/m^3):	By Vendor
Performance Requirements:	Confirm attached operating conditions. Vendor to guarantee **total Hg at outlet to be < 0.01 µg/Nm3 for End of Run (EOR) conditions**.
Expected Catalyst Life:	10 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop (kg/cm^2):	0.2 (Catalyst Bed only)

(Note 1, 3)	**Normal Case**	
	Inlet	
Components	kmol/hr	Dry mol%
H2	0.0	0.000
N2	11.9	0.588
CH4	1846.8	91.046
CO CO2	0.0	0.000
C2H6	37.7	1.857
C3H8	131.4	6.480
IC4	0.6	0.029
NC4	0.0	0.000
IC5	0.0	0.000
NC5	0.0	0.000
C6	0.0	0.000
	0.0	0.000
Total Flow kmol/hr	2028.4	
Total Flow kg/hr	35598	
Temperature, °C	48.9	
Pressure, $kg/cm_2(A)$	50	
Total Hg µg/Nm_3	**0.6**	
Total Sulfur mg/Nm_3	50.0 (as H2S)	
Water lb/mmscf	0.0025	

Nm^3 @ 1 atm , 0 °C
scf @ 1 atm , 60 °F

Notes: 1) Composition is given upstream of 102-D.
2) Vendor to specify catalyst type brand which has been in successful commercial use for at least 2 years.
3) Catalyst volume to be sized based on 110% of the normal flows given above.
4) Allow for +5% catalyst (minimum) for handling loss.

CATALYST SPECIFICATION
103-D Secondary Reformer

Type:	Nickel Reforming (Note 1)
Specification:	Top: 10% ReforMax 400GG or equivalent Bottom: 90% ReforMax 410 LDP or equivalent
Size (mm):	Top: 33 X 18 or equivalent, vendor to confirm Bottom: 19 X 16 or equivalent , vendor to confirm
Total Installed Volume (m^3): (Note 2)	20.0 top: 2.26 bottom: 17.74
Vessel ID (mm):	3100
Bed height (mm):	By Vendor
Density (kg/m^3):	top: 1040~1200 (vendor to confirm) bottom: 1120 ~ 1300 (vendor to confirm)
Special Requirement:	SiO2 content 0.1 wt% (max). Water soluble chlorides 10 ppmw (max).
Performance Requirements:	Confirm attached operating conditions. Vendor to guarantee methane leakage of not more than 1.75 mol% (dry basis) for End of Run (EOR) conditions.
Expected Catalyst Life:	10-15 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop:	< 0.5 kg/cm²

(Note 2)	Normal Case					
	Inlet Process Gas		Inlet Air/Steam		Effluent	
Components	kmol/hr	Dry mol%	kmol/hr	Dry mol%	kmol/hr	Dry mol%
H2	1983.7	54.22	0.0	0.00	3780.4	48.68
N2	19.6	0.54	2281.9	78.08	2301.5	29.64
CH4	1068.9	29.22	0.0	0.00	135.7	1.75
AR	2.2	0.06	27.5	0.94	29.7	0.38
NH3	0.0	0.00	0.0	0.00	0.0	0.00
CO	165.3	4.52	0.0	0.00	877.0	11.29
CO2	418.6	11.44	0.9	0.03	641.0	8.25
O2	0.0	0.00	612.3	20.95	0.0	0.00
C2H6	0.0	0.00	0.0	0.00	0.0	0.00
C3H8	0.0	0.00	0.0	0.00	0.0	0.00
IC4	0.0	0.00	0.0	0.00	0.0	0.00
NC4	0.0	0.00	0.0	0.00	0.0	0.00
IC5	0.0	0.00	0.0	0.00	0.0	0.00
NC5	0.0	0.00	0.0	0.00	0.0	0.00
C6	0.0	0.00	0.0	0.00	0.0	0.00
H2O	3439.9		122.9		3632.6	
Total Flow KMOL/HR	7098.4		3045.4		11398.0	
Total Flow KG/HR	106811		86866		193680	
Temperature, Deg. C	712.7		484.4		896.3	
Pressure, KG/SQCM (A)					40.2	

Notes:
1) Vendor to specify catalyst which has been in successful commercial use for at least 2 years.
2) Catalyst volume to be sized based on 105% of the normal flows given above.
3) Allow for minimum +5% catalyst volume for handling loss.

