Environmental Impact Assessment for proposed feed and fuel conversion (Naphtha to Natural gas), installation of flue gas CO_2 recovery plant and de-bottlenecking at NFCL, Kakinada (Andhra Pradesh)

Sponsor
Nagarjuna Fertilizers and Chemicals Limited, Kakinada

National Environmental Engineering Research Institute

Nehru Marg, Nagpur 440 020

September 2007

Executive Summary

1.0 Introduction

- Nagarjuna Chemicals & Fertilizers Limited (NFCL) is located at Kakinada, East Godvari district of Andhra pradesh state.
- The NFCL complex consisting of two ammonia plants each of reassessed capacity 1050 Metric Tons (MTs) per day and two-urea plant of each of reassessed capacity 1810 MT per day.
- The processes followed in the manufacture of ammonia and urea is Haldor Tepsoe Technology and Snamprogetti's (Spa) Ammonia stripping process for ammonia and urea respectively.
- M/s NFCL proposed to changeover of feed/fuel from naphtha to natural gas in Ammonia Plant (II), installation of CO_2 Recovery from flue gases (CDR) plant and debottlenecking expected to reduce in specific energy consumption 0.12 Gcal/MT of urea. The overall ammonia and urea production from each plant to attain 1300 and 2280 MT per day respectively.
- The estimated investment for the proposed projects to be Rs. 165 Crores.

2.0 Major activities involved in the project

- Fuel/feed change-over in Unit II from naphtha to natural gas:

  With Natural Gas as feed stock, the hydrogen to carbon ratio changes and carbon potential in naphtha is more and that of hydrogen is less. In the case of natural gas has higher potential of hydrogen and lower potential of carbon. Therefore, when natural gas alone is used as feed stock NFCL faces carbon dioxide shortage. The hydrocarbons are the major source of carbon dioxide for fertilizer industry via combustion or catalytic cracking/conversion. In steam reforming of hydrocarbon natural gas is used as fuel for heating purpose in the furnace that produces very huge amount of flue gases which contain nearly 8 to10% carbon dioxide. Hence, the cheapest source of carbon dioxide in fertilizer industry to meet the shortfall is flue gases.

- Carbon dioxide Recovery from Flue gases (CDR Plant):

  In order to meet the CO_2 demand to sustain the production with minimum energy levels, various modes of production planning were carried out and the best among those schemes is to install the CDR unit with an estimated recovery of 450 MTD and to de-bottleneck the plants to augment the capacities.

- De-bottlenecking at NFCL Complex:

  The prime objective of the de-bottlenecking measure is to augment the capacity by utilizing the assets of the existing Ammonia plants from 1050 to 1300 MTPD and Urea plants from 1810 to 2280 MTPD. The Process description after de-bottlenecking will be same as pre de-bottlenecking scenario. Only few equipment of high energy efficiency and higher capacities are being replaced. After de-bottlenecking, ammonia and urea plants are identical to the existing plant as they are based on the same process technologies. Further, recovery of urea from de-dusting system will increase leading to almost no change in emission of urea dust from prill towers.

Raw Material Consumption

Name of Raw Material	Name of Products	Consumption of raw material per unit of output for 2006-07	Consumption of raw material per unit of output after de-bottlenecking
Natural Gas	Urea	469.2096Sm^3/MT at 8813.3 Kcal/Sm^3	672.359 Sm^3/MT at 8202.0 Kcal/Sm^3
Naphtha	Urea	0.13529 MT/MT* at 10514.798 Kcal/kg	0
LSHS	Urea	0.0079 MT/MT** at 9365.919 Kcal/kg	0

*****Naphtha usage increased due to short supplies of Natural Gas

******Used LSHS as alternative fuel due to short supply of Natural Gas, Naphtha for a short duration

3.0 Environmental Quality

3.1 Air Environment

- The SPM and RSPM concentrations were observed to be below stipulated standards of CPCB for residential areas at all the twelve AAQM locations. The arithmetic mean of 24 hourly concentrations of SPM and RSPM ranged between 44 – 108 μg/m^3 and RSPM 7 – 21 μg/m^3 respectively

