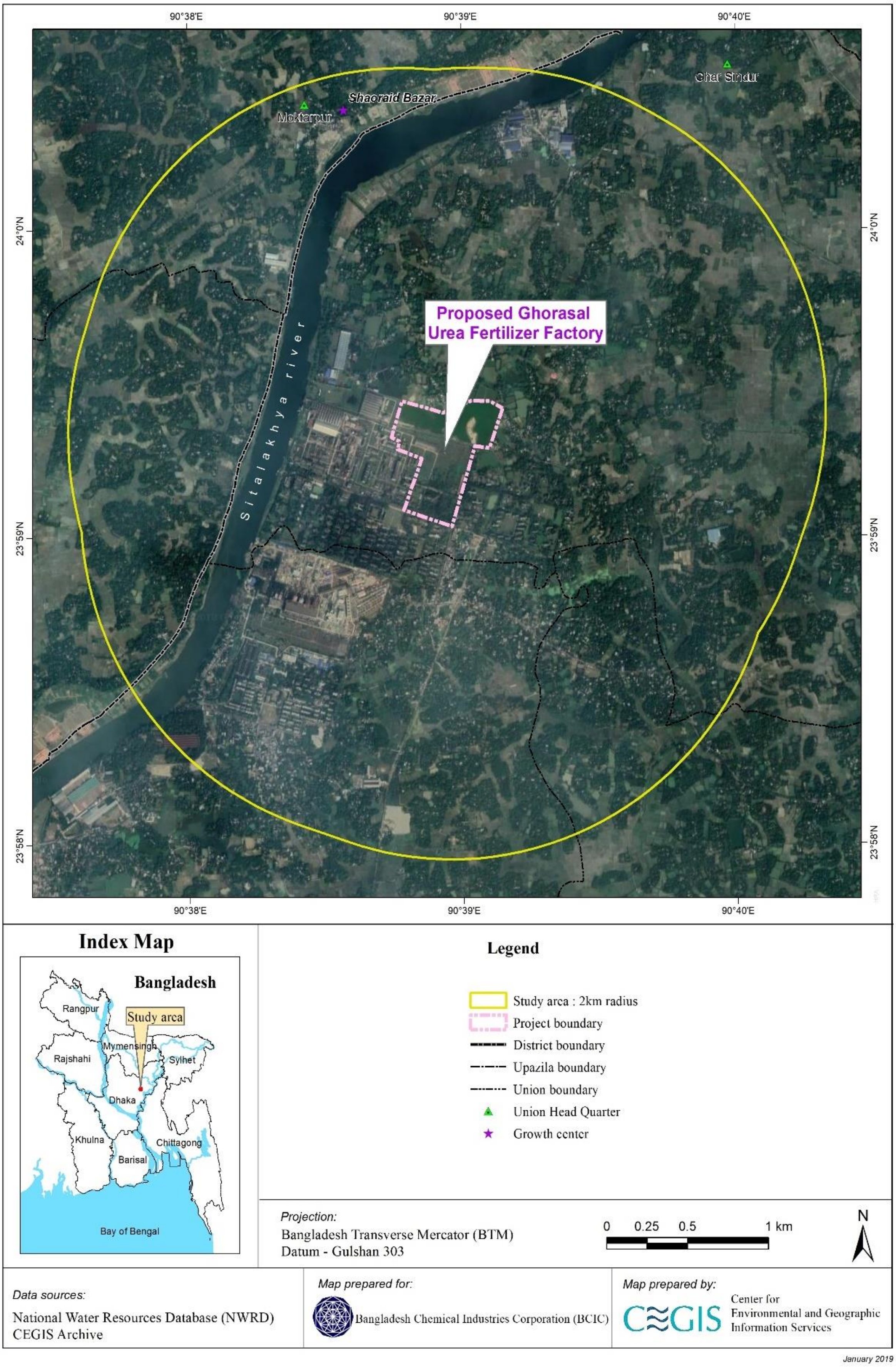


Figure 4.5: Direct impact area for the proposed Project

4.4 Nature and Size of the Project

221. The project involves dismantling of the existing infrastructures located inside the Project site. The nature of the proposed Project is a new construction of natural gas-based granulated urea plant. The urea production capacity of the proposed Project is 2,800 TPD and annual production capacity is based on 330 stream days in a year. For fulfilling the power requirements, the proposed project will have a 2x32 MW Steam Turbine Generator (STG) and one 09 MW GEG power plant as captive plant for its day to day use.

4.5 Project Concept

222. The proposed Project is a new construction of urea plant of about 0.924 million tons of urea at the rate of 2,800 TPD (based on 330 operating/stream days per year). Commissioning of the Urea Fertilizer Factory of above capacity will be done by installing utility boiler, central store, ammonia plant, cooling tower, central control room, urea unit, demi water unit, pumping station, ammonia storage tank, power plant, WWTS/ETP, etc. The proposed project will have a 2x32 MW ST and one 09 MW GEG Power Plant as captive plants for its day to day use. According to the agreement, Titas Gas Transmission and Distribution Company Ltd. (TGTDCL) used to supply about 64.7 MMCFD (UFFL- 48 and PUFFL- 16.7 MMCFD) natural gas at normal supply condition and ensured to supply to the UFFL and PUFFL about 70 MMCFD (UFFL- 52 and PUFFL- 18 MMCFD) natural gas at maximum supply conditions through the existing gas network and the proposed Regulating Metering Station (RMS). The proposed Project will use this same amount of gas for the production of three times more urea fertilizer.

223. Continuous withdrawal of water from the Shitalakhya River is 1,159 t/h (0.322 m^3/s) as makeup water and the net water requirements of the Plant is about 1,020 t/h (0.283 m^3/s) will be used for Plant's cooling and all other purposes as stipulated below, such as open recirculation cooling (cooling water of 837 t/h or 0.233 m^3/s), other plant use (183 t/h or 0.051 m^3/s), etc.

224. Product urea in bags will be conveyed by a closed conveyor belt to the jetty to be constructed on the left bank of the Shitalakhya River. From the jetty, the urea will be transported by barges. The bagged urea will also be transported by trucks and rail wagons through road and railways respectively. A railway line from the site to nearby mainline will be constructed too.

4.6 Project Components

225. The project components are broadly categorized into two types, such as (i) dismantling component; and (ii) new construction component.

4.6.1 Dismantling Components

Demolition of Existing Infrastructures

226. The existing infrastructures which fall under the proposed project site will be dismantled. The type of infrastructures and the area these belonged to are as follows: buildings of an area of about 1,87,404 sqft (17,410 sqm), semi-pucca tin-shed building of an area of about 94,680 sqft (8,796 sqm), RCC (brick chips) road of an area of about 167,494 sqft (15,561 sqm), RCC (stone chips) road of an area of about 1,680 sqft (156 sqm), carpeting

road of an area of about 86,550 sqft (8,040 sqm), boundary wall of an area of about 44,343 sqft (4,120 sqm), tin-shed/asbestos sheet/scrap yard/heavy vehicle of an area of about 10,525 sqft (977 sqm) and Titas infrastructure of an area of about 44,587 sqft (4,142 sqm) (Table 4.3). Approximately 27,400 tons of debris will be generated due to demolition of civil structures. For storing the debris generated from dismantling of infrastructure componentswill require an estimated area of about one (01) acre and spacious scrap site will be required temporarily or sold out to the relevant vendors. The existing stores/warehouses will be dismantled.

227. The project site is largely covered by grasses and having different species of trees, shrubs and climbers. Among the trees, the major ones are timber trees followed by fruit and other trees. The major timber trees are: Shegun, Mahogoni, Raindee Koroi, Kanthal, Sirish, Koroi, etc. The fruit trees are: bael, beetel nut, jackfruit, papaya, coconut, , lemon, mango, cashew nut, blackberry, embelic, etc. Trees fall in other category include Jhau, Kamini, Debdaru, Neem, Krishnochura, Bot, Daruchini, etc. A 'Demarcation Report' has been prepared and appended in *Annex 4-1*. Based on the report it is concluded that about 3,750 small to big trees (sapling mostly, juvenile and adult) will be cut down during site preparation. The trees found in the site were planted by PUFFL as a part of a greenery program from the date of commissioning of the Plant.

228. The hazardous waste generated from demolition of infrastructures will be treated as per the WBG's General EHS Guidelines, 2007 and WBG's Good Practice.

Table 4.3: List of infrastructures inside the proposed site of GPUFP

Sl. No.	Name of Infrastructures	Measurement (in sqft)
1	Administrative office building area (Two storied)	17,026
2	Technical office building area (Two storied)	13,596
3	Canteen building area	2,040
4	General store building area	30,450
5	General store semi-pucca asbestos sheet roof with M.S. tress	21,750
6	Security post (Two storied)	72
7	Factory out gate security office	364
8	Factory main gate security office	960
9	Receiving bay store office	1,200
10	Security office (Housing colony gate)	420
11	VIP Guset House building area	8,390
12	Medical Center (Three storied) and Porch	10,962
13	Officer's Club (Two storied), one storied and Porch	10,572
14	Officer's Hostel (Five storied), Porch, Passage (Three storied)	26,021
15	Employee's Hostel (Five storied), Passage, Porch	30,954
16	Union Office (One storied)	2,592
17	Employee's Club (Two storied) and Porch	9,285
18	UFFL Lagoon pump house	750

A	***Sub-total building area=***	***1,87,404***
B	***Sub-total semi-pucca tin-shed building area=***	***94,680***
C	***Sub-total RCC (Brick chips) road area=***	***1,67,494***
D	***Sub-total RCC (Stone chips) road area=***	***1,680***
E	***Sub-total carpeting road area=***	***86,550***
F	***Sub-total boundary wall area=***	***44,343***
G	***Sub-total tin-shed/asbestos/scrapyard/heavy vehicle area=***	***10,525***
H	***Sub-total Titas infrastructure area=***	***44,587***
I	**Grand Total Demolished Area=**	**6,37,263 sqft~59,204 sqm**

Source: Final Report from Demarcation Committee, BCIC, 2017

Composition of Spent Catalyst

229. The catalysts used in vessels of the existing Ammonia Plant of the PUFFL are listed in the Table 4.4 with their composition. The catalysts are as follows: Zinc Oxide, Silicon Dioxide, Nickel, Ferric Oxide, Chromium Oxide, Copper Oxide, Nickel Oxide, Aluminum Oxide, etc. Such spent catalysts form the major part of the solid wastes generated in the fertilizer complex. Catalyst wastes include nickel, iron, chromium, copper, zinc, silicon, graphite, aluminum, etc.

Table 4.4: List of catalysts used in existing Ammonia Plant of PUFFL

Sl. No.	Name of Vessels	Composition (wt%)
1.	DSV (Desulphurization Vessel)	ZnO=90; SiO_2=5-10; S=<1500ppm; Cl=<200ppm; As=<1ppm
2.	Primary Reformer	Ni=12-22; SiO_2=0.1 ppm(max); S=500 ppm(max); Na=500 ppm(max); Al=Balance
3.	Secondary Reformer	Ni=19; SiO_2=2000ppm(max); S=500 ppm(max); Na=500 ppm(max); Al=Balance
4.	HTS	Fe_2O_3=87-91; Cr_2O_3=6-10; CUO=1.5-2.1; C/Graphite=1.5-3.0; Al=<1.0
5.	LTS	CuO=52; ZnO=29; NiO=<0.03; Al_2O_3=<1.0; SiO_2= <0.01; S=<0.04; N=<0.06
6.	MTN	Ni=20$\pm$2; SiO_2=2000 ppm(max); S=100 ppm(max) Cl=500 ppm(max)
7.	ACV	Fe_2O_3=65-68; FeO=30-37; Al=1.8-3.0; K_2O=.6-1.0 CaO=.2-.7

Source: BCIC, 2019

Treatment of Spent Catalyst

230. The catalysts are used in urea fertilizer industry for the conversion of CO to CO_2 in the presence of steam. These catalysts contain 30-45% CuO, 40-55 % ZnO and 10-20% Al_2O_3, when these catalysts loose activity and the successive processes of regeneration and activation failed to renew them, it is replaced by a new one and the spent one is discarded.All catalysts are deactivated along its useful life time because of the following reasons; fouling, poisoning or thermal degradation. Spent catalyst disposal is a major environmental concern for urea fertilizer factory.

231. Disposal of spent catalyst is a problem as it falls under the category of hazardous industrial waste. The recovery of metals from these catalysts is an important economic aspect as most of these catalysts are supported, usually on alumina/silica with varying percent of metal; metal concentration could vary from 2.5 to 20%. Metals like Ni, Cu, Fe, Al, Co, etc., are widely used as a catalyst in fertilizer industries. In most cases, the pyrometallurgy and Hydrometallurgy processes are applied for recovery of precious metals. Recovery of nickel from a spent catalyst in an ammonia plant is done by leaching it in sulphuric acid solution (Hydrometallurgy). Extraction of metals from spent catalyst can be done by roasting–extraction method (Pyrometallurgy). Chelating agents are the most effective extractants, which can be introduced in the soil washing fluid to enhance heavy metal extraction from contaminated soils.

4.6.2 Newly Construction Components

232. The major components of the proposed GPUFP can be categorized in three systems/processes. These are: (a) Process Plants; (b) Utility; and (c) Off-sites.

(a) Process Plants: The process plants include the following components-

- Ammonia Plant;
- Urea Plant; and
- Urea Granulation Plant.

(b) Utility: The utility services are composed of following components-

Sl. No.	Components	Sl. No.	Components
1	River water intake Unit	7	Natural Gas Metering Station
2	Water Treatment Unit plus distribution system	8	Inert Gas Generation and Storage Facilities
3	Cooling water (Cooling Tower)	9	Waste Water Treatment System (WWTS)/ Effluent Treatment Plant (ETP)
4	Steam generation Facilities plus distribution system	10	Polyethylene Bag Making Plant
5	Electrical Generation Facilities and Power Distribution System	11	Central Control room, Substation, Switch room, etc.
6	Instrument Air and Plant Air Facilities	12	GEG, Emergency Generator & UPS

(c) Off-sites: There are some components of the proposed GPUFP which will function as forward linkages of the project. The components are as follows:

Sl. No.	Components	Sl. No.	Components
1	Ammonia Storage Unit	7	Road, Paving, Fencing, Lighting, Drainage Network
2	Urea Handling, Bulk Storage, Bagging Facilities and Bagged Urea Storage	8	Vehicle parking
3	Laboratory facilities	9	Buildings for different uses (Control Room, Administrative, Technical, Maintenance, Engineering, Security, Township etc.)
4	Warehouse for Spares, Catalysts, Resins, Chemicals, Consumable, etc.	10	Ammonia Bottling station

Sl. No.	Components	Sl. No.	Components
5	Maintenance shops(Mechanical, Electrical, Instrument)	11	Jetty
6	Fire Fighting System including First Aid Center	12	Water Intake

233. Building Infrastructures: The off-sites include the buildings for different uses of the GPUFP. The total number of new buildings and sheds to be constructed are 52. In these buildings, the number of Plant Buildings are 23 and Non-Plant Buildings are 29. Among the Plant buildings nine (09) nos. are two storied and the rests are one storied building. Details about non-Plant buildings are yet to finalize.

4.7 Resources and Utility Demand

234. Resources required to develop the project include soil, construction material, manpower etc. The site is a part of the existing urea fertilizer plant and of the same level, therefore will need only minor earth dressing except the lagoon. The lagoon though not the part of the Poject area will be filled up with dredged materials under the auspices of the GPUFP authority as it will be used as laydown area. The estimated dredged materials will be about 2,26,700 m^3. The loosened dredged materials if spilled over may contaminate river water and entrain into the food chain of fish and other aquatic organisms. Local construction material will be used for the proposed project and the project will provide employment for unskilled, semi-skilled and skilled categories. Employment opportunities will be available with the start of construction activities and continue through the operation phase, mainly in service sector.

235. Electricity demand during the construction phase will be met by the existing sub-station and distribution facility. During the construction period, water can be fetched from the nearby Shitalakhya River and drinking water can be drawn from existing underground sources such as Deep Tube well. Natural gas as fuel will be available under the existing supply of the TGTDCL from nearby Regulating and Metering Station (RMS) for the proposed GPUFP. Waste will be disposed of in the approved designated site preferably apart from the Plant site.

236. A temporary sanitation facility for the workers during pre-construction and construction phases will be developed with septic pits or tanks with adequate capacity. The sewerage system will be connected to the existing facility.

237. A temporary road and drainage system will be developed in addition to the existing system until a final road and drainage system is constructed.

4.8 Source of Natural Gas and Quality

238. At present the gas is supplied to the PUFFL and UFFL by the Titas Gas Transmission and Distribution Co. Ltd (TGTDCL) of PetroBangla through a 8˝ diameter pipeline and a Regulating and Metering Station (Titas RMS) situated at the Northeast corner of the PUFFL and UFFL complex. The natural gas is supplied under a contract for maximum 70 MMCFD but currently being used 64.7 MMCFD of natural gas for operating UFFL and PUFFL. The contract needs to be maintained to meet the demand of gas for operating the proposed Project.

