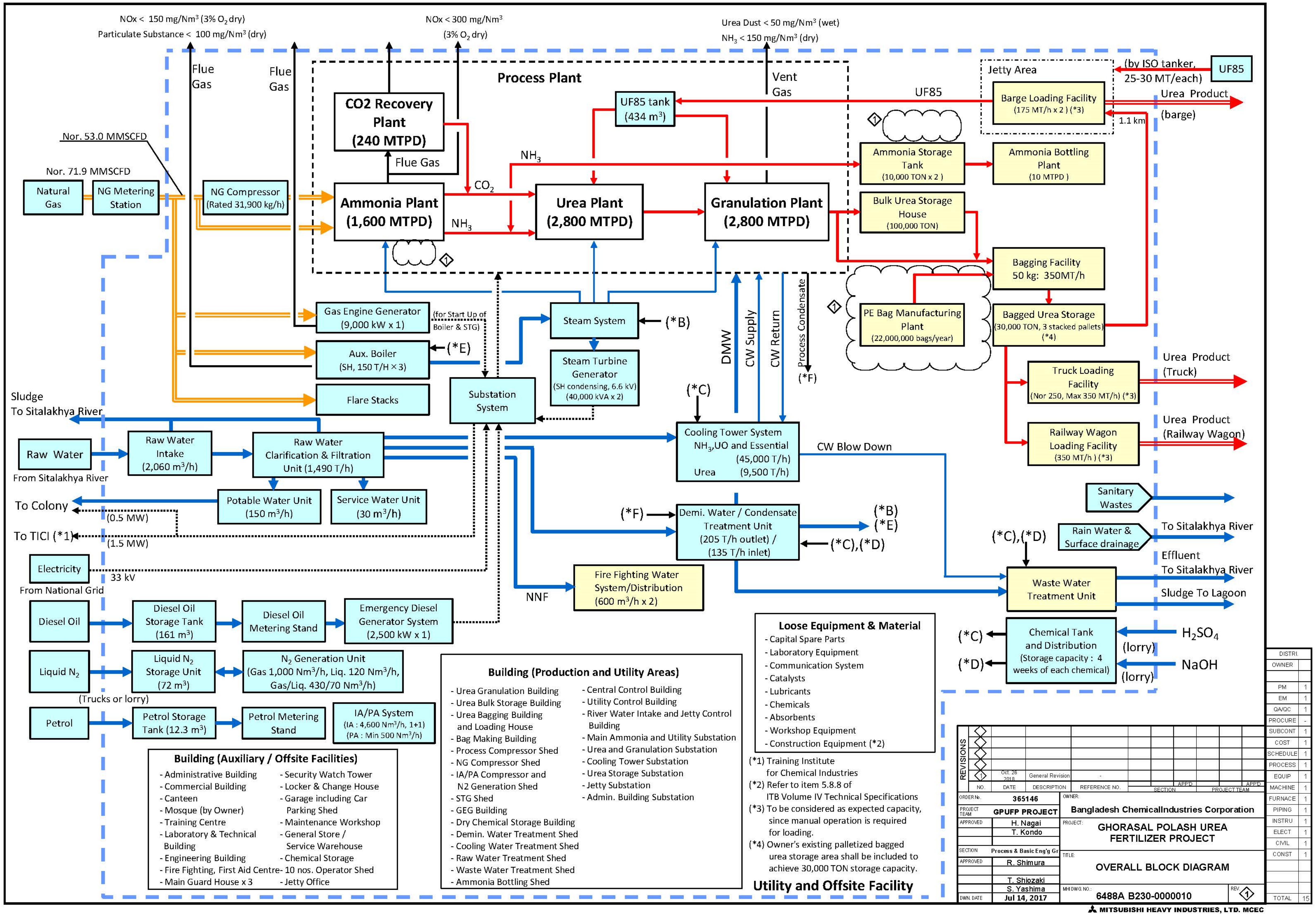


Figure 5.3: Combined process flow diagram for Urea synthesis (Ammonia-Urea Melt-Granular Urea)

Urea Synthesis and NH_3, CO_2 Recovery at High Pressure

278. 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.

279. 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.