Emission details (Kg/day)

S.No	Source	Before de-bottlenecking			After de-bottlenecking		
		SO2	SPM	NOx	SO_2	SPM	NOx
1	Natural Gas feed stock pre-heater in (Amm1)	0.072	Not Traceable	11.04	0.1992	Not Traceable	11.04
2	Primary Reformer(F201+ F202) in Amm1	1.728	Not Traceable	336.72	0.1584	Not Traceable	112.80
3	Steam Generation	0.960	Not Traceable	456.00	0.2640	Not Traceable	456.00
4	GT-A/B in utilities	0.576	Not Traceable	388.80	0.1584	Not Traceable	326.40
5	GT-C in utilities	1.800	Not Traceable	672.00	0.6648	Not Traceable	876.00
6	Naphtha super Heater in Amm2	5.040	Not Traceable	11.04	-	-	-
7	Natural Gas and naphtha feed stock pre heater in Amm2	5.040	Not Traceable	11.04	0.1992	Not Traceable	11.04
8	Primary Reformer(EF20 1+EF202) in Amm2	129.6	Not Traceable	249.6	0.4992	Not Traceable	403.20
9	CO_2 recovery plant (CDR)	-	-	-	0.3312	Not Traceable	333.60

- The arithmetic mean of 24 hourly concentrations of SO_2 and NOx at all these locations ranged between 3 – 8 μg/m^3 and 3 – 19 μg/m^3 respectively.
- organosulfur and mercaptans were found below <0.02 ppb, at sampling location Kakinada, Chidiga, Kowuru and Suryarthopeta village sampling stations.
- The levels of NH_3 observed to be in the range of 2-9 μg/m^3. The concentrations of methane, non-methane hydrocarbons and carbon monoxide varied between 4.7 – 6 ppm, 3.6-21.2 ppm, and 0.3-1.2 μg/m^3.

Wastes discharged into Environment/Unit of Output

Waste characteristics	During the current year FY2006-07	After de-bottlenecking	Concentration of pollutants mg/L		% of Variation from stds. with reasons
Pollution load	**0.94 m^3/MT of Urea**	**0.85 m^3/MT of Urea**	**For the Year 2006-07**	**After de-bottlenecking**	
Air Emission: (Per MT Urea)					
i) Quantity of Urea dust from prill tower	0.135 kg	0.118 kg	13.3 mg/NM^3	13.3 mg/NM3	No Deviation
ii) Emission from process stacks:	Kg of SO_2		mg/NM^3		
Stacks in Ammonia Plants	0.034	0.003	2.0	<1.0	No Deviation
Boilers +HRSG	0.037	0.001	2.0	<1.0	No Deviation

3.2 Noise Environment

- The levels of noise at existing NFCL complex is mainly due to activities in the complex and also winds, waves range from 60 dBA to 70 dBA
- The potential noise generating sources at the NFCL complex are gas turbines for power generation, fire water pumps and DG sets which generate noise in the range of 75-80 dBA.

3.3 Water Quality

- The surface water quality indicates that the pH is in range 7.9 – 8.0, turbidity 4-6 NTU, suspended solids 15-26 mg/l, total dissolved solids in the range of 1410 – 12000 mg/l and conductivity in the range of 2310-20500 µS/cm
- The ground water quality exhibits pH 7.3-8.2, turbidity < 1 NTU, suspended solids 0.4-6.0 mg/l and dissolved solids were 530-1320 mg/l where as total hardness was observed to be in range 450-2170 mg/l
- The nitrate and phosphate were found in the range of 0.5-0.8 mg/l and 0.88-1.23 mg/l respectively in the surface whereas oil & grease and hydrocarbons were in the range of 0.01-0.12 mg/l and ND-0.08 µg/l respectively
- The bacteriological results showed the total coliform counts in the range of 20-150 CFU/100 ml for surface water samples and in the groundwater samples the total and faecal coliform counts were in the range of 330-460 CFU/100 ml and 30-170 CFU/100 ml respectively
- The counts of phytoplankton in surface water were observed in the range of 240-520/100 ml and SWDI in the range of 0.7-1.45. The zooplankton count was recorded to be 3650 m^3