239. Natural gas will be supplied to the plant site through the existing pipeline system with minimum expected gas pressure at the plant boundary is 7-10 kg/cm^2G (6.9-9.8 bar). Considering distance from the location of existing RMS a new NG receiving system will be required to be installed in the space available at the Southwest side of the proposed site. A 8˝

diameter gas pipeline from inlet header of the Titas RMS up to the bus of the proposed gas station mentioned above is to be constructed. Existing and proposed gas supply arrangements are presented in Figure 4.6 and Figure 4.7 and the composition of gas used in the urea plant is presented in Table 4.5.

Table 4.5: Gas analysis report

Gas Composition	% Mole in Gas using PUFFL and UFFL	Expected as per Tender Document
Nitrogen	0.788	0.55
CO_2	0.008	0.43
Methane	97.644	96.6
Ethane	1.544	1.7
Propane	0.006	0.36
Normal Butane	0.002	Butane, i C_4H_{10}: 0.09 and Butane, n C_4H_{10}: 0.052
Hexane Plus	0.008	-
Air/O_2	-	0.10
Hydrogen Sulfide	-	2 ppm max
Calorific Value	>1,000 kcal/Nm^3	8691.98 kcal/Nm^3 (approx.) Lower Heating Value

Source: Bangladesh Gas Fields Company Ltd.

4.9 Pipelines for Natural Gas and new Gas Regulating and Metering System

240. At present the gas is supplied to PUFFL and UFFL from Titas Gas Transmission and Distribution Company Ltd. (TGTDCL). A Gas transmission line constituting 46.31 km distance from Titas field through one DN16 diameter pipeline with 1,000 psi pressure comes to Narsingdi (Figure 4.6). From Narsingdi VS#12, 2 nos. DN 14 of 22.31 km transmission line with the same pressure of 1,000 psi is connect to a Regulating and Metering Station (RMS) situated at the PUFFL and UFFL Complex (Figure 4.7). Gas inlet pressure of Titas RMS varies from 420 psi to 600 psi. A 8˝ diameter gas pipeline from inlet header of the Titas RMS up to the site will be constructed along with a new NG receiving system.

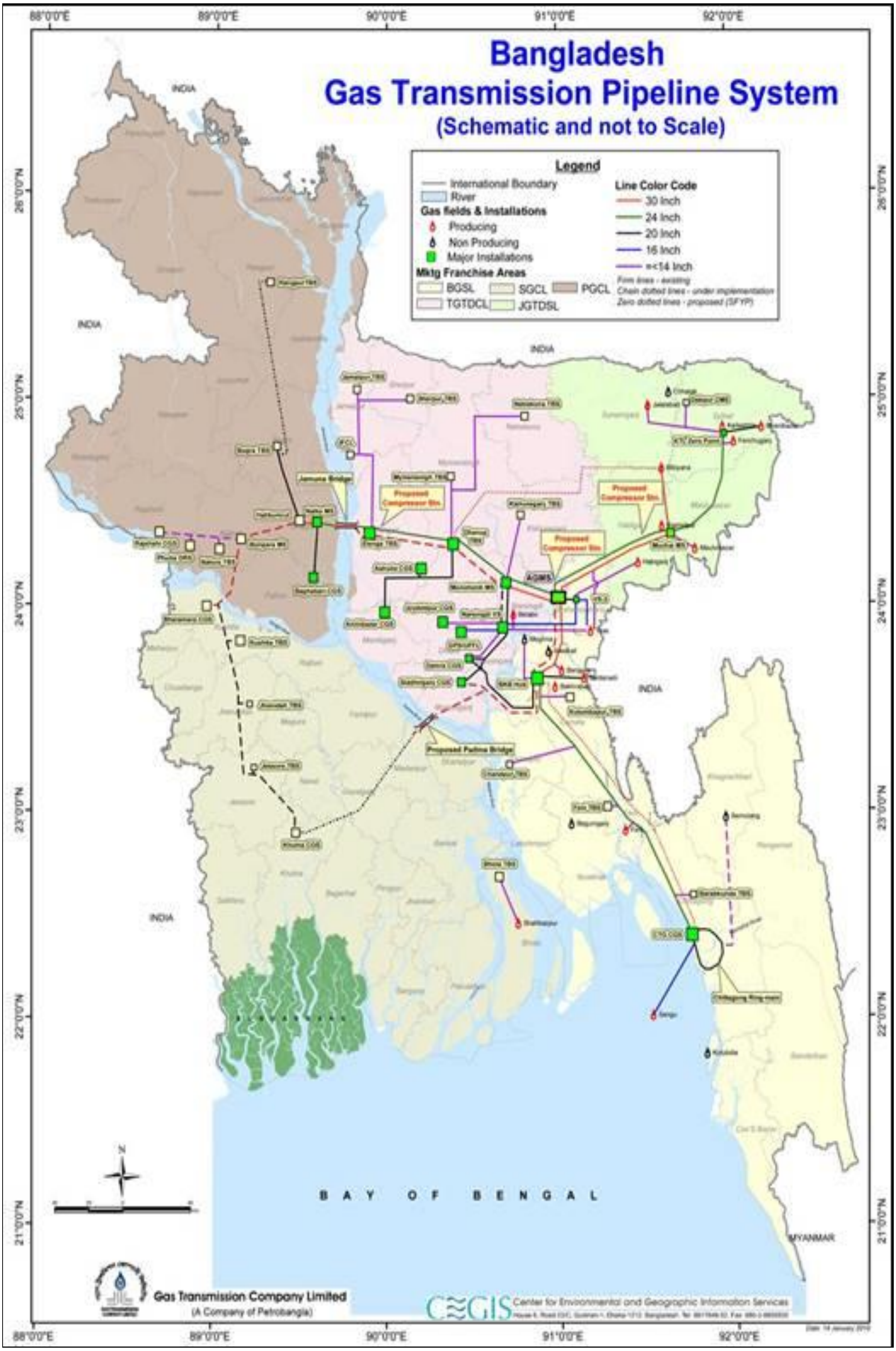


Figure 4.6: Gas transmission network

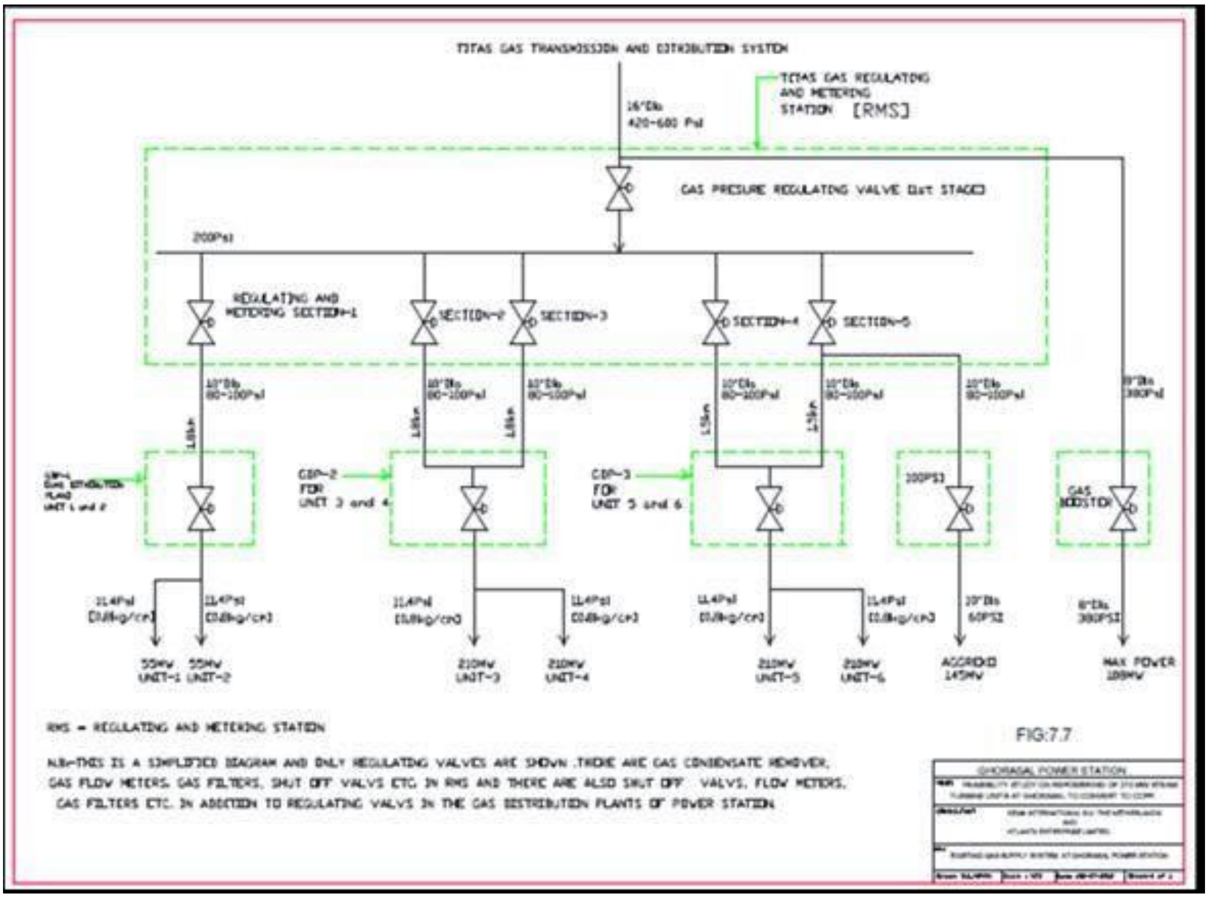


Figure 4.7: Existing Ghorasal gas connection system

4.10 Project Activities and Schedule

4.10.1 Project Activities

241. There are two main project activities, (a) Demolition of existing Infrastructures and (b) New Construction of Urea Fertilizer Factory. A list of project activities and associated concerns are given below inTable 4.6.

Table 4.6:List of activities and associated concerns

Sl. No.	Activities	Concerns
A.	**Pre-Construction Phase**	
A1.	Demolition of infrastructures and scraping	• Dismantling activities for the existing civil structures will result in loose soil within the complex. Wind flow is strong during dry months. Thus, the dust generated during the construction activities may spread to the nearby areas • Marginal exhaust emissions from dismantling equipment • Scrapping time dust emission • Noise generation • Management of spent catalysts • Associated risks
A2.	Site preparation	• Clearing of vegetation and removal of top soil • Labor mobilization

Sl. No.	Activities	Concerns
		• Lagoon to be filled up by dredged materials from the Shitalakhya River
A3.	Transportation with respect to equipment and materials procured and Site receiving, Handling and Warehousing which include:	
	A3.1 Unloading at the site	Vehicular movement; noise generation
	A3.2 Storing	
	A3.3 Receiving and issuing of equipment and materials	
A4	Temporary Works (needed by the contractor) include:	
	A4.1 Temporary warehouse	Vehicle movement; dust and solid waste generation; generation of sewage
	A4.2 Temporary office	Vehicle movement; dust and solid waste generation; generation of sewage
	A4.3 Water supply within the site	Drainage system
	A4.4 Electricity supply within the site	Pressure on grid and local allocation.
	A4.5 Temporary sewer and drainage system	Hygienic condition of labor shade, office and construction site; Drainage system would facilitate drainage of construction waste water.
	A4.6 Temporary firefighting equipment & first aid facilities.	Fire induced risk would be reduced.
	A4.7 Temporary site canteen	Solid wastage
	A4.8 Camp accommodation for contractor's and its subcontractor's personnel	Land requirement (estimate land area based on area requirement per person), solid waste, sewage, drainage, etc.; Social pressure in local market; Society may feel pressure in the following areas: mixing with local people, anarchy, diseases, house rent may increase, etc.
	A4.9 Other temporary facilities within the site as required such as scaffolding, fencing, guard house etc.	Construction of trenches, Construction waste, dust
B.	**Construction Phase (Construction and Erection work)**	
B1.	**Construction Work**	
	B1.1 Civil work (piling, foundation, structure, buildings, shades, roads, drains, pavements, etc.)	Vehicular movement and operation of construction equipment: Noise, dust, exhaust emissions (marginal increase in the levels of SO_2, NO_X, PM, CO and un-burnt hydrocarbons), construction liquid waste, solid waste, drainage, etc.
	B1.2 Shipment of Machinery to the site	Temporary load of barges increase; marginal exhaust emission; bilge and ballast water may affect water quality, etc.
B2.	**Erection Work: Installation Work (all equipment, package units if any etc.)**	

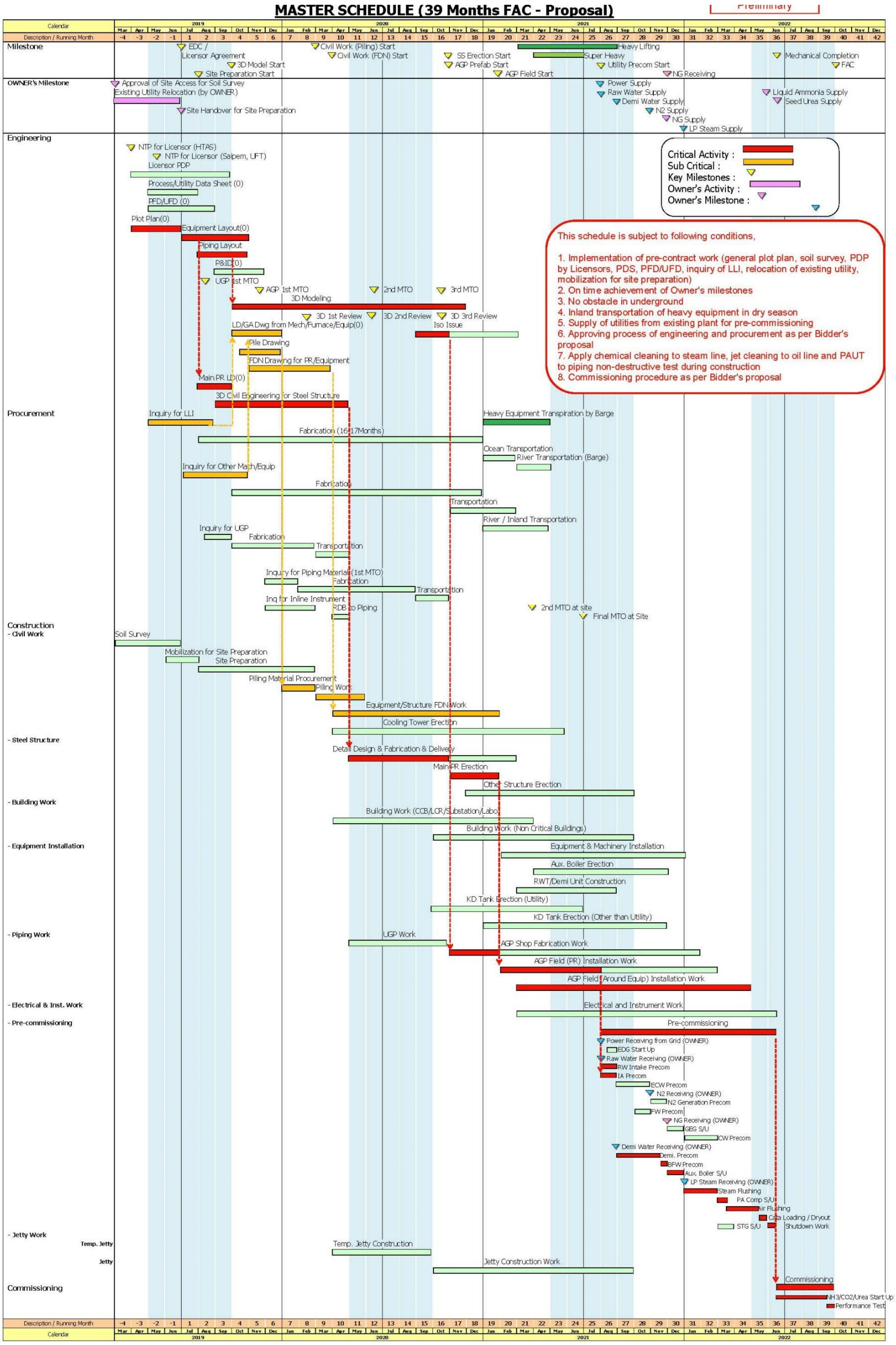
Sl. No.	Activities	Concerns
	B2.1 Piping Work B2.2 Electrical Work B2.3 Instrumentation Work B2.4 Insulation Work B2.5 Painting Work	Noise, dust, exhaust emissions (marginal increase in the levels of SO_2, NO_X, PM, CO and un-burnt hydrocarbons), construction liquid waste, solid waste, drainage, risk, health and safety, etc.
	B2.6 Flushing and Chemical Cleaning	Chemical contamination to ambient water environment
B3.	B3.1 Jetty construction	• Pile driving may affect aquatic biodiversity, vocalization behavior of the organisms may be affected. • Obstruction to water flow
C.	**Operation Phase**	
	C1. Water intake (2040 t/h) from the Shitalakhya River	Pressure on the river and environmental flow; Aquatic biodiversity; LLP-based agriculture
	C2. Drainage of rejected water C3. Sludge to Shitalakhya River	Contamination to water quality; Aquatic biodiversity, soil contamination, etc.
	C4. Effluent (chemical/fertilizer and oily)	Chemical/fertilizer mixed water pass through the ETP and oil-mixed water through oil separator.
	C5. Boiler (Aux.) and Gas Engine Generator	Flue gas (NOx, Particulate substances)
	C6. Ammonia plant	
	Ammonia Plant	Flue gas (negligible NOx); Noise
	CO_2recovery plant	Exhaust CO_2
	C7. Urea Plant	
	Urea Granulation Plant	• Urea dust • NH3 (<150 mg/Nm^3-dry) • Noise
	C8. Officials (Administrative, Plant operation, Control Tower, etc.) C9. Labor requirements	Sewage, potable water requirements, solid waste, risk, etc.
	C10. Jetty operation	Solid and liquid waste
	C11. Dispatch of urea	Water, Rail and Road ways; Bilge and ballast water waterway vessel may contaminate water; Vehicle load will be increased; social mobilization may be hampered; exhaust emission (NOx, CO_2, dust, etc.)