CATALYST SPECIFICATION
104-D1 HIGH TEMPERATURE SHIFT

Type:	Iron / Chrome (copper promoted) (Vendor to confirm) (Note 1)
Specification:	ShiftMax 120 or equivalent
Size (mm):	6 x 6 tablets, or equivalent, vendor to confirm
Installed Volume (m^3):	39.55 (Note 2)
Vessel ID (mm):	4100
Bed height (mm):	By Vendor
Density (kg/m^3):	1140~1230 (vendor to confirm)
Performance Requirement:	Confirm following operating conditions. Vendor to guarantee CO leakage of not more than 3.11 mol% (dry basis) for End of Run (EOR) conditions.
Expected Catalyst Life:	8 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop:	< 0.35 kg/cm²

104-D1 High Temperature Shift Operating Conditions (End-of run)

	Normal Case			
	Inlet		Outlet	
Components	kmol/hr	Dry mol%	kmol/hr	Dry mol%
H2	3780.4	48.68	4396.7	52.46
N2	2301.5	29.64	2301.5	27.46
CH4	135.7	1.75	135.7	1.62
AR	29.7	0.38	29.7	0.35
NH3	0.0	0.00	0.0	0.00
CO	877.0	11.29	260.8	3.11
CO2	641.0	8.25	1257.3	15.00
O2	0.0	0.00	0.0	0.00
C2H6	0.0	0.00	0.0	0.00
C3H8	0.0	0.00	0.0	0.00
IC4	0.0	0.00	0.0	0.00
NC4	0.0	0.00	0.0	0.00
IC5	0.0	0.00	0.0	0.00
NC5	0.0	0.00	0.0	0.00
C6	0.0	0.00	0.0	0.00
H2O	3632.6		3016.4	
Total Flow KMOL/HR	11398.0		11398.0	
Total Flow KG/HR	193680		193680	
Temperature, Deg. C	371.1		426.7	
Pressure, KG/SQCM (A)	39.47		39.1	

Notes:
1) Vendor to specify catalyst type brand which has been in successful commercial use for at least 2 years.
2) Catalyst volume to be sized based on 105% of the normal flows given above.
3) Allow for minimum +5% catalyst volume for handling loss.

CATALYST SPECIFICATION
104-D2 LOW TEMPERATURE SHIFT

Type:	Copper-Zinc on Alumina (Vendor to confirm) (Note 1)
Specification:	ShiftMax 210 or ShiftMax 230 or equivalent
Size (mm):	5 x 3 tablets, or equivalent, vendor to confirm
Installed Volume (m^3):	63.8 (Note 2)
Vessel ID (mm):	4400
Bed height (mm):	By Vendor
Density (kg/m^3):	1200~1600 (vendor to confirm)
Performance Requirement:	Confirm following operating conditions. Vendor to guarantee CO leakage of not more than 0.29 mol% (dry basis) for End of Run (EOR) conditions.
Expected Catalyst Life:	3 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop:	< 0.35 kg/cm²

104-D2 Low Temperature Shift Operating Conditions (End-of run)