280. The carbon dioxide feed drawn to the Urea Plant battery limits, from the CO2 removal unit in Ammonia Plant, at about 27 kPa(g) pressure and 43°C temperature, enters the CO2 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

281. 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)

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

Process Condensate Treatment (PCT)

283. This section provides conditions to process the water containing NH_3-CO_2 and urea coming out of the vacuum system, so as to have a process condensate almost free from NH_3-CO_2 urea to be sent to utility unit.

Effluents

284. 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.

285. 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.

286. 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.Points of emission for gaseous effluents are: Continuous Urea Flare Stack, collects and burns gases continuously discharged from medium pressure section vent.

287. Discontinuous Urea Flare Stack, collects and burns vapors from high and low pressure section vents and from process condensate· treatment section vent in case of their opening. Furthermore, it collects vents from urea solution tank and carbonate close drain tank.

- 1st Vent Stack Separator

288. Collects gases discharged from vacuum section vent, process condensate tank vent, off spec. condensate tank vent and Storage tank vent.

- 2nd Vent Stack Separator

289. Collects gases discharged from process safety valves and rupture disks.

Process Condensate

290. 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

291. 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

292. 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.

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

Granulation Urea Process

294. 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 and 5.5 kg formaldehyde per ton of end product. The formaldehyde addition guarantees a free flowing product without further treatment. Standard formaldehyde solution may be used or, when locally available, liquid urea/formaldehyde pre-condensate is favored.

This latter product of higher formaldehyde concentration can be stored for several months in steel tanks without degradation or 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.

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

Dust Emission and Recovery

296. 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

297. 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

298. 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

299. 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.

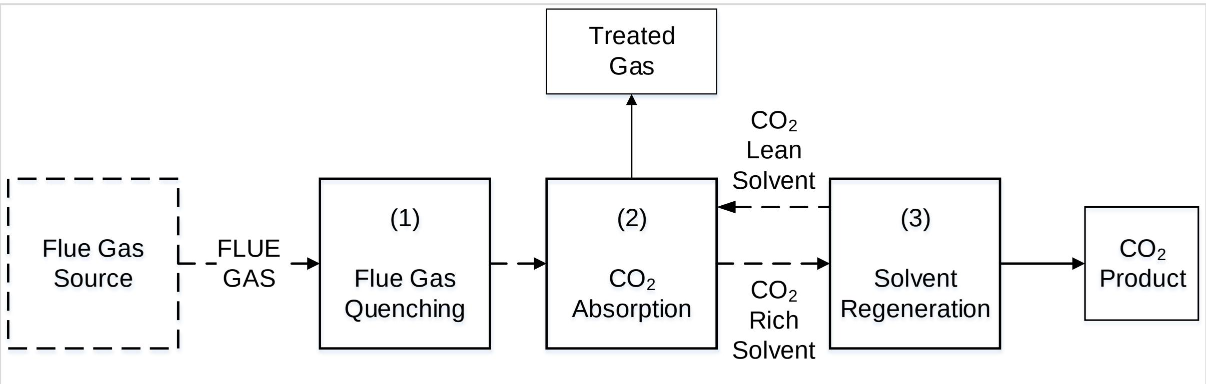


Figure 5.4: Block Flow Diagram of the CO_2 recovery plant

5.3 Description of Major Components

5.3.1 Land Requirement

300. The area of the proposed project site (battery limit) is about 110 acres including the existing RMS and excluding the lagoon. The site is partially fallow land on the eastern side of the existing PUFFL and particularly to the Compressor House having bushes, trees, civil structures (buildings) and tin shed warehouses exist. Adequate land is available within the property line of PUFFL. The Project site also includes a small portion of UFFL. About 28 acres of the lagoon (about 34 acres) will be filled up but not consider in the Project area (110 acres). No land acquisition will be required for the proposed new fertilizer factory.

5.3.2 Project Layout Including Site Drainage

301. The detailed layout plan showing all structures, road network, drainage network, different pollution abatement measures, waste water and effluent treatment facilities shall be developed by the EPC contractor before construction. The EPC contractor shall be appointed after receiving approval of the EIA report from DoE. BCIC 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 detail layout plan of the proposed GPUFP project is presented in Figure 5.5 and drainage general plan is presented in Figure 5.6. The effective area for the implementation of the given layout plan is about 73 acres, wehereas the Project area is 110 acres. 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 Preparedness Plan in this report provides more details in this context.