Source: Activities taken from Feasibility Study Report

4.10.2 Project Implementation Schedule

242. The duration of the Project is about 39 months, started from July, 2019 to September, 2022. The detail schedule of the Project implementation from Site Preparation to Commissioning is given in Table 4.7.

Table 4.7: Project implementation schedule



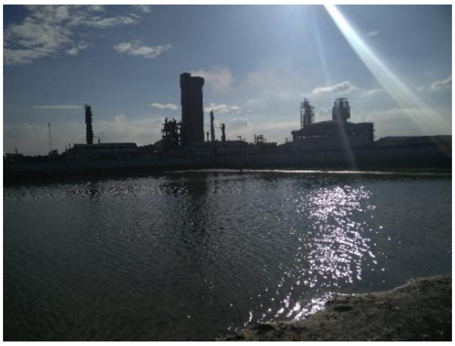
5. Project Design and Description

5.1 Overview of Existing Facility

243. At present, there are six urea fertilizer factories under BCIC. Out of these, the Ghorasal area has two Urea Plants: Urea Fertilizer Factory Ltd. (UFFL) and Polash Urea Fertilizer Factory Ltd. (PUFFL). The installed capacity of six urea fertilizer factories under BCIC is 2.80 million MT. However, due to aging some of these Plants cannot sustain the installed capacity and gradually the production is decreasing.

244. The UFFL is one of the old fertilizer plants in the country and was established in 1970. The installed production capacity of the plant was 340,000 tons of urea per year and the renovated capacity is 470,000 tons per year. At present production has come down to 600 TPD from 1,400 TPD.

245. The PUFFL having yearly production capacity of 95,000 tons of Prilled Urea was established in 1985. The economic life of the project was 15 years. The present production comes down to 250-300 TPD from 305 TPD.Figure 5.1 shows the existing major equipments of the PUFFL.


PUFFL


Compressor


Water Intake Point


Acid Tanks

Figure 5.1: Existing infrastructures of the PUFFL

5.2 Proposed Project Design

5.2.1 Design Life and Operating Time

246. The design life is 20 years for the process plant subject to appropriate maintenance and replacement for items such as catalysts, furnace tubes and mechanical seals which have

shorter life duration and will require replacement during the life of the Process Plant. The operating time/streamtime of the proposed plant is 330 days per annum.

5.2.2 Technology Selection

247. The technologies or Process Licensors for Ammonia, Urea Melt, Granular Urea and CO_2 Recovery from Primary Reformer have been selected for this Project based on different aspects mentioned in Sections 3.8, 3.9, 3.10 and 3.11 respectively. The selected Process Licensors are attributed in Table 5.1 below.

Table 5.1: Process Licensors selected for the Project

Sl. No.	Process Name	Name of Process Licensor
01.	Ammonia	Haldor Topsoe A/S (HTAS), Denmark
02.	Urea Melt	SAIPEM S. p. A., Italy
03.	Urea Granulation	thyssenkrupp Fertilizer Technology GmbH (TKFT), Germany
04.	CO_2 Recovery from Primary Reformer	Mitsubishi Heavy Industries, Ltd (MHI), Japan

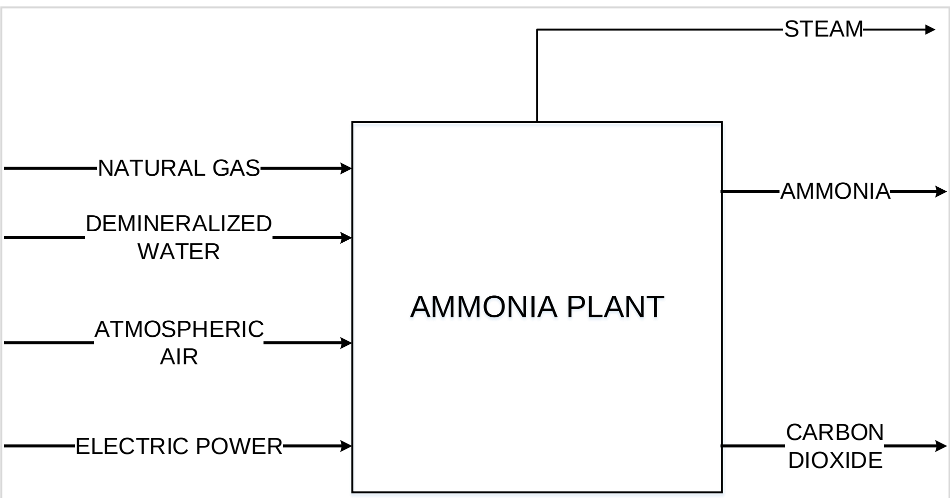
Source: MHI (EPC Contractor)

5.2.3 Process Description

Ammonia Process

248. The proposed ammonia plant is designed with a capacity of 1,600 MT/day, based on steam reforming of natural gas. In the plant, ammonia is produced from synthesis gas containing hydrogen and nitrogen in the ratio of approximately 3:1. Furthermore, high purity CO_2 is produced from the CO and CO_2 contained in the reformed gas. Besides these components, the synthesis gas contains inert gases such as argon and methane to a limited extent.

249. The source of H_2 is demineralized water and the hydrocarbons in the natural gas. The source of N_2 is the atmospheric air. The source of CO_2 is the hydrocarbons in the natural gas feed. The main function of the plant is illustrated in the following sketch. The main function of the Ammonia Plant is illustrated in the following sketch and diagram in Figure 5.2.



Sketch of the Ammonia Plant

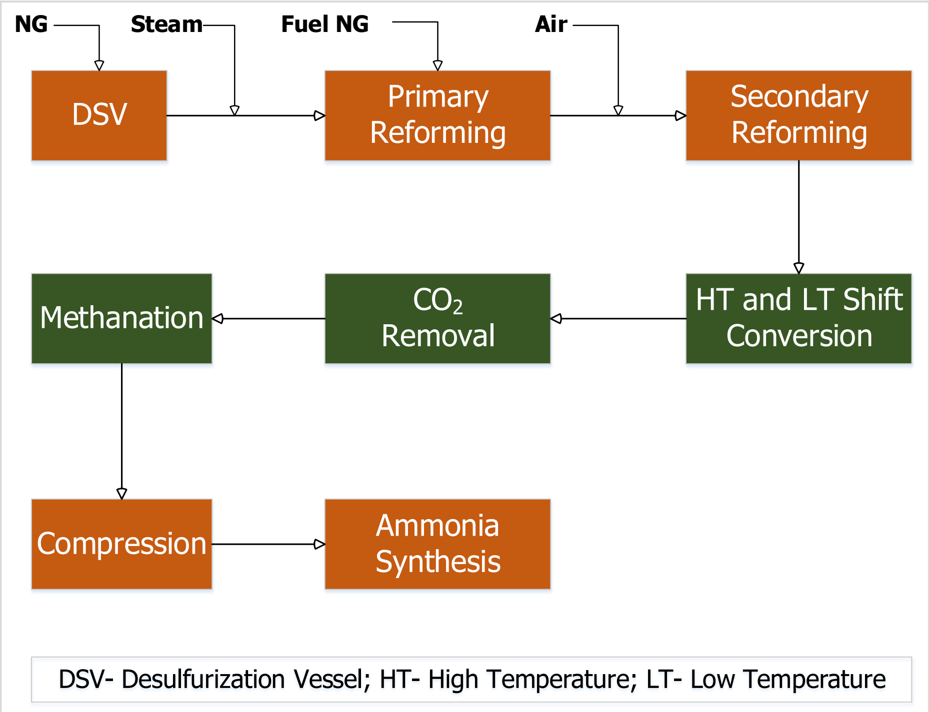


Figure 5.2: Sketch and flow diagram of ammonia synthesis

250. The process steps involved in production of Ammonia are:

- Desulphurization
- Reforming
- Carbon Monoxide Conversion
- Carbon Dioxide Removal
- Methanation
- Ammonia Synthesis
- Ammonia Refrigeration Circuit
- Ammonia Recovery
- Steam System
- Flare and Verit System

251. The descriptions of the various process steps are as follows:

Step-1: Desulfurization

252. The natural gas feedstock contains minor quantities of sulfur compounds which have to be removed in order to avoid poisoning of the reforming catalyst in the primary reformer and in the low temperature CO converter.

253. Natural gas from battery limit at 3.96 MPa g is mixed with recycle gas and heated to 370°C in the flue gas section of the primary reformer. Desulfurization is achieved by converting organic sulfur compounds to H2S. H2S is subsequently absorbed on a specially prepared zinc oxide catalyst, contained in sulfur absorbers. The sulfur contained in the natural gas will be reduced to less than 0.05 vol. ppm.

Step-2: Reforming

254. The reforming of the hydrocarbon feed takes place in two stages, a direct firedprimary reformer and an autothermal catalytic secondary reformer.

255. The primary reformer is divided into two chambers having a common flue gas duct and a flue gas heat recovery section. In the primary reformer the hydrocarbon mixed with steam is decomposed into hydrogen, carbon monoxide, and carbon dioxide over a nickel catalyst. Flue gas flow is upwards with a temperature of about 1050°C.

256. In the secondary reformer methane is decomposed. The methane concentration in the outlet gas from the secondary reformer is 0.3 vol% (dry basis).

257. Thus, the reforming unit consists of a primary reformer with a waste heat section and a secondary reformer.

Flue Gas Heat Recovery Section

258. The flue gas then passes via the flue gas duct to the flue gas heat recovery section, where most of the heat of the flue gas is utilized for preheating purposes and then leaves through the stake at a temperature of about 190°C.

Secondary Reformer

259. The gas from the primary reformer is passed on to the secondary reformer where it is mixed with the compressed process air at about 3.38 MPa g and is preheated to 550°C.

260. The process gas leaves the reforming section at about 998°C. It is cooled to about 442°C in the RG waste heat boiler, where 12.26 MPa g saturated steam is produced, and further to 360°C in the RG steam superheater. After cooling, the gas flows to the high temperature CO Converter.

Step-3: Carbon Monoxide Conversion (CO)

261. The CO conversion takes place in two adiabatic stages- HT & LT converters. After reforming, about 13.47% CO is present in the gas (dry basis). In the high temperature CO converter the CO content is reduced to approximately 3.19 vol%, and the temperature increases from 360°C to 433°C. It is then cooled to 205°C and passed on to the low temperature CO converter, in which the CO content is reduced to approximately 0.3 vol%, while the temperature increases to 228°C.

Step-4: Carbondi Oxide (CO_2) Removal

262. The gas leaving the CO conversion unit contains a considerable amount of recoverable heat. The waste heat in process gas is recovered in a high pressure Boiler Feedwater (BFW) preheater, in the stripper reboiler and in the demineralized water preheater.

263. Carbon Dioxide (CO_2) is removed from the process gas by counter-current absorption in two stages using an activated Methyl Di-Ethanol Amine (aMDEA) solution. For removal of the CO_2, BASF's OASE process is used. Main equipment in the OASE process is the CO_2 absorber, and the CO_2 stripper. In the lower part of the CO2 absorber, flash-regenerated solution is used for bulk CO removal. In the upper part of the absorber, strip-regenerated Solution is used for scrubbing.

264. The extracted CO_2 will be delivered cooled to 43°C and at a pressure of 0.05 MPa g. In this way, a nearly complete removal of CO_2 with only 0.05 vol% CO_2 (on dry basis) left in the treated gas is obtained at the expense of very low heat consumption.

Step-5: Methanation

265. After the CO_2 removal, the gas contains 0.05% CO_2 and 0.36% CO (dry basis). These compounds are poisonous to the ammonia catalyst and must be removed before the. gas is taken to the synthesis section. This is done in the methanator where CO and CO_2 react with H_2 to form CH_4 , which is harmless to the ammonia catalyst. The reaction takes place over a nickel-based catalyst. The content of CO + $C0_2$ is reduced to less than 5 ppm. The outlet gas is cooled with the inlet gas and finally cooled to 42°C.

Step-6: Ammonia Synthesis

Compression

266. The synthesis gas is compressed from 2.55 to 18.73 MPa g by the centrifugal synthesis gas compressor.

Synthesis Loop

267. At this point a considerable part of the ammonia produced in the converter has been condensed. The mixture of synthesis gas and liquid ammonia passes from the 2nd chiller to the ammonia separator in which the liquid ammonia is separated. The outlet gas contains 4.05 vol% NH3 at a temperature of 0°C.

268. Ammonia condensation will absorb the traces of makeup gas impurities like H_2O and CO_2 and are removed with the liquid ammonia in the separator. The gas leaving the separator eventually will go to the hot exchanger and get heated to the converter inlet temperature.

269. The liquid ammonia is depressurized to 2.55 MPa g and taken to the let-down vessel in which the main part of the gases dissolved in the ammonia is liberated. The let-down gas contains a considerable amount of ammonia, which is recovered by water wash in the off-gas absorber. The off-gas is then sent to the fuel header.

Step-7: Ammonia Refrigeration Circuit

270. The refrigeration circuit consists of a compressor unit, a condenser, an accumulator and a number of chillers. Evaporated ammonia from the chillers and the flash vessel is compressed by the ammonia compressor. After compression, the ammonia is collected in the ammonia accumulator.

Step-8: Ammonia Recovery

271. Purge gas from the purge gas separator is sent to the purge gas absorber. Ammonia is washed out of the gas with water and the purified gas is sent to the hydrogen recovery system where 85% of the hydrogen is recovered and returned to the synthesis loop.

272. Inert gas and let down gas is introduced to the off-gas absorber and ammonia is washed out with water. The aqueous ammonia is sent to the ARU distillation column where the ammonia is distilled and returned as product to the let-down vessel. The off-gases from the hydrogen recovery system and the off-gas absorber are mixed and sent to the fuel header.

Step-9: Steam System

273. The major part of the waste heat available is utilized for production of high pressure steam. The produced HP steam is then superheated in the flue gas duct and sent to battery limit at 11.47 MPa g and 510°c.The superheated MP steam required for ammonia plant is imported from battery limit at 3.82 MPa g and 375°C for process and heating purpose.

274. Part of the HP boiler feed water is preheated in upstream and downstream of the low temperature CO converter and in the ammonia synthesis loop. The other part is preheated in the flue gas heat recovery section of the primary reformer.

Step-10: Flare and Verit System

275. Ammonia Plants are provided two (2) separate headers. One is flammable blow out gases without ammonia along with flammable natural gas from utility system is sent to the Vent Stack and discharged to atmosphere without burning. During the normal operation, quantity of blow-out gases is zero or very small. In case of upset conditions and/or during start-up and shut down operations of-the plant, large quantity of blow- out gases is released.

Urea Processing

276. This section contains a technical description of a Urea Melt Production train with a daily operating capacity to allow the production of 2800 MTPD of granulated urea by means of a Granulation Unit based upon "fluidized bed granulation technology". The process flow diagrams (Block Diagram) of urea fertilizer synthesis are presented in Figure 5.3.

277. Saipem ammonia stripping process is characterized by a urea synthesis loop operating at about 15.2-15.7 MPa(g) with an ammonia to carbon dioxide molar ratio at urea reactor inlet of 3.1-3.5.

278. Waste heat recovery from process streams in some parts of the process layout have been introduced as a part of recent modifications, thus allowing considerable savings in overall steam and fresh water consumption, viz.:

- HP ammonia to urea reactor preheating with off-gas from LP decomposition stage.
- Heat to vacuum preconcentrator with off-gas from MP decomposition stage.
- Total recovery of process condensate as boiler feed water.

279. This Saipem License Processor allows a CO_2 conversion into urea of 60-63 % in the reactor itself, featuring the perforated trays which prevent back-flow and favor gas absorption by the liquid. Urea Melt Sections are characterized by the following main process steps:

- UreasynthesisandNH3,CO2recoveryathighpressure;
- UreapurificationandNH$_3$,CO2recoveryatmediumandlowpressures;
- Ureaconcentration;
- Processcondensatetreatment.

- Urea melt production unit is also provided with the following:
    - Steamnetworks;
    - Flushingnetworks;
    - Auxiliaryinstallation.