Water and Raw Material Consumption

i) Water Consumption

		For the Year 2006-07 (M^3/day)	After de-bottlenecking (M3/Day)
Process	-	4073	5004
Cooling	-	13874	17428
Domestic	-	2068	2648

Water consumption per unit of product of Output for 2006-07 (M^3/MT of Urea): 5.529

Water consumption per unit of product of Output after De-bottlenecking (M^3/MT of Urea): 5.50

Wastes discharged into Environment/Unit of Output

	Waste characteristics	During the current year FY2006-07	After de-bottlenecking	Concentration of pollutants mg/L		% of Variation from stds. with reasons
	Pollution load	0.94 m^3/MT of Urea	0.85 m^3/MT of Urea	For the Year 2006-07	After de-bottlenecking	
A)	Liquid Effluent (Per MT Urea)					
	Total Kjeldahl Nitrogen (as N)	0.033 Kgs	0.029 Kgs	35 mg/l	34mg/l	No Deviation
	Oil Content	3.9 gr	3.4 gr	4.2 mg/l	4 mg/l	-do-
	Total Chromium	Nil	Nil	BDL*	BDL*	-do-
	Phosphate (as P)	1.1 gr	0.85 gr.	1.2 mg/l	1.0 mg/l	-do-
	Vanadium (as V)	0.019 gr	0.017 gr.	0.02mg/l	0.02 mg/l	-do-

Characteristics of Liquid Wastes* (2006-07)

Sl. No.	Parameters	*Unit*	Prescribed Standards as per APPCB	Min	Max	Avg.	After De-bottlenecking.
1.	pH	mg/l	6.5-8.0	7.4	7.8	7.5	7.5
2.	Suspended solids	mg/l	100	27	34	30	32
3.	Dissolved solids	mg/l	2100	1036	1268	1136	1150
4.	Ammonical Nitrogen as N	mg/l	50	7.6	31.5	14.4	14.0
5.	Nitrates as N	mg/l	10	7.3	8.7	8.1	8.0
6.	BOD	mg/l	30	17	20	19	20
7.	COD	mg/l	250	63	78	69	71
8.	Oil & Grease	mg/l	10	4.0	4.2	4.1	4.0
9.	Phosphates as P	mg/l	5	1.1	1.5	1.2	1.0
10.	Chlorides as Cl	mg/l	1000	452	542	503	510
11.	TKN as N	mg/l	100	19	68	35	34

* From the records of NFCL Environmental Inventory

3.4 Land Environment

- Physical characteristics of soil indicate that soil in the area varies from clay to sandy clay, sandy loam to clay loam and loamy sand
- The bulk density of soil in the region is found to be in the range of 1.20 – 1.67 gm/cm^3, whereas porosity and water holding have been found in the range of 35.4 – 55.1% and 24.1 – 64.9% respectively
- The pH of soil in the study area is found to be 7.10 to 7.80. Organic matter was found in the range of 0.39 – 2.54%.
- Available phosphorous (4.38 kg/ha) and nitrogen (13-320 kg/ha). The soils in the study area fall in moderate fertile class whereas towards coast showed moderate fertility
- The landuse/landcover classification obtained from digital image processing indicates 19.4% is agricultural land, 29.3% is brackish water, 18.3% is built-up land, and 9.4% is plantation

Hazardous Wastes

Specified under (Hazardous waste/management and Handling) Rules 1989

Hazardous Waste	During the current financial Year (2006-07)	Proposed generation after project implementation per annum
Used lube oil	33,855 lts**	34,000 lts
Detoxified containers (MS Drums)	191 Nos ***	Nil
From Pollution Control Facilities	Nil	Nil

** Out of this, 16480 liters re-used internally in the complex. Higher value due to refilling of Lube Oil console in Unit II which happens once in every five to six years