302. 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.

303. 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.

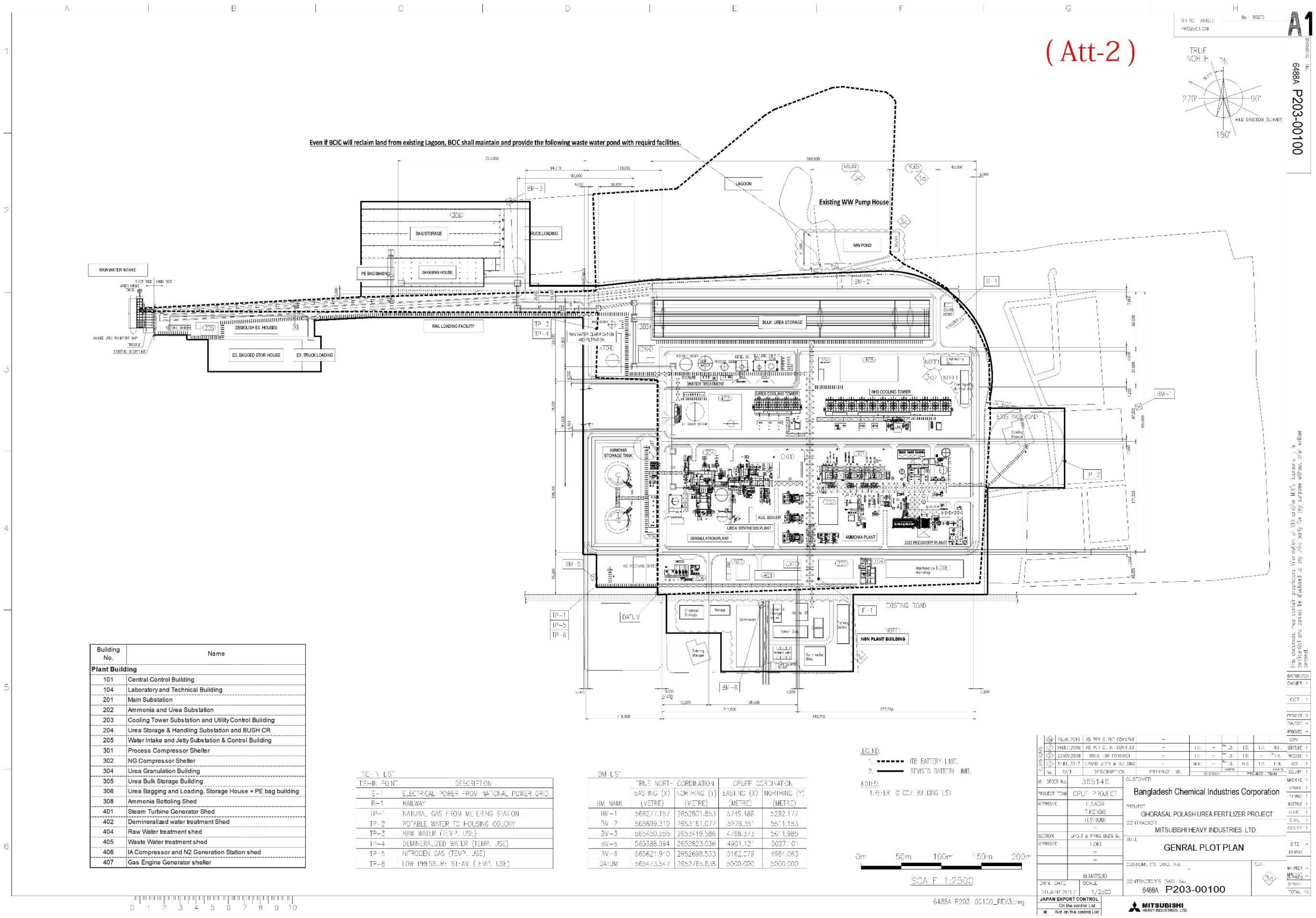


Figure 5.5: Detail layout of the GPUFP

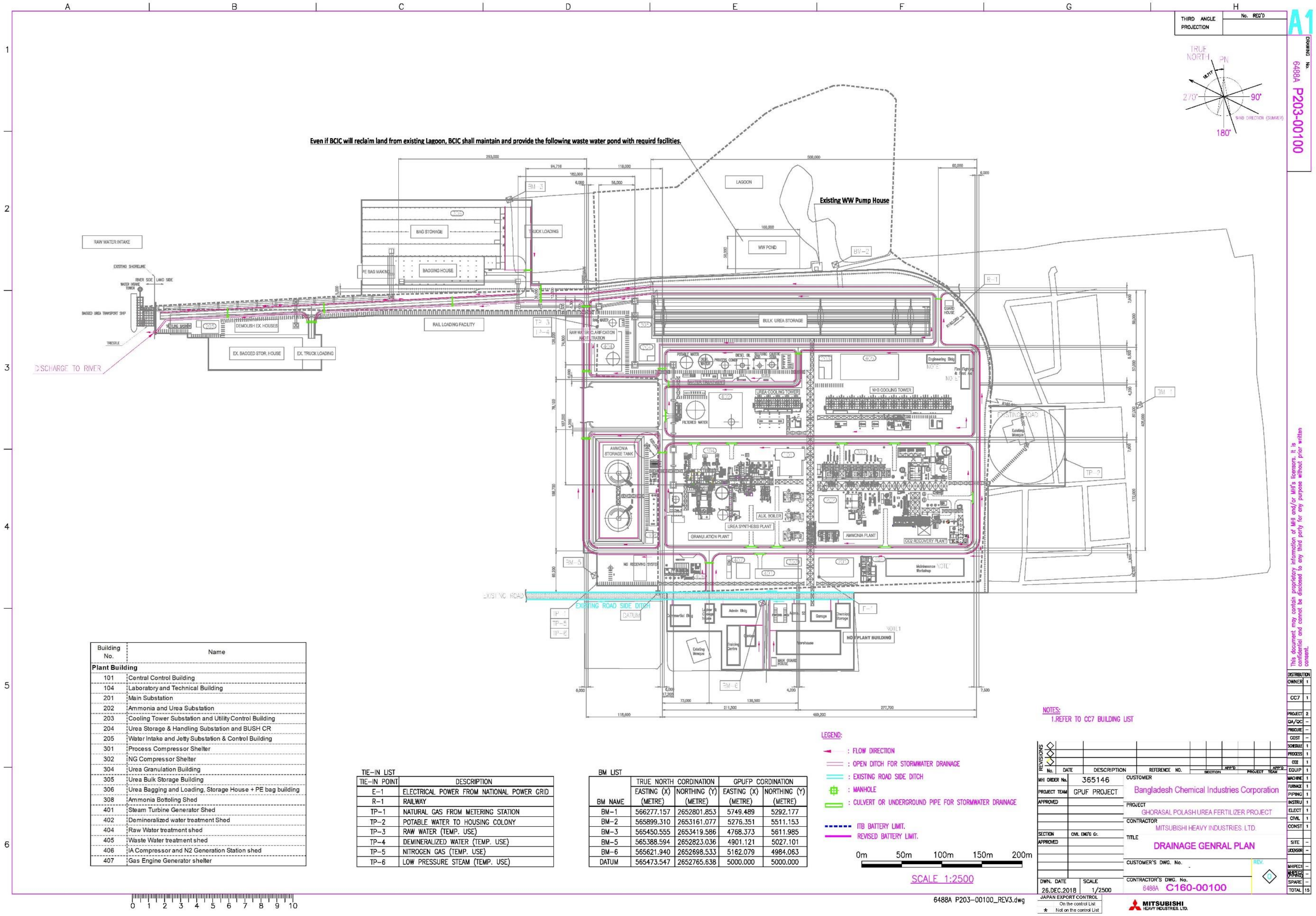


Figure 5.6: Drainage general plan of the GPUFP

5.3.3 Plant Components of the Layout Plan

304. 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

305. 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

306. At present, approximately 0.583 m3/s (2,100 t/h) of surface water from the Shitalakhya River is used for different cooling water systems, boiler and cooling blow down, etc. of both UFFL and PUFFL. Raw water withdrawal from the Shitalakhya River would be about 0.567 m3/s (2,040 t/h) (Design value) for the proposed Project having three pumps, each with 1,020 t/h capacity and one with standby; after storage tank it would be about 0.322 m3/s (1,159 m3/h); and after clarified water tank it would be about 0.283 m3/s (1,020 t/h). So, the specific relative consumption of water for the GPUFP is much bleow in compared to UFFL and PUFFL. The source of water for all cooling, steam generation and other purposes including potable water and losses would be surface water from the Shitalakhya River at an amount of about 1,020 t/h.