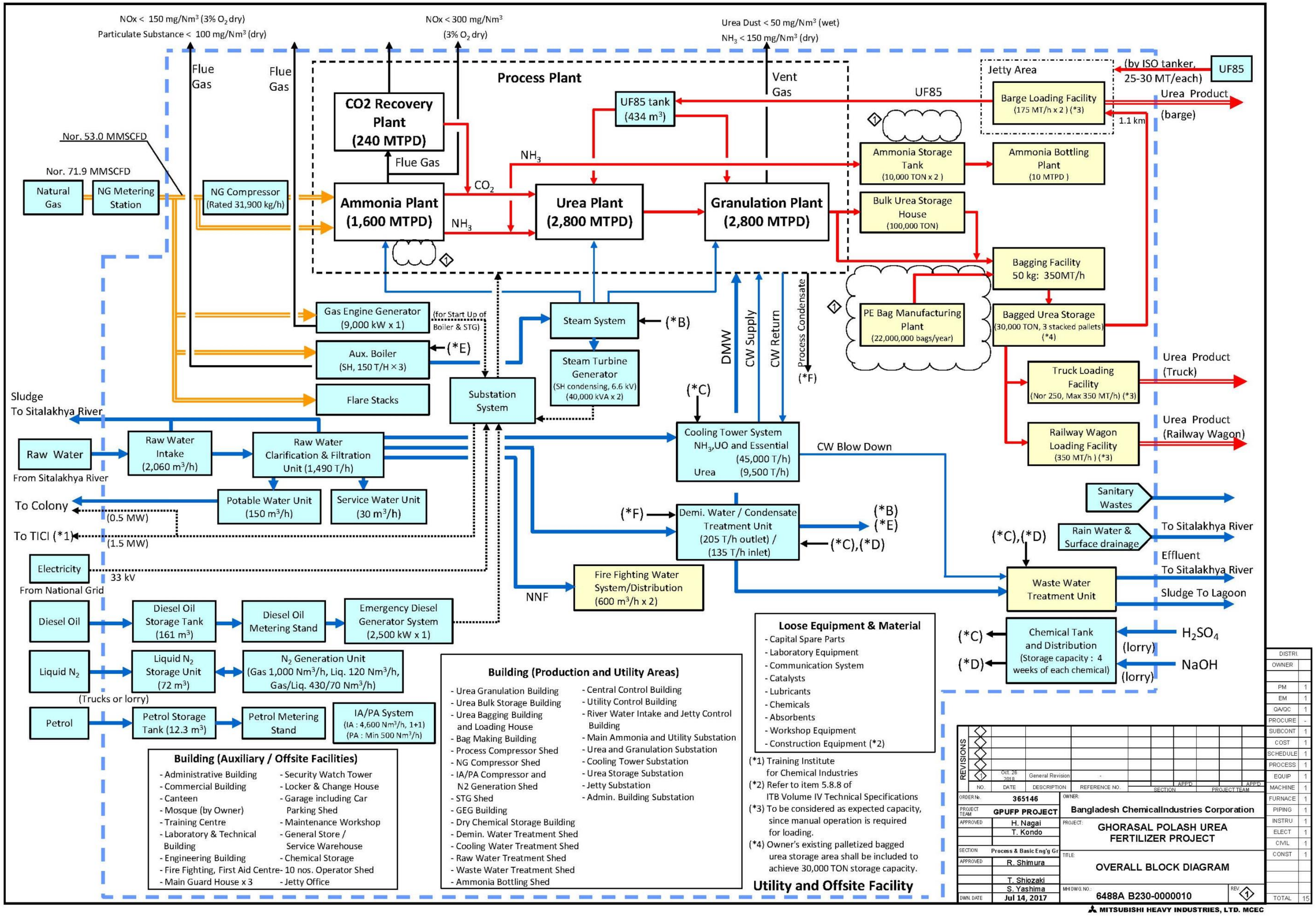


Figure 5.3: Combined process flow diagram for Urea synthesis (Ammonia-Urea Melt-Granular Urea)

Urea Synthesis and NH_3, CO_2 Recovery at High Pressure

280. Urea is produced by synthesis from liquid ammonia and gaseous carbon dioxide. In the urea reactor, the ammonia and carbon dioxide react to form ammonium carbamate, a portion of which dehydrates to urea and water.

281. The liquid ammonia feed to Urea Plant is filtered through NH_3 filters, then enters into NH3 recovery tower, and is collected in the ammonia receiver, it is drawn and pumped to about 2.31 MPa(g) pressure by means of ammonia booster pump. Part of this ammonia is sent to medium pressure absorber, as a reflux, the remaining part enters the high pressure synthesis loop.

282. The carbon dioxide feed drawn to the Urea Plant battery limits, from the CO_2 removal unit in Ammonia Plant, at about 27 kPa(g) pressure and 43°C temperature, enters the CO_2 compressor, and leaves it at a pressure of about 15.9 MPa(g) and 120°C.

Urea Purification and NH_3, CO_2 Recovery at Medium and Low Pressures

283. Urea purification and relevant overhead gases recovery take place in two stages at decreasing pressure, as follows:

- 1st stage at 1. 72 MPa(g) pressure (MP Recovery)
- 2nd stage at 0.38 MPa(g) pressure (LP Recovery)

284. It is pointed out that the exchangers where Urea purification occurs are called decomposers because in these equipment the residual carbamate decomposition takes place.

ProcessCondensateTreatment(PCT)

285. ThissectionprovidesconditionstoprocessthewatercontainingNH_3-CO_2andureacomingoutofthevacuumsystem,soastohaveaprocesscondensatealmostfreefrom NH_3-CO_2 ureatobesent toutilityunit.

Effluents

286. Every effort has been made in the design of urea melt sections to solve pollution problems. Urea solution sections normally have the following sources of pollution: (i) ammonia from inert vents; and (ii) ammonia and urea in liquid effluents.

287. Ammonia vented with inerts is minimized in Snamprogetti plants since the quantity of air required for passivation, is much less than in other processes. Furthermore water scrubbing is provided for all the vents to recover the ammonia in the inerts.

288. A liquid effluent treatment system (process condensate treatment system) fully integrated in the process is provided to recover ammonia by distillation. In addition a hydrolyzer is provided in order to eliminate completely the urea present in the process condensate.Pointsofemissionforgaseouseffluentsare:ContinuousUreaFlareStack, collectsandburnsgasescontinuouslydischargedfrommediumpressuresectionvent.

289. DiscontinuousUreaFlareStack, collectsandburnsvaporsfromhighandlowpressuresectionventsandfromprocesscondensate·treatmentsectionventincaseoftheiropening.Furthermore,itcollectsventsfromureasolutiontankand carbonateclosedraintank.

- 1stVentStackSeparator

290. Collectsgasesdischargedfromvacuumsectionvent,processcondensatetankvent,offspec.condensatetankventandStoragetankvent.

- 2ndVentStackSeparator

291. Collectsgasesdischargedfromprocesssafetyvalvesandrupturedisks.

Process Condensate

292. The final contents of ammonia and urea in the treated condensate are such that it can be reused as boiler feed water after treatments in polishing unit.

Open Drain System

293. This system is designed for the collection of the liquid effluents accumulated from the Urea Synthesis and Granulation Plant and distribution to the Process Condensate Treatment (PCT) System.The chemical contaminated water which is mainly contaminated with ammonia and carbonate is collected from the following Urea Melt and Granulation Plant drain lines.

Recycle and Reuse of Effluents

294. The water consumption is optimized itself in technology and design of plants. Boiler blow down and condensate from air compressor intercooler is routed to cooling tower make-up. The granulator wash water is routed to dissolving tank for recovery. Chemical Drain from the amine area is collected to the aMDEA solution sump and recovered in aMDEA Storage Tank. The process condensates generating in ammonia and urea plant are being treated inside plants and treated process condensates is being routed to condensate storage tank. The steam and turbine condensates also routed to this condensate storage tank. The homogenized and mixed condensate is treated in polisher unit to remove salts and silica. The purified water is used as boiler feed water. The floor washing water from urea synthesis section is collected in dedicate pits inside urea plant and treated in hydrolyser and stripper. The treated stream is routed to treat in effluent pit. The scheduled quality control on treated stream is administered to access the performance of treatment facility. The re-generation effluent generated during regeneration of polisher resin is collected in dedicated neutralization pit having neutralization facility and after pH correction, transferred to Inside Battery Limit (ISBL) treated effluent pit. The treated effluent pit have neutralization facility for pH correction. The air sparer are also provided to improve the water quality by increasing dissolved oxygen concentration. The treated effluent from treated effluent pit is routed to equalization pond by means of closed pipe line. If the pH of treated effluent goes beyond 8.0 or less than 6.5, then the control valve automatically closed and stop the transfer to equalization pond. In such cases the pump discharge recycled back to treated effluent pit by recycle line.

295. The effluents coming from different sections of the Plant being treated in the waste water treatment system (WWTS) and ETP can be reused in gardening, firefighting, washing etc. This is the compliance of ECR, 1997 and 7th Five Year Plan.

Granulation Urea Process

296. Feedstock is urea solution at a concentration of 97% wt. and a temperature of 130 - 136°C.Formaldehyde solution is added to the urea solution. The total rate of addition is between 4.0 and5.5 kg formaldehyde per ton of end product. The formaldehyde addition guarantees a free flowingproduct without further treatment. Standard formaldehyde solution may be used or, when locallyavailable, liquid urea/formaldehyde pre-condensate is favored.

This latter product of higherformaldehyde concentration can be stored for several months in steel tanks without degradationor polymerization, and gives outstanding results in a granulation plant.The flow diagram is based on the addition of UF-85 liquid urea/formaldehyde pre-condensate. The process flow diagram of Granular Urea Plant is shown in Figure 5.3 above.

297. The used ambient air contains entrained urea dust and the traces of ammonia which is washedin the granulator dust scrubber. The cleaned air is then discharged to atmosphere bygranulator scrubber exhaust fan through a stack.Urea dust entrained with air in the granulator dust scrubber amounts for the whole plantto 3.5 % of plant production and is recovered as a 45% solution which is recycled later on, to theurea plant concentration section.

Dust Emission and Recovery

298. There are three main locations where urea dust laden air originates from: (i) Granulator; (ii) First fluid bed cooler and (iii) Final fluid bed cooler.In addition there are various dedusting points i.e. top of the bucket elevators, roll crushers, vibrating screens, that merge into the duct to the dedusting fan.

Ammonia Emission

299. The ammonia present in the urea melt coming from the urea solution plant is stripped out in the granulator and. ends up in the granulator exhaust air stream. The ammonia abatement system located at the granulator will reduce the ammonia content in the air exhaust air stream before sending to Granulator Dust Scrubber.

CO_2 Recovery Process

- Integration of CO_2 recovery facility

300. The CO_2 recovery plant is designed to recover CO_2 from the flue gas of Natural gas reformer. The flue gas is extracted from the stack and brought to the CO_2 recovery plant by the Flue gas blower. The flue gas is emitted directly to the atmosphere through the stack in case of Flue gas blower failure.

- CO_2 recovery plant

301. The CO_2 recovery plant consists of three main sections; (i) Flue gas quenching section, (ii) CO_2 absorption section, and (iii) Solvent regeneration section. The following block flow diagram shows the CO_2 recovery plant in Figure 5.4.

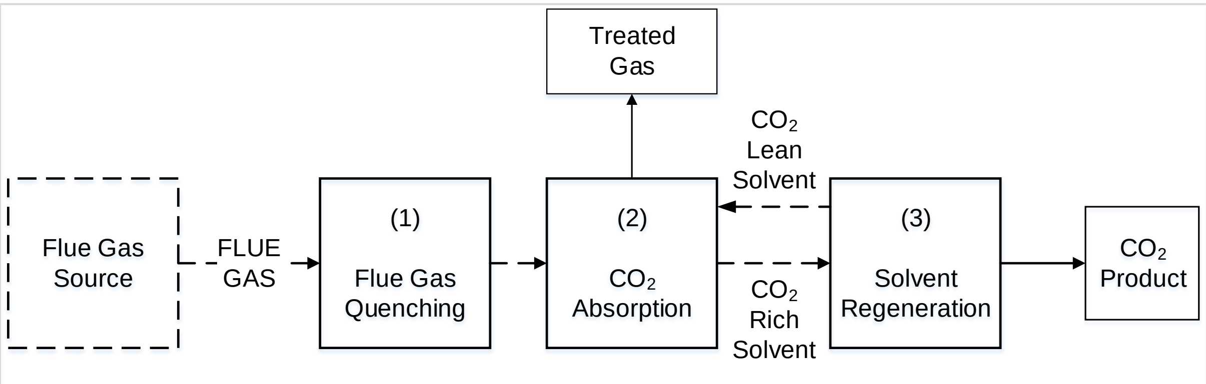


Figure 5.4: Block Flow Diagram of the CO_2 recovery plant

5.3 Description of Major Components

5.3.1 Land Requirement

302. The proposed Project site (battery limit) including existing RMS and excluding lagoon is about 110 acres, located inside the premise of the PUFFL. The site is partially fallow land on the eastern side of the existing Polash Fertilizer Factory and particularly to the Compressor House having bushes, trees, civil structures (buildings) and tin shed warehouses. Adequate land is available within the property line of PUFFL. The Project site also includes a small portion of UFFL. About 28 acres out of 34 acres of the lagoon will be filled up by dredged materials but is not considered in the Project area (110 acres). Due care should be taken so that dredged material will not affect the nearby waterbody during filling activity. For ensuring environment friendliness of lagoon filling, dredged materials must be managed in a manner so as to minimize the amount of material returned by spillage, erosion or other discharge to waters of the state during re-handling and/or off-loading activities. Dredged material to manage in such a way as to prevent dredged material spilled over the roads. Dredged material deposited on a public roadway must be immediately removed and properly disposed. This filled up area will be used as a temporary laydown area. No land acquisition will be required for the proposed new fertilizer factory.

5.3.2 Project Layout Including Site Drainage

303. A tentative and detailed layout plan showing all structures, road network, drainage network, different pollution abatement measures, waste water and effluent treatment facilities has been developed by the EPC contractor. The EPC contractor has already been appointed by BCIC. The Proponent shall submit the final layout plan to DoE for their review and comments considering availability of land, landscape, ground features, elevation, environmental aspects and social concerns recommended by the EIA study. However, a preliminary and detailed layout plan of the proposed GPUFP project is presented in Figure 5.5 and drainage general plan is presented in Figure 5.6. As per the tentative layout plan, the effective area for the implementation of the proposed Project is about 73 acres, wehereas the Project area is 110 acres (excluding Lagoon area). The EPC contractor will need to show waste storage and sorting areas as well as a secured disposal location on the layout plan. Given the sensitivity of the demolition activity, it is recommended that the EPC Contractor is certified on OHSAS 18000. The Environmental Management Plan (EMP) and the Emergency Response Plan (Volume- 2) in this report provides more details in this context.

304. There is an existing drainage network in PUFFL for storm water runoff. Runoff is collected through open drains and stored in a common basin for sedimentation. The overflow is then connected with another drain to finally discharge to the condenser cooling water discharge channel for ultimate disposal to the Shitalakhya River.

305. The run-off drainage network of PUFFL requires improvement with the construction of the proposed Project as new equipment will be installed and existing structures will be demolished. Segregation of storm water run-off and cooling water discharge may be required to avoid possible contamination at the disposal site close to the jetty area. Moreover, it is recommended to avoid demolition work during the monsoon season.