	Normal Case			
	Inlet		Outlet	
Components	kmol/hr	Dry mol%	kmol/hr	Dry mol%
H2	4396.7	52.46	4632.2	53.76
N2	2301.5	27.46	2301.5	26.71
CH4	135.7	1.62	135.7	1.57
AR	29.7	0.35	29.7	0.34
NH3	0.0	0.00	0.0	0.00
CO	260.8	3.11	25.3	0.29
CO2	1257.3	15.00	1492.7	17.32
O2	0.0	0.00	0.0	0.00
C2H6	0.0	0.00	0.0	0.00
C3H8	0.0	0.00	0.0	0.00
IC4	0.0	0.00	0.0	0.00
NC4	0.0	0.00	0.0	0.00
IC5	0.0	0.00	0.0	0.00
NC5	0.0	0.00	0.0	0.00
C6	0.0	0.00	0.0	0.00
H2O	3016.4		2780.9	
Total Flow KMOL/HR	11398.0		11398.0	
Total Flow KG/HR	193680		193680	
Temperature, Deg. C	210.0		230.5	
Pressure, KG/SQCM	38.7		38.3	

Notes:

1) Vendor to specify catalyst type brand which has been in successful commercial use for at least 2 years.

2) Catalyst volume to be sized based on 105% of the normal flows given above.

3) Allow for minimum +5% catalyst volume for handling loss.

CATALYST SPECIFICATION
105-D AMMONIA SYNTHESIS CONVERTER

Type: Iron synthesis catalyst

Specification/Brand: First Bed Prereduced: AmmoMax 10RS or equivalent
Rest Bed: AmmoMax 10 or equivalent

Size (mm): 1.5-3 mm granules (Top ~ 90% each Bed)
3–6 mm granules (Bottom ~10% each Bed)

Catalyst Volume (note 4):

Bed 1:	m^3	11.54	[pre-reduced, top: 1.5-3mm, cat. volume: 10.54 bottom: 3-6mm granules, cat volume: 1
Bed 2:	m^3	25.72	[non-reduced, top: 1.5-3mm, cat. volume: 23.49 bottom: 3-6mm granules, cat volume: 2.22
Bed 3A:	m^3	17.59	[non-reduced, top : 1.5-3mm, cat. volume: 16.07 bottom: 3-6mm granules, cat volume: 1.52
Bed 3B:	m^3	17.59	[non-reduced, top: 1.5-3mm, cat. volume: 16.07 bottom: 3-6mm granules, cat volume: 1.52
Total	m^3	72.44	

Density (kg/m^3): 2100 - 2800 Pre-reduced (to be confirmed by Vendor)
2800 - 3300 Non Reduced (to be confirmed by Vendor)

Performance requirement: Confirm operating conditions below. Vendor to guarantee minimum ammonia concentration of 19.8 mol % at the exit of Bed 3B @ End of Run (EOR) conditions.

Expected Catalyst Life: >10 years
Guaranteed Catalyst Life: By Vendor
Guaranteed Pressure Drop By Vendor

105-D Ammonia Synthesis Converter Operating Conditions

	Normal Case							
Total Mole Flow KMOL/HR	BED 1		BED 2		BED 3A		BED 3B	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
H2	13866.8	11425.5	11425.5	10153.5	10153.5	9793.5	9793.5	9461.6
N2	4632.9	3819.2	3819.2	3395.2	3395.2	3275.2	3275.2	3164.5
CH4	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
AR	680.0	680.0	680.0	680.0	680.0	680.0	680.0	680.0
NH3	349.1	1976.7	1976.7	2824.6	2824.6	3064.6	3064.6	3285.9
Total Flow KMOL/HR	19532.5	17905.0	17905.0	17057.0	17057.0	16817.0	16817.0	16595.7
Total Flow KG/HR	190906	190906	190906	190906	190906	190906	190906	190906
Temperature, Deg. C	360.0	509.8	388.0	467.9	395.0	417.9	417.9	436.3
Pressure, KG/SQCM (A)	157.2	156.8	156.7	156.3	156.1	155.6	155.6	155.0

Notes:
(1) Bed 1 catalyst to be pre-reduced iron type. Bed 2, 3A and 3B contain non-reduced iron catalyst. All beds are adiabatic with gas cooling between beds #1/#2 and #2/#3. Bed 3A & 3B are in series without cooling in between.
(2) Catalyst volumes set by KBR based on converter design. Vendor to confirm performance requirement for the above specified effective catalyst volumes.
(3) Vendor to specify catalyst type brand that has been in successful commercial use for at leas two years.
(4) Catalyst volume to be sized based on 105% of the normal flows given above
(5) Allow for minimum +5% catalyst volume for handling loss.