307. A utility flow diagram of waste water treatment system is presented in Figure 5.7 for the new construction of the Project. Specific relative consumption of water for the GPUFP (production: 2,800 TPD) will be significantly low compared to the urea production from the existing facilities (UFFL and PUFFL altogether production: 900 TPD) due to adoption of modern and efficient technology. There are a number of small-medium industries along the left bank of the Shitalakhya River. In the 10 km study area, 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.

308. BCIC has applied to WARPO seeking permission of usage of 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 (*Appendix 5.1*). This is the compliance of Water Act, 2013 and Rule, 2018 of Bangladesh.

Table 5.3: Breakup of water supply and distribution

Sl. No.	Items	Quantity of Water (m^3/s)
A.	**Supply**	
A1	*Raw Water Withdrawal from Shitalakhya River*	0.5667
A2	*After Storage Tank*	0.3219
A3	***After Clarified Water Tank***	***0.2833***
B.	**Distribution**	
B1.	**Makeup Water**	**0.2458**
	(i) Cooling tower evaporation loss	0.1756
	(ii) Drift loss	0.0125
	(iii) Blow down loss	0.0444
	Sub-Total (Total Water Loss in Cooling Tower)=	***0.2325***
B2.	**Other Losses as Waste Water**	
	(i) Cooling tower back wash	0.0133
	(ii) Loss from potable water	0.0083
	(iii) Loss from Demi. Unit	0.0044
	(iv) Loss as service water	0.0042
	(v) Oily contaminated water	0.0039
	(vi) Non-Oily waste water	0.0031
	(vii) CO_2 recovery plant	0.0022
	(viii) Loss from Caustic soda, Sulfuric acid, coagulation and Polymer injection system	0.0114
	Sub-Total (Other Losses as Waste Water)=	***0.0508***
	Total Distribution (B=B1+B2)	**0.2833**