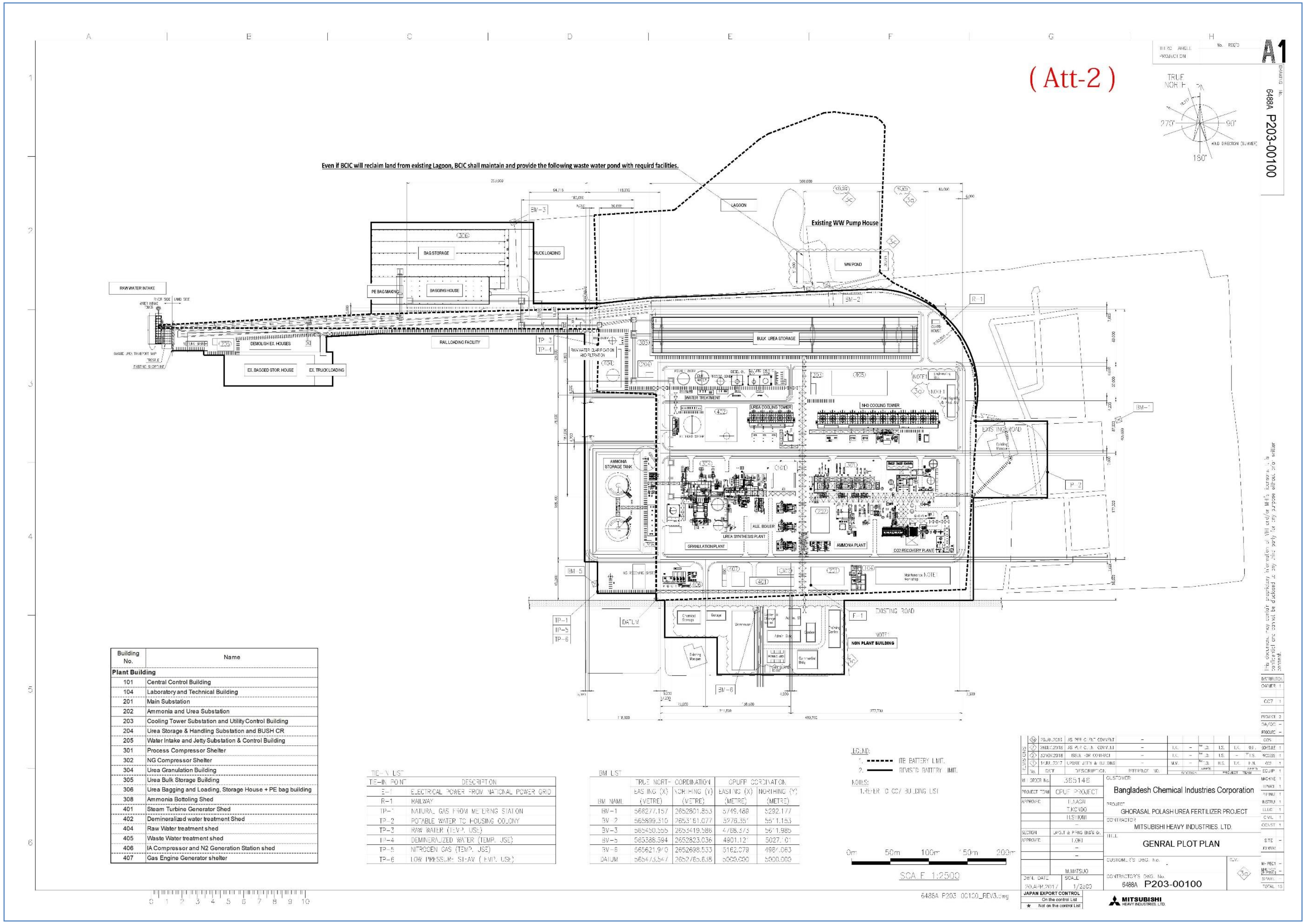
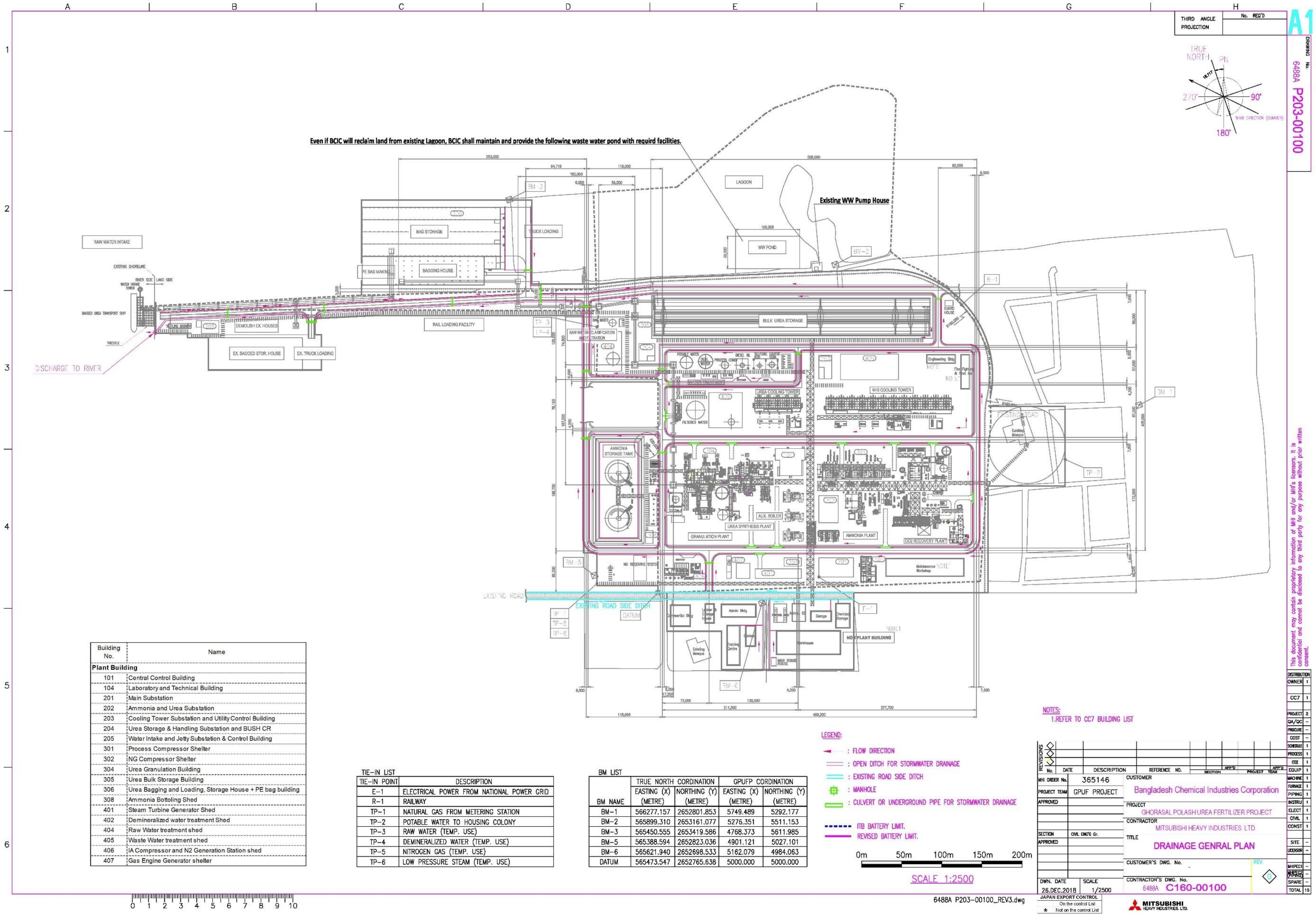


Figure 5.5: Tentative and detailed layout plan of the GPUFP



Building No.	Name
Plant Building	
101	Central Control Building
104	Laboratory and Technical Building
201	Main Substation
202	Ammonia and Urea Substation
203	Cooling Tower Substation and Utility Control Building
204	Urea Storage & Handling Substation and BUSH CR
205	Water Intake and Jetty Substation & Control Building
301	Process Compressor Shelter
302	NG Compressor Shelter
304	Urea Granulation Building
305	Urea Bulk Storage Building
306	Urea Bagging and Loading, Storage House + PE bag building
308	Ammonia Bottoling Shed
401	Steam Turbine Generator Shed
402	Demineralized water treatment Shed
404	Raw Water treatment shed
405	Waste Water treatment shed
406	IA Compressor and N2 Generation Station shed
407	Gas Engine Generator shelter

TIE-IN LIST

TIE-IN POINT	DESCRIPTION
E-1	ELECTRICAL POWER FROM NATIONAL POWER GRID
R-1	RAILWAY
TP-1	NATURAL GAS FROM METERING STATION
TP-2	POTABLE WATER TO HOUSING COLONY
TP-3	RAW WATER (TEMP. USE)
TP-4	DEMINERALIZED WATER (TEMP. USE)
TP-5	NITROGEN GAS (TEMP. USE)
TP-6	LOW PRESSURE STEAM (TEMP. USE)

BM LIST

BM NAME	TRUE NORTH CORDINATION		GPUFP CORDINATION	
	EASTING (X) (METRE)	NORTHING (Y) (METRE)	EASTING (X) (METRE)	NORTHING (Y) (METRE)
BM-1	566277.157	2652801.853	5749.489	5292.177
BM-2	565899.310	2653161.077	5276.351	5511.153
BM-3	565450.555	2653419.586	4768.373	5611.985
BM-5	565388.594	2652823.036	4901.121	5027.101
BM-6	565621.940	2652698.533	5162.079	4984.063
DATUM	565473.547	2652765.638	5000.000	5000.000

Figure 5.6: Drainage general plan of the GPUFP

5.3.3 Plant Components of the Layout Plan

306. The major components of the proposed Plant layout are listed in Table 5.2.

Table 5.2: Major components of the layout plan

Code No.	Components	Code No.	Components
101	Central Control Building	305	Urea Bulk Storage Building
104	Laboratory and Technical Building	306	Urea Bagging and Loading, Storage House + PE Bag BuildingAmmonia Plant
201	Main Substation	308	Ammonia Bottling Shed
202	Ammonia and Urea Substation	401	Steam Turbine Generator Shed
203	Cooling Tower Substation and Utility Control Building	402	Demineralized Water Treatment Shed
204	Urea Storage and Handling Substation and BUSH CR	404	Raw Water Treatment Shed
205	Water Intake and Jetty Substation and Control Building	405	Waste Water Treatment Shed
301	Process Compressor Shelter	406	IA Compressor and N_2 Generation Station
302	NG Compressor Shelter	407	Gas Engine Gebnerator Shelter
304	Urea Granulation Plant	--	Drainage System

Source: MHI (EPC Contractor)

307. Drainage of storm water and effluent generated from the condenser cooling will follow the existing drainage system of the GPUFP. The new drainage network to be built for the proposed Plant will be connected with the existing drainage network.

5.4 Utility and Offsite Systems

5.4.1 Water Requirements and Source of Water

308. *Water Requirements for Existing PUFFL and UFFL*: The requirement of water for the existing fertilizer plants (PUFFL and UFFL) is about 0.583 m^3/s (2,100 t/h). This quantity of water is used for different cooling water systems, boiler and cooling blow down, potable water for office and colony etc. of both UFFL and PUFFL. The source of water is the Shitalakhya River.

309. *Water Requirements for the Proposed GPUFP*: The Project has the provision of three raw water intake pumps for withdrawal of surface water from the Shitalakhya River, each with 1,020 t/h (0.283 m^3/s) capacity, two would be operational at 50%-60% load and the rest one would be standby. The design capacity of water intake pipeline is 2,040 t/h (0.567 m^3/s), which would be used for filling up the Raw Water Storage Tank having effective volume of 610 m^3 (13-T-201 in Figure 5.7). After sedimentation in the storage tank, the mud free clean water at the rate of 1,159 t/h (0.322 m^3/s) is supplied to the Clarified Water Storage Tank having effective volume of 5,020 m^3 (13-T-202 in Figure 5.7) where there is a settling and coagulation loss of 139 t/h (0.039 m^3/s) and the remaining 1,020 t/h (0.283 m^3/s) is supplied to the Filtered Water Storage Tank having effective volume of 12,900 m^3 (13-T-203 in Figure 5.7). The water of Filtered Water Storage Tank is supplied to fulfil the requirements of the Plant as consumptive and non-consumptive water (waste water) which is used for cooling, steam generation and other purposes including potable water. So, the continuous withdrawal of surface water from the Shitalakhya River would be 1,159 t/h (0.322 m^3/s) through two pumps

as makeup water which is only 0.4% of the lowest discharge of the Shitalakhya River (83 m^3/s) during dry season. This means that the specific relative consumption of water in the proposed Project 1,020 t/h (0.283 m^3/s) will be significantly less in compared to the existing consumption of water (2,100 t/h or 0.583 m^3/s) for UFFL and PUFFL. A detail water balance diagram is shown below in Figure 5.7. All waste water will be sent to WWTS/ETP and after being treated as per DoE regulation, it would be reused as gardening water in greenbelt and other areas and for some other miscellaneous purposes like fire fighting, washing, etc. except in monsoon when part of this treated water is to be discharged to the natural drains. No untreated water will be drained to the River in any condition. Mud-mixed water from the Raw Water Storage Tank will be directly drained to the river as no chemical will be added in this tank. There is no provision of use of ground water in the proposed GPUFP as plant water and also as potable water even for the colonies. No ground water would be used in the proposed Project during construction and operation phases.

310. A utility flow diagram of waste water treatment system (WWTS) of the proposed Project is presented in Figure 5.7. Since, specific relative consumption of water for the GPUFP is less so generation of liquid waste would be less as well. There are a number of small-medium industries along the left bank of the Shitalakhya River. In the 10 km study area, high water consumptive industries that abstract water from the river are Desh-Bandu Sugar Mills, Gazi Textile and Ghorasal Power Station. The following Table 5.3 shows the supply and distribution of water.

311. BCIC has applied to WARPO seeking permission (*Appendix 5.1*) for using the surface water from the Shitalakhya River required for the operation of the Plant, which has the low specific relative consumption than earlier ones and will replace the earlier water intake pumps.

Table 5.3: Breakup of water supply and distribution

Sl. No.	Particulars	Water Quantity (m^3/s)	Water Quantity (t/h)
A.	**Supply**	**0.322**	**1,159**
A1	Raw water withdrawal from the Shitalakhya River	0.322	1,159
A1.1	Settling and coagulation loss in Clarifier System	0.039	139
A2	Filtered Water Storage Tank (**Makeup Water**)	0.283	1,020
B.	**Distribution (B1+B2)**	**0.283**	**1,020**
B1.	**Water Loss in Cooling Tower**	**0.233**	**837**
	(i) Cooling tower evaporation loss	0.176	632
	(ii) Drift loss	0.013	45
	(iii) Blow down loss	0.044	160
B2.	**Other Losses as Waste Water**	**0.051**	**183**
	(i) Cooling tower back wash	0.013	48
	(ii) Loss from potable water	0.008	30
	(iii) Loss from Demi. Unit	0.004	16
	(iv) Loss as service water	0.004	15
	(v) Oily contaminated water	0.004	14
	(vi) Non-Oily waste water	0.003	11

Sl. No.	Particulars	Water Quantity (m^3/s)	Water Quantity (t/h)
	(vii) CO_2 recovery plant	0.002	8
	(viii) Loss from Caustic soda, Sulfuric acid, coagulation and Polymer injection system	0.011	41

Source: MHI (EPC Contractor) [Utility flow diagram for waste water treatment system]; Estimation done by CEGIS

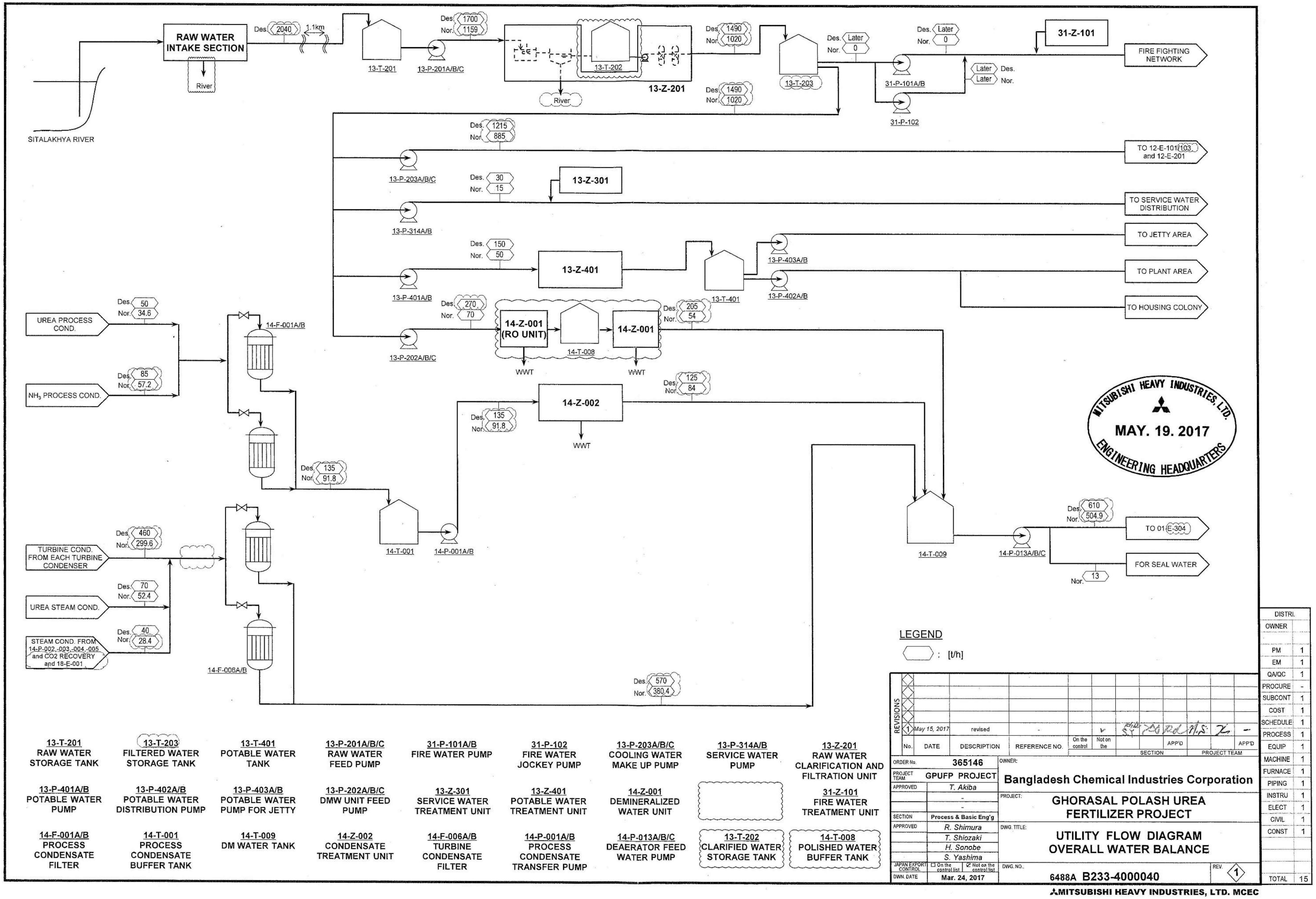


Figure 5.7: Utility flow diagram for overall water balance

5.4.2 Water Intake Pump

312. The design water intake capacity of each of the three pumps is 1,020 t/h (0.283 m^3/s). Among the three pumps two will be operational and one will be standby. The diameter of each of the intake pipelines is 350 mm. The mesh sizes of strainers to be installed around the intake mouth are in the range of 2~10 cm. These design values will be finalized during detail engineering stage.