*** Out of these, 3 drums were issued internally for re-use in the complex

Solid Wastes

	Solid Waste	During the current year (2006-07)	Proposed generation after project implementation per annum
a)	From Process (spent Carbon)	Nil	Nil
b)	From Pollution Control Facility	Nil	Nil
c)	Quantity recycled or re-used	Nil	Nil
	1. Chromium Sludge		
	2. Arsenic Sludge	Nil	Nil
	3. Carbon	Nil	Nil
	4. Others	260.0 MT ++	286 MT

++ Siliceous sludge from Clariflocculator which is used in Green belt for land filling

3.5 Biological Environment

- Agricultural fields dominate the land area. The most dominant trees in this region are Bomax ceiba, Artocarpus chaplasa, Albizzia process, Azadirachta indica, Magnifere indica, Tamarindus indica, Caesealpinia spries, Achrus sapote etc.
- The marine fishes, crabs, prawns etc. are found in bulk and are supplied to the market
- The major kharif crops in this region are paddy, red gram, ground nut, Jowar, Bajra, sugarcane, maize, seasum, cotton whereas rice, maize, tobacco, black gram, green gram, groundnut, horsegram are the rabi crops

3.6 Socio-economic Environment

- The study area covers total 24 villages which are from 5 mandals of east-Godavari district
- Total population of mandals under study area is 415600 (2001). Density of population in study area is 961. The percentage of schedule caste is 26.85% whereas schedule tribe is 0.8%. Sex ratio of study area is 994.
- Literacy rate in the study area was 69.71%
- Agriculture and fishing are the major occupation

4.0 Environmental Impacts & Mitigation

- Every industrial activity interacts with the environment and leaves some environmental impact. Some environmental impacts associated with the current project are also inevitable. As per good industry practices, such environmental impacts arising out of the project are identified well in advance and the consequences are assessed for incorporating the preventive/mitigation measures through a precautionary approach. In the environmental impact assessment and the environmental management plan, the following recommendations were given:

- Impact during construction phase of the proposed developments on air quality shall be limited to marginal dust emission i.e., 5-10 ug/m^3 at the NFCL plant site.

- Dust emissions are due to compacting of earth filling and this will be prevented by water sprinkling etc. Care will be taken while transporting the materials to avoid dust emissions.

- The deployment of D.G. sets during construction will not contribute significantly to change is NO_x levels in ambient air quality

- Impact of fertilizer complex on air environment would mainly be due to emissions from reformers and boilers One ammonia unit in the complex, utilizing 60% of naphtha is fuel/feed contributing 200 kg of SO_2 per day.

- Due to changer over of fuel/feed to natural gas reduces SO_2 emission to 20 kg per day. This is far below the stipulated standard (800 kg per day) set by A P Pollution control Board.

- Prediction of the Ground Level Concentrations of SO_2 for different stability conditions from stacks indicate an elevation of 1.4 $\mu g/m^3$ at a distance of approx 2 km at 21.2 km in SW direction.

- The elevated levels will only be experienced for shorter durations and the resultant emissions will get dispersed and diluted with time. The resultant ground level concentrations of SO_2 would not exceed the permissible ambient concentrations.
- Fugitive emissions from the NFCL plant operations are mainly from the routine minor leaks from process equipments, valves and glands.
- However, the existing greenbelt/cover (spread in 789 acres) is to adequately mitigating the impact of fugitive emissions. Since the terrain is plain and sufficient amount of atmosphere mixing is available in the region, the impact of emissions will be negligible from the proposed activities.
- Vegetation and human settlements in the vicinity of the NFCL plant are not likely to be affected by the proposed debottlenecking project because the change in air quality is only marginal and within permissible ranges.
- Net impact from changed scenario of emissions (Point and fugitive) due to the proposed project shall be positive impact on human health and vegetation in and around the project site.
- The background noise levels in the villages near the plant site varied between 35 and 45 dBA, and in commercial places and roadways it varied from 45 to 50 dBA.
- Based on the noise attenuation studies, assessment of likely noise sources in the NFCL complex and the distances to the nearby inhabited villages, the impact of noise generated in the NFCL complex on the general population is considered to be insignificant.
- However, the average noise levels will increase (2-3 dBA rise) due to the proposed project and transportation activities in and around the project site. The increase will only be marginal in comparison to the existing noise levels.