Source: Utility flow diagram for waste water treatment system

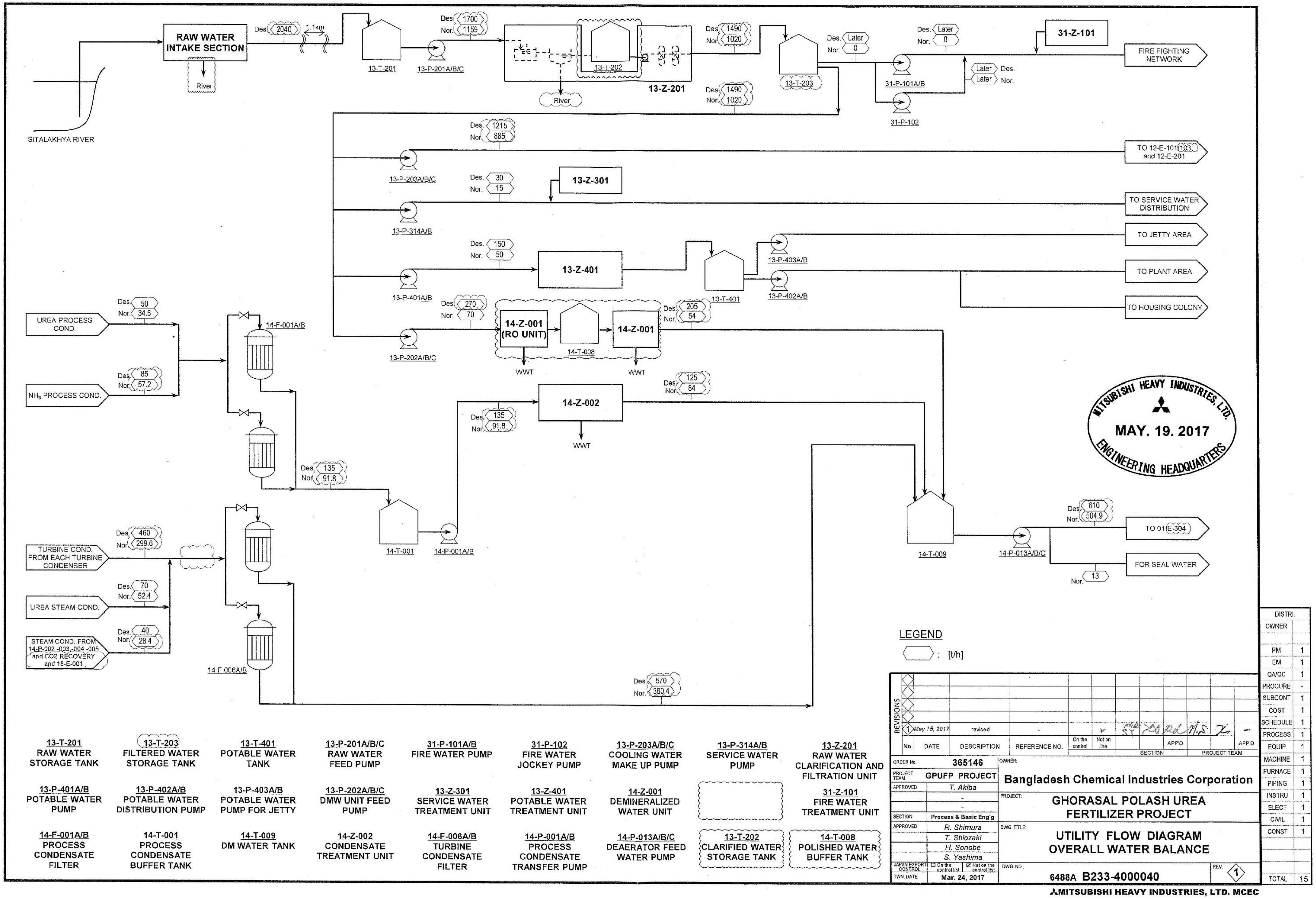


Figure 5.7: Utility flow diagram for overall water balance

5.4.2 Water Intake Pump

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

309. 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

310. 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

311. 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

312. 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

313. 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

314. 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

315. 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:

316. For Ammonia Plant

- Blow Down Cooler
- Critical Oil Coolers

317. For Urea Plant

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

318. 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

319. 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.

320. 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 Clarification and 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.

321. 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.

322. 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.