5.4.3 Cooling Water System

313. The Project has two cooling water systems which are separated into normal and essential. Essential cooling water system is connected to essential cooling water pump.

Cooling Tower

314. The Plant will have two cooling towers namely Urea cooling tower and ammonia and utility cooling tower. Cooling towers are mechanical heat rejection device to remove process heat and cool the working fluid to near the ambient air temperature. The cooling tower is counter flow type.

Chemical Injection

315. In order to maintain the required quality of cooling water, the following chemicals are added separately to each basin of cooling tower:

- Sodium Hypochlorite for Biocide Agent
- Sulphuric Acid for pH control
- Corrosion inhibitor
- Scale inhibitor
- Microbiological Control Agent (if required)

Make Up Water and Blow Down

316. During continuous operation of cooling tower, circulated water from the cooling tower system is lost by way of evaporation and drifts which ultimately cause an increasing salinity in the system. Therefore, to maintain the limit of salinity, a small quantity of water is continuously drained-off from the discharge header of the circulating water pumps as blow down to waste water system by manual. Accordingly, all these losses from the system are made up by continuous feed of raw water to the basin under level control. About 0.102 m^3/s (885 t/h) of surface water will be used as cooling water make-up for two cooling towers with a total of 45,840 m^3 water as one time cooling tower filling water.

Side Filtration

317. Normally, around 2% of the circulating water will be filtered from the discharge header of circulating pumps and circulated back to the basin to remove the suspended solids and control the limit of total suspended solids in circulating water.

Circulation

318. Ammonia, Utility and Offsite unit circulation is established by two steam turbine driven pumps and two motor driven pumps. One motor driven pump shall be kept as stand-by for

auto-start. Urea unit has two motor driven circulating pumps, out of which one shall be kept as stand-by for auto-start.

Priority Supply

319. Considering the need of uninterrupted supply of cooling water for some critical equipment/ exchangers, a separate priority header, which is called essential cooling water line. This essential cooling water header (ECW) feeds to following 'equipment mainly:

320. For Ammonia Plant

- Blow Down Cooler
- Critical Oil Coolers

321. For Urea Plant

- Seal Water Coolers
- Flushing Condensate Cooler
- Critical Oil Coolers

322. For Utility and Offsite Facilities

- Auxiliary Boiler Blow Down Cooler
- Ammonia Storage Refrigeration Unit
- Instrument Air Compressor
- Critical Oil Coolers

a) System Performance

- Ammonia, Utility and Offsite Cooling Water System
    - Circulation Capacity: Design 42,000 t/h; Normal 34,802 t/h
    - Temperature: Supply Max. 33°C; Return Max. 43°C
- Urea Cooling Water System
    - Circulation Capacity: Design 9,500 t/h; Normal 7,592 t/h
    - Temperature: Supply Max. 33°C; Return Max. 43°C

b) Equipment Performance

- For Ammonia. Utility and Offsite Cooling Water System
    - Cooling Tower: One set with counter flow type
    - Cooling Water Circulation Pump: 3 running+1 stand-by with rated capacity of 14, 100 m3/h each·
- For Essential Cooling Water System
    - Essential Cooling Water Circulation Pump: 1 running+1 stand-by with rated capacity of 2,900 m3/h each
- For Urea Cooling Water System
    - Cooling Tower: One set with counter flow type
    - Cooling Water Circulation Pump: 1 running+1 stand-by with rated capacity of 9,700 m3/h each·

5.4.4 Raw Water Treatment System

Raw Water System

323. Raw Water Intake facilities are located on the left bank of the Shitalakhya River. The raw water is pumped to settling basins located in the Jetty area and transferred to the Raw Water Storage Tank through the pipeline of about 1.1 km long.

324. Raw water will be received in Intake Section from the Shitalakhya river at an amount of about 0.567 m^3/s (2,040 t/h) and stored in Raw Water storage Tank (Figure 5.8). Raw water from Storage Tank will be transferred to Raw Water Clarificationand Filtration Unit at an amount of about 0.322 m^3/s (1,159 t/h). After clarified the net consumable water will be about 0.283 m^3/s (1,020 t/h). Raw Water Clarification and Filtration Unit shall be capable of producing filtered water for Fire Water; Cooling Water Make-up, Potable Water, Service Water and Demineralized Water Unit Feed. Raw Water Clarification and Filtration Unit consists of the clarifier and sand filter.

325. Large suspended solids are settled by gravity on the bottom of the basin, and it is removed by the scraper and sent back to the river by mud removal pump.

326. Raw water is fed to the clarifier where the suspended solids are settled. Chemical injection units are provided for sedimentation of suspended solids. Sludge from the clarifier is sent back to the Shitalakhya River with due treatment and meeting the applicable DoE's standard.

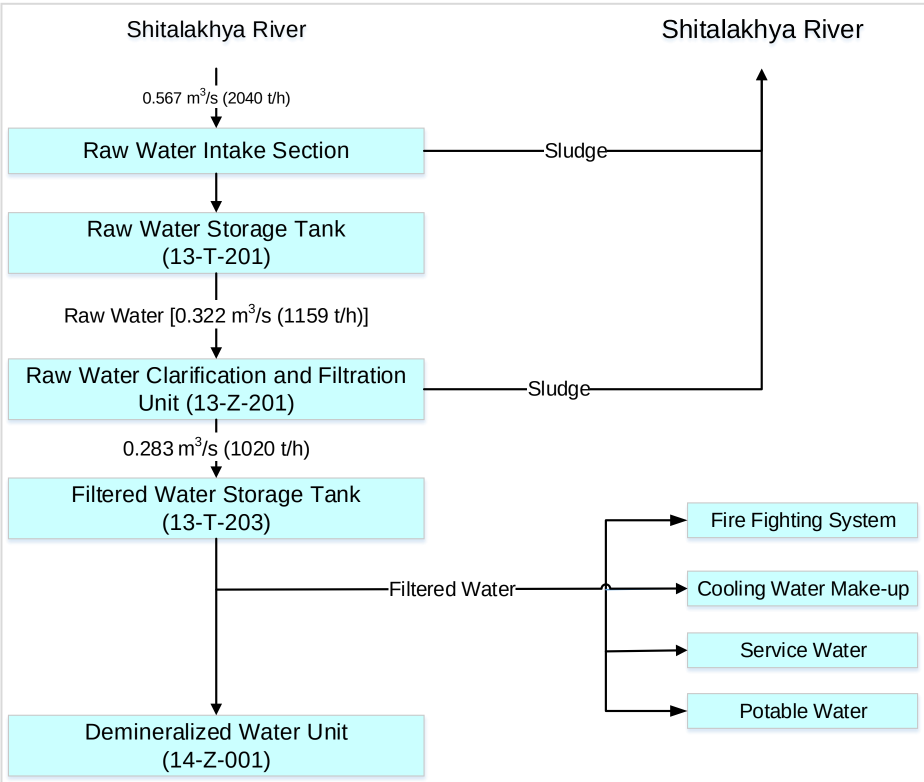


Figure 5.8: Block diagram of water intake and distribution

Potable and Service Water System

327. Filtered water from Raw Water Clarification and Filtration Unit is applied for potable water and service water. The system shall consist of Chlorination Unit for Potable Water at an

amount of about 0.0417 m^3/s (150 t/h). The system shall consist of Service Water Treatment Unit with the capacity of at least 0.0083 m^3/s (30 t/h).

Demineralized Water and Condensate Treatment

328. The Demineralized Water Unit consists of the Reverse Osmosis (RO) system and ion exchanger. Filtered water in filter water storage tank is fed to the Reverse Osmosis (RO) system and ion exchangers in the Demineralized Water Unit for demineralization. The Condensate Treatment Unit consists of the ion exchangers. The sources of condensate are: (i) Stripped process condensate from the Ammonia Plant; and (ii) Stripped process condensate from the Urea Plant. The source of demi water is filtered water from Raw Water Clarification and Filtration Unit.

329. Effluent from the neutralization pit for Demineralized Water Unit is transferred by neutralization pump and fed to the Waste Water Treatment System (WWTS) at an amount of at least 0.0569 m^3/s [205 t/h (outlet)].

330. The regeneration stage of the ion exchangers receives chemicals from the sulphuric acid and caustic soda distribution system and injects chemical at the regeneration.

331. Spent regenerant, blowdown and waste water from the Condensate Treatment Unit are discharged into the neutralization pit for the Condensate Treatment Unit lined with chemical resistant material. Air for the polishing unit and neutralization pit is supplied by the mixing air blower for Condensate Treatment Unit.

332. Effluent from the neutralization pit for Condensate Treatment Unit is transferred by neutralization pump and fed to the Waste Water Treatment System (WWTS) at an amount of 0.0375 m^3/s [135 t/h (Inlet)]. The following block diagram in Figure 5.9 shows the process condensate and filtered water.

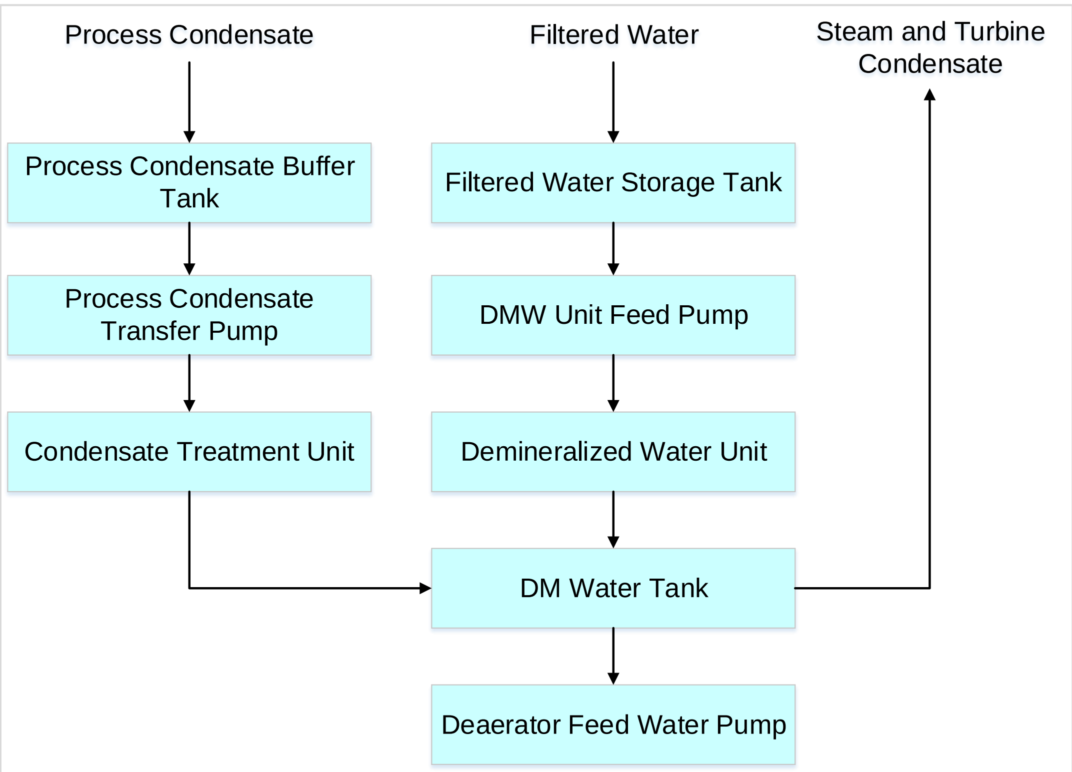


Figure 5.9: Block diagram of process condensate and filtered water

Boiler Feed Water System

333. The chosen boiler water treatment program will be All Volatile Treatment (AVT) using volatile oxygen scavenger (Hydrazine) and neutralizing amine (Ammonia).

Steam Generation System

334. The Steam Turbine Generator is condensing type. In normal operation, all steam generated in the Ammonia Plant, and Auxiliary Boiler is self-balanced without any venting. Auxiliary Boiler has a remote automatic control, combustion safeguards with flame detection and sampling and analyzer system for supervising the steam and boiler water quality and flue gas components.

5.4.5 Electric Power Generation System

335. The Project has provisioned captive power for day-to-day use. For this, two units of Steam Turbine Generator (STG) of 32 MW each and One unit of Gas Engine Generator (GEG) of 9 MW capacity. The STG will supply power to the entire plant while GEG will supply power for start-up of Auxiliary Boiler and Steam Turbine Generator. The STG will be operated in half load condition.

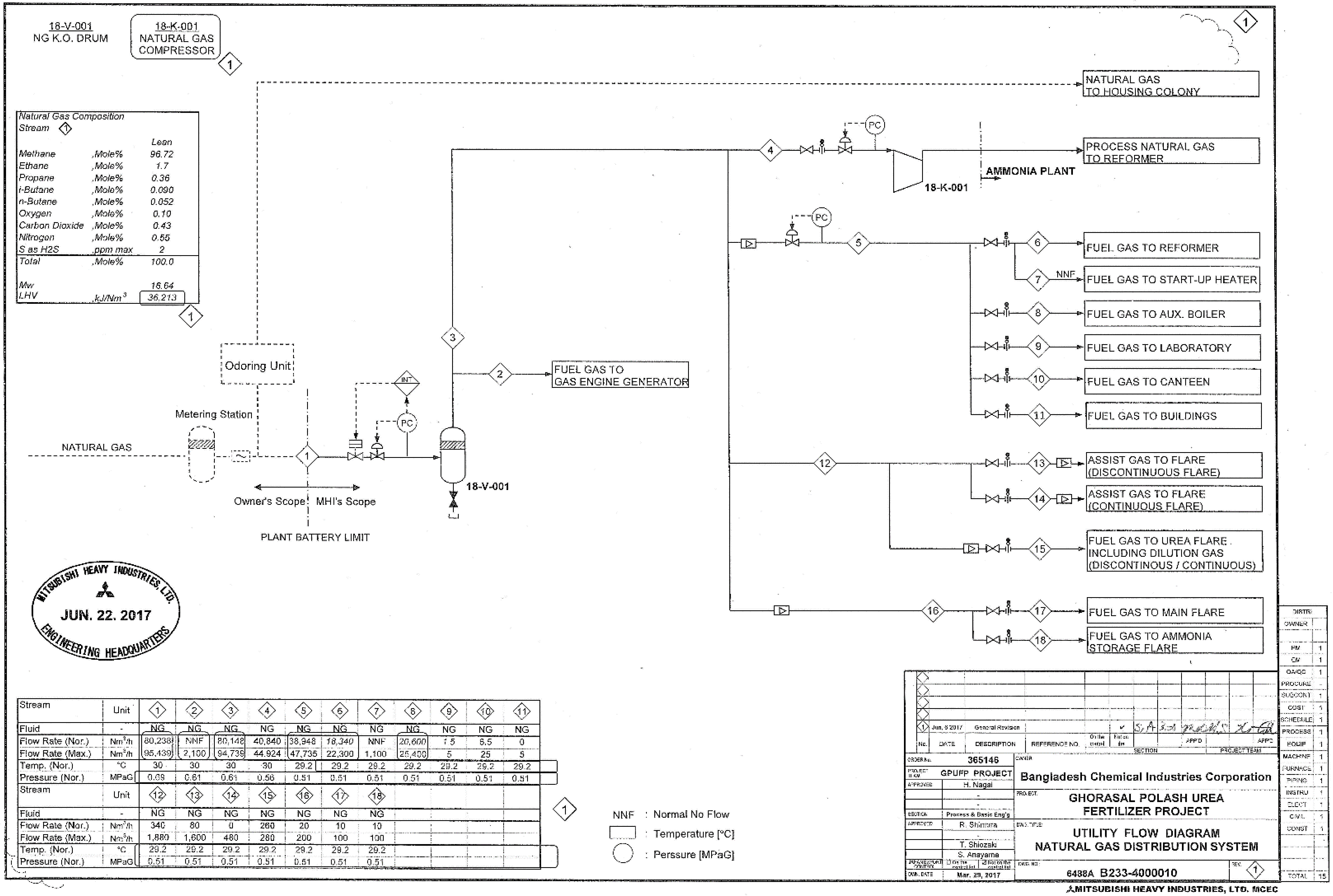
5.4.6 Natural Gas and Fuel Gas System

336. Natural gas is used for the process feed and fuel for GPUFP Project. Natural gas is supplied through the incoming line from the battery limit of the Plant. The pressure ranges from 0.69-0.98 MPaG. Natural Gas has two functions, e.g., process natural gas and fuel natural gas.The natural gas is distributed as process gas and fuel gas to the users of the followings:

- Process natural gas
  - to Primary Reformer of Ammonia Plant.
- Fuel gas (0.505 MPaG)
  - to Primary Reformer of Ammonia Plant
  - to Start-up Heater of Ammonia Plant
  - to Auxiliary Boiler
  - to Gas Engine Generator
  - to Laboratory
  - to Canteen
  - to Building.
  - to Main Flare Stack
  - to Ammonia Storage Flare Stack
  - to Continuous Urea Flare
  - to Discontinuous Urea Flare.