- The process wastewater generated in the NFCL will be treated to meet requirements of stipulated standards prior to its disposal. After treatment, the treated wastewater will be reused for greenbelt/cover.
- It is expected that 700-800 m3 per day of wastewater to be generated additionally and this will be applied to greenbelt/cover spread in an area of 789 acres.
- Regular chemical analysis of the treated wastewater is meeting the stipulated standards of State/Central Pollution Control Boards, no adverse impact on land quality in envisaged.
- There is no additional land requirement for this debottlenecking project. However, 50 m X 25 m land is required to set-up CO2 recovery (CDR) plant in the existing NFCL complex.
- The land utilized for CDR plant is devoid of vegetation. Presently, no significant agricultural activity was observed in and around the NFCL plant site.
- The existing green belt should help in mitigation of ground level pollutants and protect surrounding areas.
- The manpower requirement for proposed project will enhance direct and indirect employment opportunities for the local population, thus improving their social status.
- There will be no adverse impact on sanitation or community health of the local population.
- Infrastructure facilities like transportation & communications will be improved which will influence the quality of life.
- EMP recommends welfare activities such as provision of safe drinking water, sanitation facilities, health care programs, and encouragement to occupational and recreational activities.
- Monitoring of coastal/marine biology environment in the area of should be done at regular intervals and the data base should be

maintained for assessing the long-term impact of development activities on marine environment.

- There is a waste management plan developed by NFCL for categorization and handling of solid/hazardous wastes. All hazardous wastes being handled as per applicable rules.
- NFCL should look into the socio-economic issues of the local population and devise schemes for sustainable community assistance.

5.0 NFCL Commitment

NFCL is committed for the prevention of pollution and protection of environment through a precautionary approach. In line with this objective, the company will embark on adherence to best industry practices in its operations and committed to use the state of art technologies for waste minimization.

Chapter 6

Environmental Management Plan

The objective of the EMP is to identify project specific actions that will be undertaken by the project proponent for mitigation of the specific impacts due to proposed CO_2 recovery plant, change over from Naphtha to NG and de-bottlenecking projects at NFCL complex, Kakinada. These actions will be incorporated into the NFCL`s project management system and integrated into the implementation at various stages of project development. As this report pertains to the project activities of the overall project definition – installation of CDR , change-over of fuel/feed from naphtha to natural gas and De-bottlenecking schemes - the EMP broadly defined here is concerned with the impacts identified due to these developmental activities.

6.1 Construction Phase

- Land acquisition: The existing unutilized land will be use for installation of CDR Plant, which merely reuse 50x60 m of land. Hence, there is no issue of fresh land acquisition for changeover from Naphtha to Natural Gas and de-bottlenecking, the changeover within the existing plants.

- Environmental pollution during construction phase will be mainly due to the activities involving site preparation and construction. The proposed site for CO_2 recovery plant by the side of Ammonia-I plant reformer is already leveled and there is no need of soil transportation. So the nuisance creaked by leveling and transportation is bare minimal. Small quantity of soil generated during piling etc will be used for filling low laying areas in green belt.
- Construction workers are to be given adequate personal protective equipment like helmets, safety shoes, goggles etc while working in the site to protect themselves from occupational hazards.
- No trash or debris from construction activities should be left on plant site. All the wastes are to be handled as per standard industry practices.
- Hazardous wastes like paints, waste lubricating oils etc should be handled as per Hazardous Wastes Handling rules. Hazardous materials such as diesel, lubrication oil and paint materials required at the site during construction activities should be stored as per accepted industrial safety norms.

6.2 Operations Phase

The operational phase commences after completion of debottlenecking and installation of CDR Plant at existing NFCL Complex. The following actions are considered in the EMP.

6.2.1 Commissioning Stage

- System integrity of all the facilities should be checked prior to change over of fuel/feed from naphtha to natural gas, and recovery of CO_2 from flue gases
- Safety checks for leakages from valves and flanges should be ensured prior to commencement of operations

- Pigging wastes/waste waters should be handled through necessary treatment prior to their disposal. The disposed wastes should comply with the standards
- Local population should be appraised about the project through public awareness programs.
- Contingency plans for emergencies like process failure and ruptures of NH_3 storage tank etc. is already existing. However, the revision in the existing emergency plan encompassing the proposed project charges will be done before commissioning.