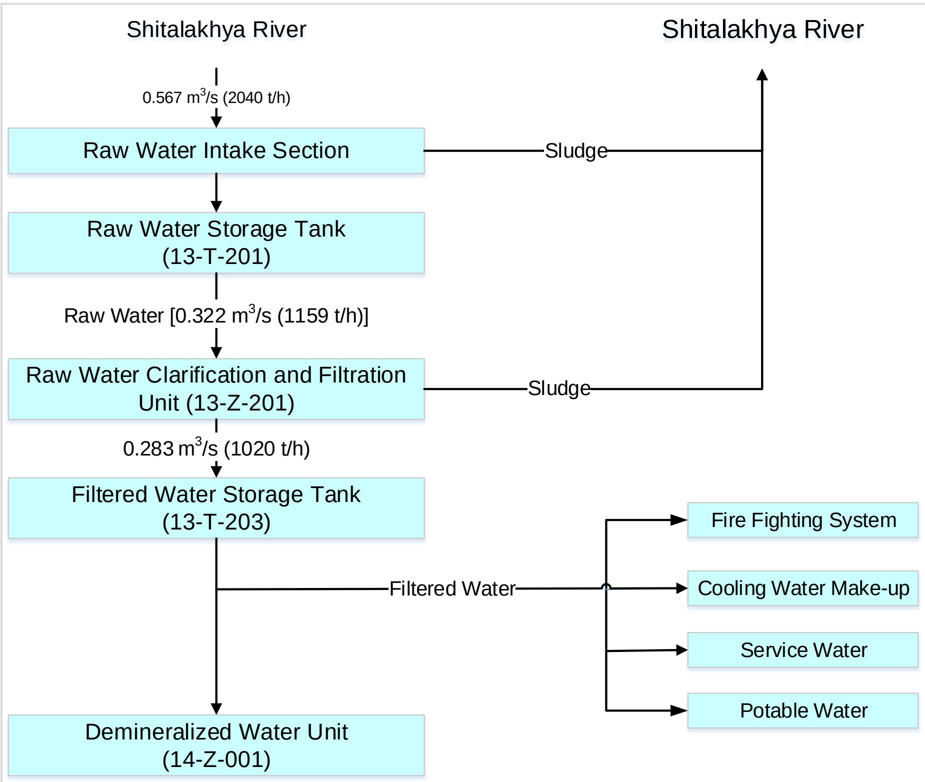


Figure 5.8: Block diagram of water intake and distribution

Potable and Service Water System

323. 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

324. 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.

325. 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)].

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

327. 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.

328. 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.