CATALYST SPECIFICATION

106-D METHANATOR

Type:	Nickel (Vendor to confirm) (Note 1)
Specification:	Meth 134 or equivalent
Size (mm):	3 - 6 spheres, or equivalent, vendor to confirm
Installed Volume (m^3):	24.53 (Note 2)
Vessel ID (mm):	3100
Bed height (mm):	By Vendor
Density (kg/m^3):	900~1200 (vendor to confirm)
Performance Requirement:	Confirm following operating conditions. Vendor to guarantee CO2 and CO total leakage of not more than 5 ppmv (dry basis) for End of Run (EOR) conditions.
Expected Catalyst Life:	10-20 years
Guaranteed Catalyst Life:	By Vendor
Guaranteed Pressure Drop:	0.30 kg/cm²

106-D METHANATOR Operating Conditions (End-of-Run)

	Normal Case			
	Inlet		Outlet	
Components	kmol/hr	Dry mol%	kmol/hr	Dry mol%
H2	4610.6	64.94	4520.8	64.49
N2	2296.0	32.34	2296.0	32.75
CH4	135.0	1.90	163.7	2.34
AR	29.7	0.42	29.7	0.42
NH3	0.0	0.00	0.0	0.00
CO	25.2	0.36	0.0	0.00
CO2	3.6	0.05	0.0	0.00
O2	0.0	0.00	0.0	0.00
C2H6	0.0	0.00	0.0	0.00
C3H8	0.0	0.00	0.0	0.00
IC4	0.0	0.00	0.0	0.00
NC4	0.0	0.00	0.0	0.00
IC5	0.0	0.00	0.0	0.00
NC5	0.0	0.00	0.0	0.00
C6	0.0	0.00	0.0	0.00
H2O	18.0		50.3	
Total Flow KMOL/HR	7118.0		7060.5	
Total Flow KG/HR	78150		78150	
Temperature, Deg. C	316.0		343.3	
Pressure, KG/SQCM	36.9		36.6	

Notes:

1) Vendor to specify catalyst type which has been in successful commercial use for at least 2 years.
2) Catalyst volume to be sized based on 105% of the normal flows given above.
3) Allow for minimum +5% catalyst volume for handling loss.

CATALYST SPECIFICATION
108-DA/DB/DC HYDROTREATER & DESULFURIZER

	108-DA	108-DB/DC (Note 6)
	HYDROTREATER	**DESULFURIZER**
Type:	Cobalt-Molybdenum (Vendor to confirm)	Zinc Oxide
Specification:	HDMax 200 or equivalent	ActiSorb S2 or equivalent
Size (mm):	2.5 Extrusions or equivalent vendor to	4.5 Extrusions or equivalent vendor to
Installed Volume (m^3): (Note 4)	9.5	49.23 each (Note 7)
Vessel ID, mm	2200	2200
Density (kg/m^3):	560~850	1090 ~1350
Special Requirement:	Catalyst shall be free of Arsenic	Catalyst shall be free of Arsenic
Performance Requirements:		Confirm attached operating conditions. Vendor to guarantee a maximum total sulfur leakage of
Expected Catalyst Life:	5 years	1 year lead vessel vendor to confirm
Guaranteed Catalyst Life:	By Vendor	By Vendor
Guaranteed Pressure Drop (KG/SQCM):	By Vendor	By Vendor