6.2.2 Plant Operations Stage

EMP for routine operations should address mitigation measures on various components of environment. These are briefly addressed below:

6.2.2.1 Air Environment

Environmental management plan, incorporating short and long term measures is suggested for mitigation of adverse impacts due to fugitive emissions as also from point sources.

Fugitive Emissions

The main sources of fugitive emissions from the NFCL Complex includes, minor leaks from the process equipment viz., vessels, valves & pumps and the fugitive emissions from storage tanks. The NFCL terminal already has two Ammonia Storage tanks for a capacity of 5000 MT each and there is no new addition required. Other additional storage tanks for process chemicals will also be located in the site. In order to control fugitive emissions of Natural Gas from process leaks, a systematic plant preventive maintenance program is being practiced by NFCL and the same will be followed. With routine and periodic maintenance preventive maintenance philosophy, the sources of fugitives can be identified, controlled and minimized. Additionally, the existing green belt cover in and around the plant premises will also significantly reduce the impact of fugitive emissions.

Emissions form Point Sources

The major point sources of emissions from the industry are the emissions from stacks of reformers, urea prill tower and steam boilers during processing. Emissions of concern from the use of Natural Gas, in general, in the turbines and flares are sulphur dioxide and oxides of nitrogen. The Natural Gas being handled in the project contains traces of hydrogen sulfide, hence the presence of sulphur dioxide in the emissions is very minimal (2 ~ 3 ppm). Oxides of nitrogen which form in traces while burning the clean Natural Gas (with methane content approx. > 90 %) is the only pollutant which is also well below the prescribed limits. Another interesting process is de-dusting of urea prill tower emission to recover approx. 6 tons of urea, per day from each Prill tower. This drastically reduces suspended particulates matter in the ambient air. In the case of solid / hazardous wastes, the most common waste is lube oil and siliceous sludge. 40% of lube oil is being re-used in the plant and remaining 60% is sold to the authorized vendors. The sludge produced from the Raw-water pre-treatment is being utilized for filling low lying areas in the green belt.

6.2.2.2 Noise Environment

The machinery deployed in the plant should be designed with the sufficient noise and vibration controls for minimizing noise at source and purchased through reputed manufacturers and vendors.

Acoustic shields and other isolation walls to be provided around the units wherever possible.

Use of ear-muffs by workers and other protective devices in noise-prone areas are recommended.

Hearing conservation programmes should also be launched.

Enclosures to be provided around the noise generating sources wherever, it exceeds the prescribed limits.

As the proposed developments/modifications have minimum noise generation, and hence existing practices are sufficient.

6.2.2.3 Water Environment

Water requirement for plant operations will be met from river Godavari. The industry has authorization to use fresh water up to 40 000m^3 per day However, our daily consumption including the proposed projects will be around 25080 M^3 only. The treated effluent generated will be around 3953 M^3/day which will be fully utilized for green belt development. A schematic process flow-sheet for effluent treatment plant is shown in **Figure 2.5.** Conservation programs should be implemented for minimizing water use in the site. Rainwater harvesting schemes are already in force to recharge the ground water reservoirs

6.2.2.4 Land Environment

The project envisages no additional land requirement. The developed greenbelt / cover comprising of appropriately selected species of shrubs and trees. Possesses mini zoo status. The plantation in and around the plant and road sides, around waste treatment units are spread in an area of 789 acres. The green belt is existing in NFCL Complex is significantly reducing or mitigating adverse impacts due to gaseous pollutants, noise, odour and nuisance etc. Also, the same green cover/belt can serve as shelterbelts for farming areas, stabilise and improve soil permeability and aesthetic environment, even for proposed developments.

It is a known fact that when ammonia leaks from an atmospheric storage tank, initial flashing will be for about 0.2% of ammonia leaked compared at 20% from a pressure storage tank, thus the atmospheric storage tank of double integrity walls are used.