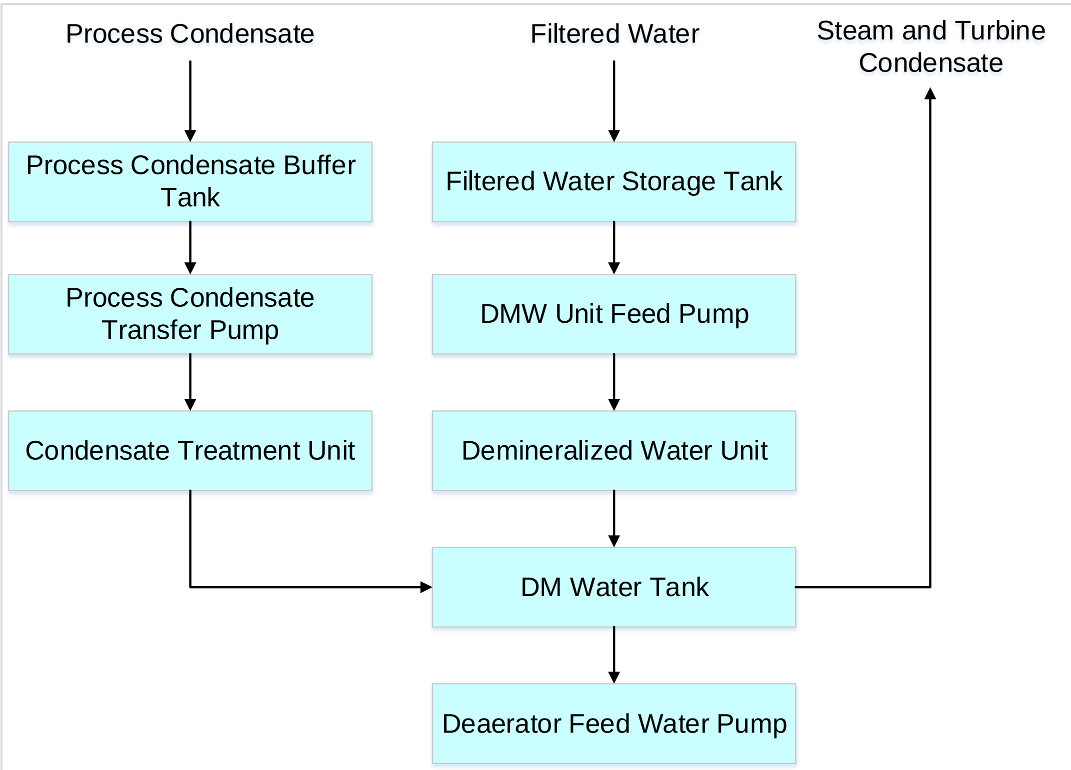


Figure 5.9: Block diagram of process condensate and filtered water

Boiler Feed Water System

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

Steam Generation System

330. 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

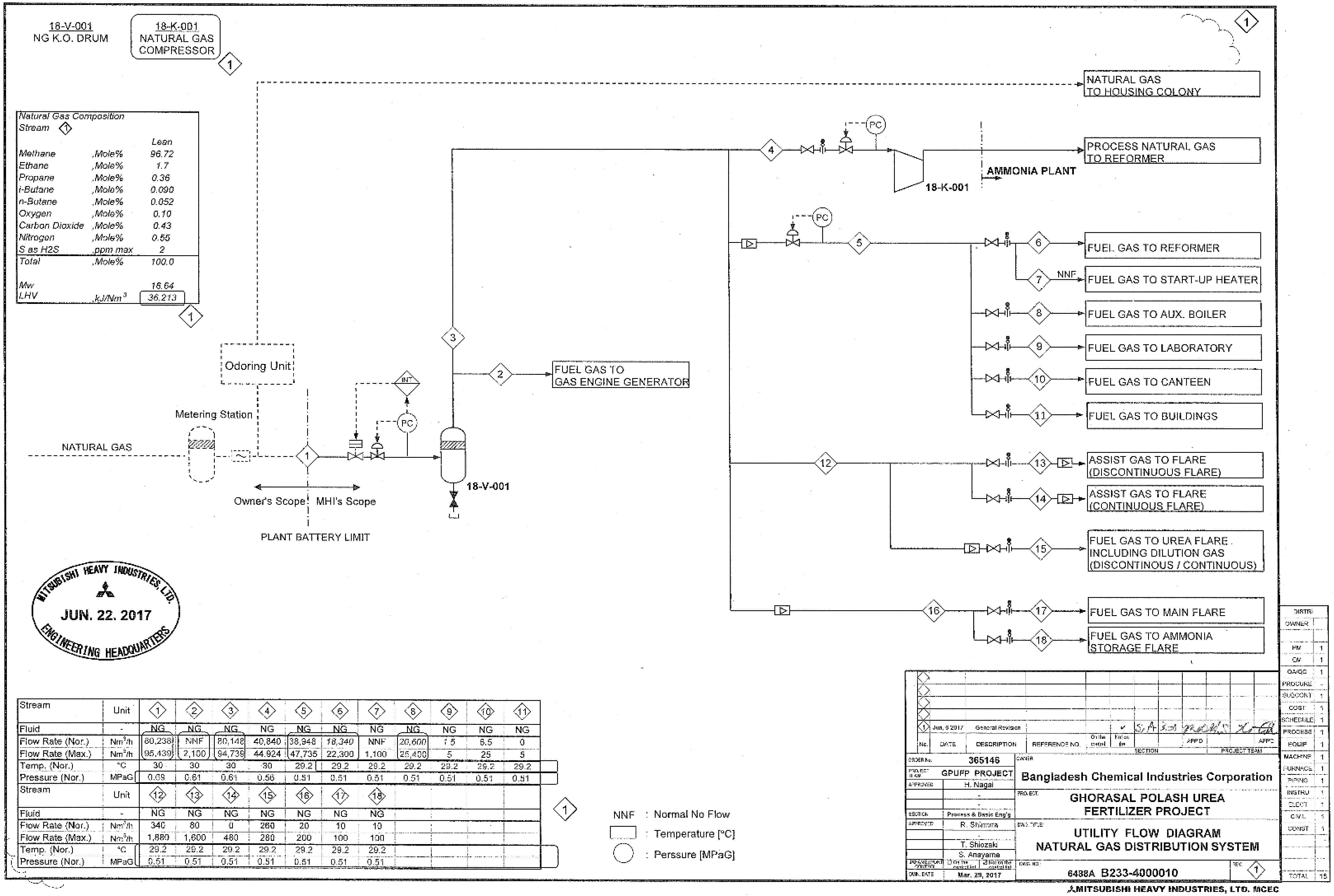
331. The Project has provisioned captive power for day-to-day use. For this, two units of Steam Turbine Generator (STG) of 32 MW each and One unit of Gas Engine Generator (GEG) of 9 MW capacity. The STG will supply power to the entire plant while GEG will supply power for start-up of Auxiliary Boiler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

5.4.6 Natural Gas and Fuel Gas System

332. 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.

333. 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

334. 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

335. 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.

336. 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

337. 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 t/h (Normal) and 350 t/h (Design)

Source: MHI (EPC Contractor)

5.4.10 Effluent Treatment and Maintaining Discharge Standard

338. 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.

339. Sludge will be generated in the Raw Water Intake section and in the Raw Water Clarification and filtration. This sludge 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).

340. 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.*