(Note 1, 3 & 4)	Normal Case	
	Inlet	
Components	kmol/hr	Dry mol%
H2	31.2	1.95
N2	19.6	1.22
CH4	1420.4	88.56
AR	2.2	0.14
NH3	0.0	0.00
CO	0.0	0.00
CO2	29.0	1.81
C2H6	101.1	6.30
C3H8	0.5	0.03
IC4	0.0	0.00
NC4	0.0	0.00
IC5	0.0	0.00
NC5	0.0	0.00
C6	0.0	0.00
H2O	0.0	
Total Flow KMOL/HR	1604.0	
Total Flow KG/HR	27823	
Temperature, Deg. C	371.1	
Pressure, KG/SQCM (A)	49.7	

Notes: 1) Composition is given upstream of 108-DA.
2) Vendor to specify catalyst type brand which has been in successful commercial use for at least 2 years.
3) Design for Total Sulfur of 50 mg/Nm3 (as H2S) at inlet with H2S content of ≤5mg/Nm3(as H2S), Mercaptans content of 15mg/Nm3 (as H2S) and the rests of organic sulfurs.
4) Catalyst volume to be sized based on 105% of the normal flows given above.
5) Allow for minimum +5% catalyst volume for handling loss.
6) ZnO beds are in lead-lag arrangement.
7) Each ZnO vessel contains two beds of equal volume catalyst with toal catalyst volume of 49.23m^3.

CATALYST SPECIFICATION
109-DA/DB MOLECULAR SIEVE DRYER

Type: Type A Zeolite (4A or 13X) (Vendor to confirm)

Size: By Vendor

Density, kg/m³: By Vendor

Installed Volume, m³: 23.81 each vessel (Vendor to confirm)
two-bed setup (one on line while the other regen. standby)

Vessel ID, mm (Externally Insulated): 3500 mm

Performance Requirements: Confirm following operating conditions. Vendor to guarantee the total of CO2, NH3, and H2O at the outlet stream to be ≤ 1.0 ppmv (note 2)

Expected Catalyst Life: 3~5 years
Guaranteed Catalyst Life: By Vendor

Guaranteed Pressure Drop: <0.2 kg/cm²

Operating Cycle (24 hour cycle):

Drying	24	hrs
Depressurization	By vendor	hrs
Regeneration	By vendor	hrs
Cooling	By vendor	hrs
Pressurizing	By vendor	hrs
Standby	By vendor	hrs

Gas Flow and Composition:

		Process Gas		Regeneration Gas		Cooling Gas	
		Inlet	Outlet	Normal	Alternate	Normal	Alternate
Composition, Dry mol%							
H2		64.76	64.76	6.17	64.76	6.17	64.76
N2		32.38	32.38	76.03	32.38	76.03	32.38
CH4		2.24	2.24	15.36	2.24	15.36	2.24
AR		0.62	0.62	2.44	0.62	2.44	0.62
NH3		2-20 ppmv	**Note 2**				
CO2		0-10 ppmv	**Note 2**				
Dry Flow	kgmol/hr	7312.4	7312.4				
	kg/hr	80308	80308				
H2O	kgmol/hr	2.00	**Note 2**				
Total Flow	kgmol/hr	7314.4	7312.4	Note 3	Note 3	Note 3	Note 3
	kg/hr	80344	80308	by Vendor	by Vendor	by Vendor	by Vendor
Temperature, °C		4.0	4.0	245(note 4)	245(note 4)	1.8	4.0
Pressure, kg/cm²(a)		35.8	35.6	2.5	2.5	2.7	2.7
Average MW		10.98	10.98	24.86	10.98	24.86	10.98

Notes:

1) Drying is downflow. Regeneration is upflow. Cooling is downflow.
2) **Total of CO2, NH3 and H2O to be guaranteed to be 1.0 ppm or less.**
3) Normal regeneration and cooling gas is Purifier Waste Gas (dry gas) from downtream Purifer.
   Alternate regeneration and cooling gas is dried syngas from the exit of online dryer.
   Regen. flows to be specifed by vendor.
4) For both normal regen. gas and alternate regen gas, the supply conditions are 245 °C and 2.5 kg/cm²(a)