An exclusive refrigeration system has been provided for Ammonia Storage. The system keeps all the vapour condensed and recycles back to the tank so that there is absolutely no vapor coming out from tanks.

Emergency water curtain system has been provided around the tank to prevent escape of ammonia into atmosphere.

For any miner escape / release of ammonia from storage tanks will be let of by flaming only through a dedicated flare stack system existing.

6.2.2.5 Biological Environment

The treated and untreated wastewater should be subjected to bioassays tests using common fish and plankton at regular intervals.

6.2.2.6 Socio-economic Environment

Based on the observations, following measures are suggested so that there would exist a balanced situation wherein available resources would be used to the maximum extent for several useful activities without causing stress to the ecosystem as well as the human environment.

The EMP measures suggested for smooth functioning of the activities are given below:

- The facilities like education, medical, transportation are poor in rural area. This provision needs to be strengthened under social welfare activity
- The low economic status of local people is responsible for exploitation of forest for fire wood and its destruction. The ways to improve the earnings would be the best way to avoid local people's dependence on the forest / green belt.
- Taking into consideration the aspirations of local and regional people about the employment due to increasing activities, efforts should be made to provide employment by way of contract labour by providing different training schemes and scholarships to local vocational training institutes. Project authority should give due emphasis so that the to contractors should employ the local people first and then outsiders
- To remove unemployment problem, some schemes for self-employment in rural area should be launched.
- For all the social welfare activities to be undertaken by the project authorities, collaboration should be sought with the local administrations viz. Gram panchayat, Block development office etc. for better co-ordination and also to reach to the public

- Sanitation facilities in rural area are inadequate. The insanitary conditions cause health problems. As such it is necessary that activities like water supply and health checkup, rural education etc. should be taken.
- The medical facilities in the area are very poor. As such health camps for general health, eye check up, family planning, health awareness should be conducted for the rural people as being done new and the same should be strength end.

6.3 Post Project Environmental Monitoring

6.3.1 Air Environment

The ambient air quality monitoring network is recommended for NFCL Complex for monitoring variations in ground level concentrations. A weather station for wind speed, direction, temperature and rainfall is recommended to be installed within the plant premises.

The post project monitoring work can be carried out by NFCL on its own or by hiring services of competent agency. In case NFCL desires to carry out the post project monitoring by its own staff, the following equipments are recommended:

A. High Volume Sampler

Blower	:	1.5m^3/min capacity with adopter for uniform suction through filet
Voltage Stabilizer	:	A properly calibrated monometer assembly for the determination of flow rate through filter paper
Rotameter	:	Calibrated reotameter (0.1-2.0 liter/min) for maintaining flow rate for gaseous sampling
Main Housing	:	Rectangular main housing (29 cm x 36 cm)

B. SO_2 Analyser

Minimum Range	:	0-100 $\mu g/m^3$
Flow Rate	:	1 l/min
Min. Detectable Level	:	4 ppb
Response time	:	1 min

C. NO_x Analyzer

Minimum Range	:	0-100 $\mu g/m^3$
Min. Detectable	:	0-100 $\mu g/m^3$
Linearity	:	$\pm$ **%** full scale
Accuracy	:	$\pm$ 2 Full Scale
Response time	:	25 sec.
Output	:	0-15 mv DC

D. Gaseous Ammonia Monitor

E. Specific Ion Meter: For Fluoride monitoring

F. Stack Sampling Kit: For dust monitoring and accessories for monitoring all above gases

G. Weather Recording System: to monitor the following parameters -Wind speed, wind direction, dry bulb temperature, relative humidity and solar radiations.

Signal output should be electrically connected with microprocessor based data analyzer.

6.3.2 Noise Environment

Monitoring of noise levels is essential to assess the efficiency of maintenance schedules and noise protection measures undertaken to reduce noise levels.

A good quality sound level meter will be essential for this purpose. Audiometric tests are also helpful in monitoring the effectiveness of ear protection devices and of noise abatement programmes. The examination should be performed under the supervision of health officials.