337. During the normal operation, quantity of blow-out gases is zero or very small. In case of upset conditions and/ or start-up and shut down operations of the facilities, large quantity of blow-out gases is vented. It is sent to Vent Stack located in Ammonia Plant and vented to

atmosphere without burning. The natural gas distribution system along with in and out is shown in the utility flow diagram in Figure 5.10.



Natural Gas Composition Stream 1		Lean
Methane	,Mole%	96.72
Ethane	,Mole%	1.7
Propane	,Mole%	0.36
i-Butane	,Mole%	0.090
n-Butane	,Mole%	0.052
Oxygen	,Mole%	0.10
Carbon Dioxide	,Mole%	0.43
Nitrogen	,Mole%	0.55
S as H2S	,ppm max	2
Total	,Mole%	100.0
Mw		16.64
LHV	,kJ/Nm³	36.213

Stream	Unit	1	2	3	4	5	6	7	8	9	10	11
Fluid	-	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Flow Rate (Nor.)	Nm³/h	80,238	NNF	80,148	40,840	38,948	18,340	NNF	20,600	1.5	6.5	0
Flow Rate (Max.)	Nm³/h	95,439	2,100	94,739	44.924	47,735	22,300	1,100	25,400	5	25	5
Temp. (Nor.)	°C	30	30	30	30	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Pressure (Nor.)	MPaG	0.69	0.61	0.61	0.56	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Stream	Unit	12	13	14	15	16	17	18				
Fluid	-	NG	NG	NG	NG	NG	NG	NG				
Flow Rate (Nor.)	Nm³/h	340	80	0	260	20	10	10				
Flow Rate (Max.)	Nm³/h	1,880	1,600	480	280	200	100	100				
Temp. (Nor.)	°C	29.2	29.2	29.2	29.2	29.2	29.2	29.2				
Pressure (Nor.)	MPaG	0.51	0.51	0.51	0.51	0.51	0.51	0.51				

Figure 5.10: Natural gas distribution system

5.4.7 Nitrogen Gas System

338. Nitrogen gas will be used as inert gas for each facility, as purge gas of the flare system and as separation gas for the dry gas seal system of compressors at plant normal operation, and nitrogen gas will be also used for N_2 purging to whole plant during start-up and shut-down period. Gaseous and liquid nitrogen will be produced by cryogenic separation of air.

5.4.8 Fuel Oil System

339. The Project has two fuel oil systems. One is diesel oil system, the other is petrol oil system. Diesel oil is received to Diesel oil storage tank via diesel oil unloading pump and distributed as fuel by transfer pump and diesel oil filling station for vehicles. Petrol oil is also received to petrol oil storage tank via petrol oil unloading pump and supplied by petrol oil filling station for vehicles.

340. Received diesel oil is transferred by pump to the following users: (i) Emergency Diesel Generator; (ii) Diesel Oil Driven Fire Water Pump; and (iii) Local consumption for vehicle.

5.4.9 Waste Water Treatment System

341. This system is designed to collect and treat chemical waste water including drained MDEA solution, oily waste water, non-oily contaminated waste water, demineralized water unit waste water, cooling tower waste water and CO_2 recovery plant waste water in the Plant. The treated waste water is discharged to the Shitalakhya River.

a) Rainy water drainage system: The clean rainy water including fire water and clean water in the plant will be directly delivered to the Shitalakhya River. The rainy water contaminated with oil in diked area is collected into the sump pit and sent to Rain Water Temporary Storage Basin, by area sump pump. Holding time of rainy water is approx. 30 minutes and in case of overflow from Rain Water Temporary Storage Basin, the rainy water is delivered to the Guard Pond.
b) Chemical sewer system: Chemical contaminated waste water containing large suspended solids such as the cooling tower back wash waste water (no oil contamination) is sent to the equalization basin. Effluent from the oil separation unit is also fed to the equalization basin. Other chemical contaminated waste water containing small suspended solids such as the cooling tower blow down and CO_2 recovery plant waste water, etc. (no oil contamination) is sent to the final pH adjustment basin. Waste water in the equalization basin is fed to the neutralization basin for coagulation and sedimentation treatment.
c) Oily water sewer system: The area handling oil is diked. The spilled oil and oil contaminated waste water in the diked area are collected into the sump pit. Water in the sump pit' is delivered to the ‘oily water collection pit’ through the rain water temporary storage basin. At the beginning of rain, the diked area may be potentially contaminated with oil. These oily water is also sent to oily water system through sump pit. Water in the oily water collection pit passes through the plate pack oil separator and oil is separated by the rotatable slotted pipe skimmer.
d) Oil separated water flows into the oil separator effluent basin and separated oil is drained off into the skimmed oil pit. Oil in the skimmed oil pit is loaded to a tank lorry for disposal by oil pump. Oil separated water in the oil separator effluent basin overflows into the equalization basin.

e) MDEA waste solution collection and disposal: The drained solution is recovered into the solution preparation tank and sent to the solution storage tank by the solution transfer pump. The rainy water in the paved area and diked area in a MDEA CO_2 removal section can be contaminated with a MDEA solution. The rainy water is collected in MDEA collection sump pit and is delivered to Oily water sewer system or Guard pond or lorry.

f) Key Stage (KS1) waste solution collection and disposal: The rainy water in the paved area and diked area in CO_2 Recovery Plant can be contaminated with KS1 solution. The rainy water is collected in KS1 collection sump pit and is delivered to Oily water sewer system or Guard pond or lorry.

g) Urea waste solution collection and disposal: The rainy water in the paved area and diked area in Urea Plant can be contaminated with urea. The rainy water is collected in sump pit and can be recovered in process or transferred to Oily Water sewer system or Guard pond.

h) Coagulation and Sedimentation treatment system: The neutralized waste water in the coagulation basin overflows to the sludge thickener. Chemical injection units are provided for sedimentation of suspended solids. Sludge from the sludge thickener will be delivered to the guard pond.

i) pH adjustment system: Waste water in sludge thickener and chemical contaminated waste water containing small suspended solids such as the cooling tower blow down and CO_2 recovery plant waste water, etc. (no oil contamination) are fed to the final pH adjustment basin, where the waste water is neutralized according to the Bangladesh regulation. Sulphuric acid or caustic soda is injected for neutralization. The pH adjusted water overflows into the treated waste water effluent basin. Treated waste water is delivered by the treated waste water pump to the followings according to the water quality of the followings: (i) Shitalakhya River; (ii) Equalization basin for retreatment via guard pond; and (iii) Guard Pond.

j) Guard Pond: The Guard Pond is the ultimate protection against the off spec. effluent disposal. In case that waste water from Waste Water Treatment system is off-spec, discharge of waste water will be diverted to the Guard Pond. In case that waste water from sump pits in a MDEA CO_2 removal section, CO_2 recovery plant, Urea Plant is contaminated with MDEA/KS1/urea, discharge of waste water can be diverted to the Guard Pond. In case that rainy water overflowed from Rain Water Temporary Storage Basin is delivered to the Guard Pond as non-contaminated waste water will be transferred to the river.

k) Waste Water Stripping System: The regeneration waste water from the Condensate Treatment Unit is treated by this system. The ammoniacal content in the waste water is reduced to less than 10 mg/l as NH_3 by steam stripping. After reduction of ammoniacal content, the treated waste water is sent to the final pH adjustment basin in waste water treatment system.

l) Sanitary Waste Water: Sanitary water from each plant and non-plant building is treated by septic tanks. Sanitary waste water from each septic tank is sent to the collection pit and discharged to the Shitalakhya River through the chlorination unit in Waste Water Treatment system as per Bangladesh regulation. The Table 5.4 attributed the treatment capacity of waste water treatment system.

Table 5.4: Treating Capacity of Waste Water Treatment System

Sl. No.	Treatment Unit	Design Capacity
01.	Primary Treatment / Oily Contaminated Water to Oil Separator	40 ton/hr at the inlet of Oily Water Collection Pit
02.	Primary Treatment / Waste Water to Equalization Basin	100 ton/hr at the inlet of Equalization Basin
03.	Sludge Treatment / Coagulation and Sedimentation Treatment Unit	100 ton/hr at the inlet of Neutralization Basin
04.	Final Treatment / pH Adjustment System	350 ton/hr at the inlet of Final pH Adjustment Basin
05.	Discharge Waste Water	257 ton/hr (Normal) and 350 t/h (Design)

Source: MHI (EPC Contractor)

5.4.10 Effluent Treatment and Maintaining Discharge Standard

342. A comprehensive waste water management system shall be provided in the Fertilizer Complex to treat the liquid effluent to meet the DoE standard as per Schedule- 12 (Standards for Sector-wise Industrial Effluent or Emission) of ECR, 1997. The waste water treatment plant at GPUFP shall be designed based on combining physical, chemical and biological treatment systems to effectively control the quality of effluent. The following parameters and limit in Table 5.5 shall be applied based on ''The Environment Conservation Rules, 1997, Schedule 12''.The overall layout plan of ETP is given in Figure 5.11. The capacity of Effluent Treatment Plant (ETP) provisioned in the GPUFP in normal condition is about 257 t/h whereas the design capacity is 350 t/h. The effluents will come from different sections of the waste water treatment system (WWTS) described in Article 5.4.9.

343. Muddy water will be generated in the Raw Water Intake section and in the Raw Water Clarification and filtration. This muddy water (in case of chemical dosing only) is sent back to the Shitalakhya River with due treatment and meeting the applicable DoE's standard. The quantity of sludge (slurry) to be generated in the WWTS/ETP is approx. 50-100 m^3/day and it will transfer to the lagoon (Six acres of lagoon will be kept unfilled).

344. The sludge from ETP would be available which that mostly coming from Ammonia Plant and Urea Plant. The sludge (effluent) allowed to settle, dry and solidified within a period of six months. The sludge then looks like cake and send to landfill and/or other uses.

Table 5.5: ETP Design Treated Effluent Quality (ECR, 1997)

Sl. No.	Parameters	Unit	Concentration
1.	pH	--	6.5 to 8.0
2.	Ammoniacal Nitrogen	mg/l	50
3.	Total Kjedahl Nitrogen	mg/l	250
4.	Suspended Solids	mg/l	100
5.	Oil & Grease	mg/l	10
6.	Hexavalent Chromium as Cr	mg/l	0.1
7.	Total Cr as Cr	mg/l	0.5

Notes:

1) *'DO (dissolved oxygen)' is excluded in regulatory parameters as DO contained in the effluent is uncontrollable.*

2) 'Radioactive materials' are excluded in regulatory parameters as no radioactive materials are contained in raw river water and produced in ammonia and urea production processes.

3) Following inorganic parameters are not included in raw river water quality analysis records. The effluent limits of these parameters will comply with the above-mentioned regulation, provided that no substances of these parameters are contained in the raw river water.

- Total Chromium and Chromium Hexavalent

4) The effluent from Raw Water Intake Unit, Raw Water Treatment Unit and their related facilities will be discharged directly to river without any treatment and the above-mentioned regulations are not applied for those effluents.

5) When water quality at the battery limit for effluent discharge from Waste Water Treatment Unit to river is deviated from any regulatory parameters due to any factors such as plant upset condition and/or undesirable raw river water quality, the water will be discharged to existing Lagoon (out of Contractor's scope). If Owner will discharge any effluent from existing Lagoon (out of Contractor's scope) to river, Owner shall control water quality based on the above-mentioned regulation. Each parameter of those effluent water qualities is excluded in regulatory parameters for Contractor's scope due to outside battery limit.

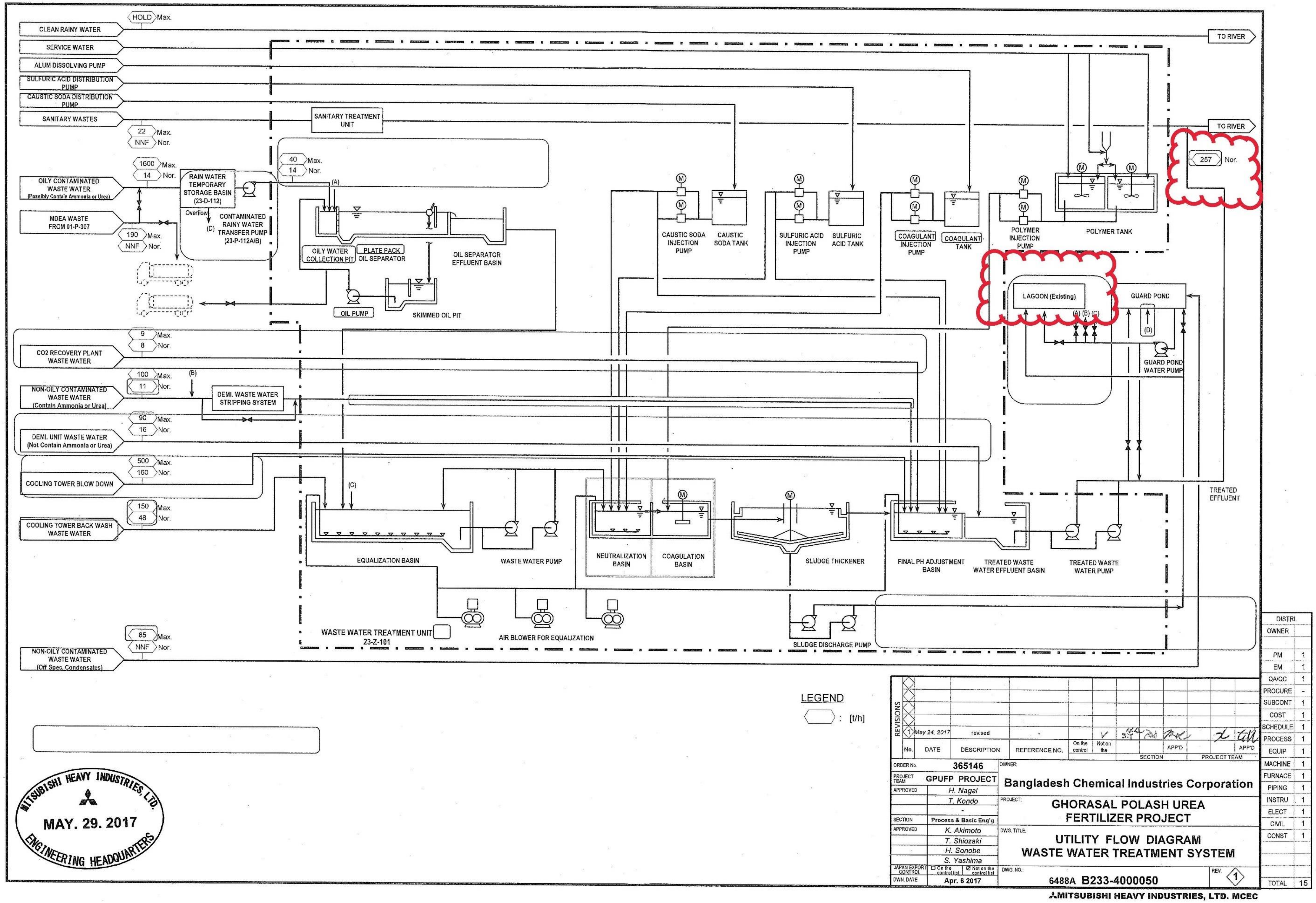


Figure 5.11: Utility flow diagram for waste water treatment system

5.4.11 Fire Fighting Unit

345. The Project has the provision of strong fire-fighting system having (i) Fire fighting system for gas firing; and (ii) Fire fighting system for liquid and solid firing. The systems are designed according to NFPA (National Fire Protection Association) codes and standards of Bangladesh.

346. In the Plant, three kinds of flammable gases such as Natural Gas, Hydrogen Gas and Ammonia Gas are handled. These flammable gases are vented or flared from the provided stacks in safe location in the Plant. These flammable toxic gases are monitored by the gas detection system in the Plant.

5.4.12 Ammonia Storage and Handling System

347. Ammonia Storage Tank with an effective/working capacity of 10,000 metric tons (MT) with Refrigeration Unit will be provided. A sump pit will be provided to collect waste water in the unit and to be sent to Waste Water Treatment System. There is a provision of ammonia leak detection system. The Ammonia Storage Flare Stack will be located outside the dike area in the safe zone. The capacity of ammonia transfer system from the Ammonia Storage Tank to Urea Plant is designed to feed liquid ammonia from the storage tank to Urea Plant.

5.4.13 Bulk Urea Storage and Handling System

348. The Bulk Urea Storage and Handling System is comprised of following facilities:

- Product granulated urea transfer conveyors including tripper car from Urea Plant to Bulk Urea Storage House (BUSH)
- Reclaiming System
- Magnetic Separator
- Bulk Urea Storage House with humidity controller (Air heating)
- Product granulated urea transfer conveyors from BUSH to urea bagging facility
- 50 kg bag bagging system with empty bag storage and palletizing machine
- Bagged urea storage house
- Truck Loading Facility
- Barge Loading Facility
- Railway Wagon Loading Facility.

349. TotalcapacityofBUSHisnet100,000ton. BUSH is provided with a full portal reclaimer at 350 ton/h rated cpacity to feed reclaimer side conveyor.

350. The palletized bagged urea is manually de-palletized and delivered to truck loading station by lift trucks or portable conveyor. The de-palletized urea bags can be transferred from palletized urea bags storage area to Burge Loading facilities or Railway Loading facilities.