Laboratory Facilities

NFCL should establish laboratory facilities and skilled personnel for post project monitoring. The recommended laboratory requirements from environmental monitoring point of view are given below:

An independent laboratory with facilities for chemical & biochemical analysis should be set up in plant premises, away from the process areas. The laboratory should have a provision for fume-hood and cold room. A separate air-conditioned dust-proof room will have to be provided for installing analytical instruments. Following instruments need to be incorporated:

Single Pan Balance	-	D.O. analyzer
pH Meter	-	B.O.D. Incubator
Conductivity Mete	-	Total Organic Carbon Analyzer
Turbidimeter	-	UV/VIS Spectorphotometer
Ion analyzer	-	IR Spectrophotometer
	-	Flame Photometer
	-	Hydrocarbon analyzer
	-	Atomic Absorption sepctrophotometer
	-	Gas Chromatograph

Sufficient funds should be allocated to maintain pollution monitoring systems and treatment facilities. It is an important to appoint Plant Manager/Safety & Environment Manager to be the designated responsible person for environmental issues.

6.4 Summary of Risks due to Existing Facilities

M/s KLG-TNO Safety Technology Ltd. has carried out risk analysis study for existing facilities at NFCL in 2000. The findings of the report are: (i) individual risk from all facilities is tolerable, as it is below the tolerance criterion of individual risk not to exceed 1.OE-5 per year in populated areas (ii) F-N curve of societal risk lies entirely within the ALARP (As Low As Reasonably Practicable) region. The maximum number of fatalities that may be expected is 70 for a frequency 9.9E-8 per year. A major leak in urea reactors (ER/R101) in Urea plant-I and II and a major leak in ammonia receivers (EV101/V101) in Urea plant-I and II solely contribute the societal risk and (iii) the PLL (Potential Loss of Life) due to all facilities is 4.55E-5 statistical fatalities per year.

Urea reactor contains large inventory of ammonia (30.8 MT) at very high temperature and pressure. Any potential major leak from the reactor will result in release of ammonia that gets air-borne in no time. Due to severe operating conditions, ammonia will behave as a neutral gas on release. Damage distance up to 1.5 km was calculated for stability class E and wind velocity of 2 m/s. The estimated failure frequency is 1E-5 per year. Catastrophic failure of pressure vessels containing ammonia is known to have occurred world-wide due to internal corrosion. Measures need to be taken to guard against stress corrosion cracking.

Liquid ammonia from ammonia plant enters the ammonia receiver in urea plant before being sent to urea reactor. The risk in ammonia receivers is due to a large inventory (40.8 MT) of liquid ammonia stored at pressurized conditions. Any potential major leak from the receiver will result in release of ammonia that gets air-borne in no time. Dame distance up to 1 km was calculated or stability class E and wind velocity of 2 m/s. These scenarios are dominant risk contributors, due to the large fatality distance and high release likelihood. Frequency analysis for the above scenarios indicates that the pump failure and the bottom line failure dominate the overall release likelihood. The generic frequency for centrifugal pump catastrophic failure from historical data is 1.0×10^{-4} yr^{-1}, a high frequency. Any potential major leak in the bottom line (70m) would release ammonia from ammonia receiver in no time and then ammonia at the pump rate till the leak is detected and isolated.

The safety management practices suggested in the report is (i) special attention in terms of inspection and maintenance, and safety management systems (ii) hazard and operability Study may be performed for at least the dominant risk contributors i.e. for urea reactor and ammonia receiver (iii) adequate number of ammonia leak detectors may be suitably located with means of prompt isolation.

The proposed projects are not envisaged any additional storage of ammonia and other chemicals. NFCL having a well documented onsite emergency preparedness plan, in case of any emergency listed in risk assessment report. Hence, the existing risk criteria will be considered and the suggested recommendations will be followed for risk and safety management.

6.5 Conclusion

It is pertinent to point out that the recommendations given above in EMP, are being practiced in respect of air, noise, water, land, biodiversity and social responsibility. **This is so because, NFCL is an Operating unit and the facilities to carryout the EMP are already available adequately.**