351. The product loading facility to railway wagon has enough space for loading of bagged urea to railway wagons at five points simultaneously. The bagged urea shall be manually loaded to railway wagons by using the portable conveyors. The bulk urea handling system is shown in Figure 5.12.

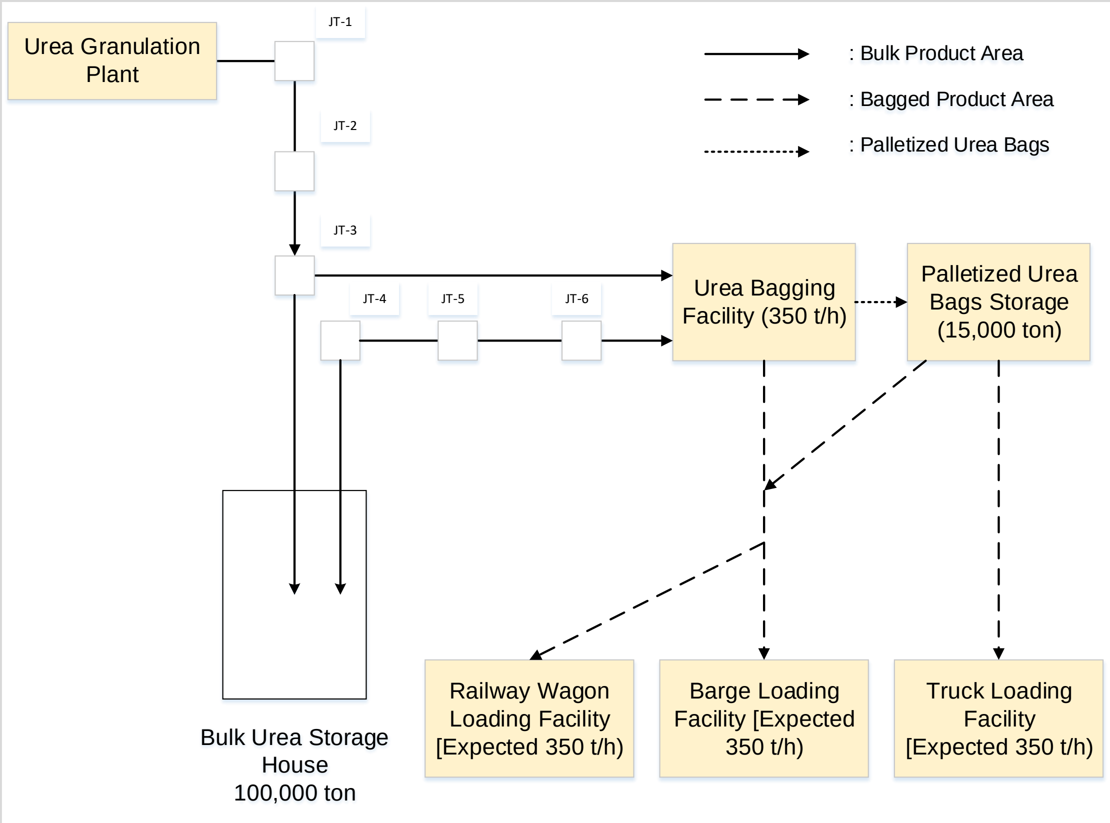


Figure 5.12: Base Flow Scheme of Bulk Urea Handling System

5.4.14 Jetty Equipment

352. Jetty will be constructed on the left bank of the Shitalakhya River by taking permission of appropriate authority as per Article No. 20[3], Sub-article No. 1 of the Water Act, 2013. In that case it will be constructed inside the land with keeping proivision of mooring of required barges. The dimension of the jetty is as follows: length is 45.6m and width is 9.6m (Size of Jetty may finalize during basic engineering stage). Considering 5m depth from the ground level, the quantity of excavated soil will be about 2,200 m^3. This soil can be used for levelling the Project site or in filling up the lagoon. The bagged urea product, can be transferred to the jetty area by covered conveyors and manually loaded into river going barges by using Burge Loading facilities. Barge Loading facilities contain two units having design capacity of 175 ton per hour each (Total 350 t/h) which is considered as expected capacity since manual operation is required for loading.BCIC has applied to BIWTA seeking permission of construction of new and modern jetty in place of earlier jetties (*Appendix 5.2*).

[3] The article describes that no person or organization shall, without the permission of appropriate authority, stop natural flow of any water course or, create obstacles to such flow or divert or attempt to divert the direction of any water course by constructing any structure, whether it is on the bank or not, of any water source, or by filling any water source or by extracting sand or mud from any water source.

Provided that for the interest of the development of a water source or of the prevention of erosion of bank thereof, any kind of structure on such water source may be constructed, or any water source may be fully or partly filled, on the basis of the result of necessary survey and with the permission of appropriate authority.

5.4.15 Fuel Requirement and Performance

353. According to the agreement, Titas Gas Transmission and Distribution Company Ltd. (TGTDCL) is presently supplying about 64.7 MMCFD (UFFL- 48 and PUFFL- 16.7 MMCFD) natural gas at normal supply condition (*Appendix 5.3*) and ensured to supply about 70 MMCFD (UFFL- 52 and PUFFL- 18 MMCFD) natural gas at maximum supply conditions through the existing gas network and the proposed Regulating Metering Station (RMS).

354. More than 32 years have already been elapsed since start-up of the factory in November, 1985. It has been over three decades, and the capacity of many equipment/ machineries have deteriorated due to aging and prolonged operation. This has caused a sharp rise in down time, usage ratio, maintenance frequency and adverse effect on the productivity. Due to an outdated design and old technology the plantis not producing the desired output in terms of production and energy efficiency. The usage ratio of natural gas of PUFFL is about 49.8 MCF/MT of urea and UFFL is about 32.4 MCF/MT of urea. The proposed GPUFP is designed with modern and improved technology and as energy efficient. The performance or efficiency of the proposed Project will be increased by about 126% from the PUFFP and about 47% from the UFFL.

5.5 Material Storage and Handling

5.5.1 Hazardous Waste

355. Hazardous waste disposed at PUFFL includes soot removed from the cleaning of the boilers operating on fuel gas. There is no facility available for storage of hazardous waste at the plant. Currently, hazardous liquid waste is discharged and dumped into the lagoon located close to the plant on the North. The demolition of the civil structures in the demarcated area will generate debris including asbestos cement sheet. Adding asbestos to cement makes it highly toxic.The debris will be dumped in a designated area in a confinement or else take away outside of the Project Site through selected Vendors. A secured onsite asbestos sheet disposal facility should be constructed until Vendor is selected to take away outside the Project site. It is estimated that about 27,400 tons of debris and rubbles including over 550 sheets of asbestos (about 15 tons) will be generated and needs removal from the demarcated area of the PUFFL. Condensate is generated at gas regulating and metering stations, which requires proper handling and storage if RMS is shifted to other place.

5.5.2 Non-Hazardous

356. Other solid wastes generated would include kitchen waste, cardboard, paper, plastic and garden wastes. Amongst these cardboard, paper and plastic wastes is being handed over to scrap dealers whilst kitchen and garden wastes is going to designated landfill area of the Ghorasal Municipality. The same practice shall be made after proposed new Plant construction. The annual estimated kitchen waste generation in the labour camp considering resident labour of 1,700 during construction period would be about 160 MT. Considering household size of 4.6 and 350 staff in the Colony would generate about 1.25 ton/day of kitchen and municipalwaste and about 0.15 ton/d from the administrative building and other offices. Municipal wastes generated in the housing colony will be stored in designated garbage disposal areas (made of concrete) for collection by the Ghorasal Municipality waste collection system.

5.5.3 Material Handling Conditions

357. Material as ammonia and urea that would be produced in the proposed factory would be handled in following ways:

a) Bagged urea transported by urea barge loading;

b) Bagged urea transported by urea truck loading;

c) Bagged urea transported by urea railway wagon loading; and

d) Ammonia bottling.

5.6 Solid and Liquid Waste and Air Emission

5.6.1 Solid Waste

Solid Hazardous Waste:

358. During the design stage itself due care will be taken to select the process technologies generating minimum solid wastes so that their handling, treatment and disposal do not cause any serious impact on the existing land environment. Also, efforts will be made to recycle some of the spent catalysts by way of returning to the original supplier for reprocessing. The following wastes shall be generated from the Complex:

1) Spent Catalyst

2) ETP Sludge

3) Waste Oil (Dealt in liquid hazardous waste)

Spent Catalysts and Management:

359. The catalysts to be used in sections/vessels of the proposed Plant (GPUFP) are listed in Table 5.6 with their composition, life, volume and density. The catalysts are as follows: Nickel Oxide, Molybdenum Trioxide, Zinc Oxide, Nickel, Magnesium Oxide, Ferric Oxide, Chromium Oxide, Silicon Dioxide, Nickel, Copper Oxide, etc. The above catalysts being spent form the major part of the solid wastes to be generated in the proposed fertilizer complex. The spent catalysts are hazardous in nature and flammable in open environment. So due care should be paid for the management of such spent catalysts in environment friendly manner. Catalytic wastes include nickel, iron, chromium, copper, zinc oxide, silicon, aluminium, magnesium, molybdenum, etc.

Table 5.6: List of catalysts, composition, life, volume and density used for GPUFP

Sl. No.	Section/ Vessel	Catalyst Composition (Wt%)		Catalyst Life (Years) Expected	Catalyst Volume (m^3)	Bulk Density (kg/m^3)
1.	Hydrogenator (TK-261)	NiO MoO_3 Al_2O_3	2.3 9.8 Balance	5	7.7	500
2.	Sulfur Absorber (HTZ-5)	ZnO	99-100	2 x 2	2 x 20.3	1,300
3.	Primary Reformer (R-67R-7H)	Ni NiO MgO Al_2O_3	12-15 0-3 25-30 60-65	3 - 5	4.8	900

Sl. No.	Section/ Vessel	Catalyst Composition (Wt%)		Catalyst Life (Years) Expected	Catalyst Volume (m^3)	Bulk Density (kg/m^3)
4.	Primary Reformer (R-67-7H)	NiO MgO Al_2O_3	15-20 20-25 55-60	3 - 5	27.1	900
5.	Secondary Reformer (RKS-2)	NiO MgO Al_2O_3	7-13 25-30 60-70	>10	3.1	1,100
6.	Secondary Reformer (RKS-2-7H)	NiO MgO Al_2O_3	7-13 25-30 60-70	>10	23.6	900
7.	High Temp. CO Converter (TK-20)	$Mg(Al_2O_2)_2$ Al_2O_3	95-100 0-5	5	4.4	900
8.	High Temp. CO Converter (SK-201-2)	Fe_2O_3 Cr_2O_3 CuO	80-90 8-13 1-2	5	47.4	1,200
9.	Low Temp. CO Converter (LSK-2)	ZnO Al_2O_3 CuO $CuCO_3$	18-31 25-43 18-24 2-5	5	5.2	1,100
10.	Low Temp. CO Converter (LSK-823)	Cu Zn Al Cs C and O	<38 22 +/- 2 6 +/- 2 <1 Balance	5	65.6	1,200
11.	Methanator (PK-7R)	Ni NiO Al_2O_3	25-30 1-5 60-70	10	18.2	550
12.	Ammonia Converter (KM1R)	Fe Oxides K_2O, Al_2O_3,CaO, SiO_2	91-95 5-9	>10	14.2	2,200
13.	Ammonia Converter (KM1)	Fe, FeO K_2O, Al_2O_3,CaO, SiO_2	89-93 7-11	>10	47.4	2,800

Source: MHI (EPC Contractor)

360. The following strategies may be recommended for the management of spent catalysts (applicable for spent catalysts of both existing PUFFL and proposed GPUFP):

- On-site management: This includes submerging pyrophoric spent catalysts in water during temporary storage and transport until they can reach the final point of treatment to avoid uncontrolled exothermic reactions.
- Off-site management: The spent catalysts could be sent to the manufacturers for regeneration/ recovery; or to waste disposal companies that can recover the heavy metals through recovery and recycling processes.

ETP Sludge and Waste Oil and Management:

361. The following strategies are recommended for solid and liquid waste management:

- The provisions of Hazardous Waste and Ship Breaking Waste Management Rules, 2011 will be complied with for spent catalysts.
- The ETP Sludge (minor generation) shall be used as manure.
- The Waste Oil generated shall be sold to authorized agencies/vendors.

362. About 15 tons of asbestos tin sheet material will also be generated during demolition and removed from the demarcation area. This material will be temporarily stored in the laydown area for taking away from the site with due auction process or buried in a scientifically made trench in a designated area.

Solid Non-Hazardous Waste:

363. During construction, large amount of construction waste that includes unused construction materials, construction debris, excavated spoils, abandoned or broken machine parts, debris, kitchen wastes from labor sheds, packaging materials, used home appliances, etc will be produced. Moreover, food waste, plastic, papers, cock sheet, cartons, metal or plastic binders, etc. may be produced as solid waste during this stage. Wastes generated during demolition of the existing civil structures of the site including wastes (e.g., scrap iron, wooden frames, glass canvas, etc.), and some other solid wastes (e.g., from construction camps). Non-hazardous solid waste will be disposed of at designated sites. Scrap material will be sold out and the remaining waste will be collected by the Ghorasal Municipality for final disposal to designated landfill sites.

5.6.2 Liquid Waste

Oily Water:

364. Waste oil and oil contaminated water is collected in a spill wall or into an oil trap of a pit for each potential source of oily water. The major potential sources of oil are: (i) Compressor; and (ii) Different pump glands. Oil is skimmed manually at each pit periodically and further removed in oily water separator prior to discharging to the open environment, the Shitalakhya River.

Sanitary Sewage Handling:

365. The maximum number of workforce provisioned in the Project is about 4,000, which will be engaged in the construction phase. Organic soild waste generated from such a huge workforce will need a separate management and thus knowing the amount of the same is essential.

366. Considering solid waste generation rate of 0.29 kg/person/ day[4] for maximum number of 4,000 labours in the camp for about two (02) years, an estimated amount of about 1,740 m^3 of organic solid waste would be generated which would require sound management. Failure of management may pollute the surrounding environment, lose aesthetic value and may cause diseases to labours and local inhabitants. Managing of such a big septic tank and disposal of waste would be cumbersome and unhygienic.

367. There is a provision of septic tank for a building or cluster of buildings or connect to existing septic tank depending upon the layout to be decided during detailed engineering for the new buildings.

[4] CCAC Municipal Solid Waste Initiative; www.unep.org/ccac

368. The sludge removal from the septic tanks is expected to be done once a year or as per the requirement of local laws and regulations by the Project Proponent. As such cleaning of the septic tank would be much convenient to manage, hygienic and environmentally sound.

5.6.3 Air Emissions

369. Air emissions will include those from the operation of construction equipment and machinery, vehicles transporting construction materials to the site and construction debris out of the site. If construction equipment such as stone (aggregate) crushers is used at the site, this may result in emission of particulate matter during its operation. Since construction of the proposed GPUFP would involve significant earthworks, an increase in particulates in the air from wind-blown dust will also be a concern, especially considering the close proximity of the high school and the staff colony (and also the residential area) to the project site. Moreover, demolition activities will also be a source of dust dispersion. During the operation phase, air emissions will also be generated due to the operations of the existing UFFL, Ghorasal Power Station (GPS) units (nearby to the project site) and new GPUFP.

370. The Ammonia-Urea complex has a number of stacks (at least three) for burning the ammonia released from the process and ammonia storage tanks in stacks provided with flare fueled by natural gas. Only source of ammonia that enters into the atmosphere is from the urea granulator fluidized by air. This exhaust air is treated in a scrubber with water. The technology employed is proven in commercial plants of similar size and complexity. This system has been provided in the proposed urea granulation unit and expected level of ammonia emission will be about 130 mg/Nm^3 air. The contractor shall guarantee the emission level of 150 mg/Nm^3 air. This exhaust air will be discharged to atmosphere from the stack of 50 meter height and the ammonia present shall be dispersed in the atmosphere by diffusion. Ammonia present at the ground level will be around 1 ppm and this does not affect human health.

371. Ammonia emission level of 50 mg/Nm^3 from granulation vent stack can be achieved theoretically only by installing an additional scrubbing system by scrubbing with dilute sulfuric acid. The scrubbing produces ammonium sulfate solution which poses serious disposal problems along with corrosion. But this system having proper disposal of ammonium sulfate solution is yet to be common in commercial plants of similar capacity (2800 TPD, granular urea).

372. The World Bank's guidelines of 50 mg/Nm^3 ammonia in stack exhaust is a target value and not a value that has been achieved in commercial plants of similar size and complexity now in operation. For the plants in Bangladesh, they shall be required to comply with the standards currently laid down by the Department of Environment (DoE) of Bangladesh. Bangladesh does not have a discharge standard for ammonia gas as such from ammonia-urea plants as well as from urea granulator exhaust stack.

373. The technical specification of the contract for this project stipulates that the process, system and equipment shall be proven for at least two years commercial operation in plants of similar size and complexity.

374. **Feed and Fuel:** The plant feed is natural gas (NG) which will be available at plant battery limit. The fuel gas for the reforming and steam boiler is part of the total natural gas delivered at the battery limit. Natural gas would be used as fuel gas in the following areas:

- Reformer fuel of ammonia reformer and start-up heater;