



क्षेत्रीय कार्यालय, उत्तर प्रदेश प्रदूषण नियंत्रण बोर्ड
REGIONAL OFFICE, U. P. POLLUTION CONTROL BOARD

दूरभाष / Ph. : 0532-2554121

आवास विकास परिषद कालोनी, सेक्टर-10, योजना संख्या-3, झुंसी, प्रयागराज - 221006

Avas Vikas Parishad Colony, Sector-10, Scheme No. 3, Jhansi, Prayagraj.

संदर्भ सं०... (500/114) / 2021-04/2021

दिनांक... 24/5/2021

To,

The Registrar,
The National Green Tribunal
Principal Bench,
New Delhi

E-Mail/Registered Post

E-Mail- judicial-ngt@gov.in & ngt.filling@gmail.com.

Subject:- Compliance of direction issued on dated 18-01-2021 by Hon'ble National Green Tribunal in Original Application No. 04/2021 w.r.t. News Item Published in Navbharat Times dated 24-12-2020 titled "Gas Leaks in IFFCO Plant, 2 Officer Dead"- reg.

Sir,

With reference to the subject mentioned above, this is to inform you that in compliance of order issued on 18-01-2021 by Hon'ble National Green Tribunal in Original Application No. 04/2021 w.r.t. News Item Published in Navbharat Times dated 24-12-2020 titled "Gas Leaks in IFFCO Plant, 2 Officer Dead"- reg.

The compliance report is submitted for your kind perusal and necessary action please.

Encl: As above.

Your Sincerely

(Pradeep Kumar Vishwakarma)
Regional Officer

24/05/21

Copy to:-

1. District Magistrate, Prayagraj for information.
2. Member Secretary, U.P. Pollution Control Board Lucknow for information.
3. Sri Pradeep Misra, Advocate Hon'ble Supreme Court/NGT, New Delhi for perusal and necessary action please.
4. Chief Law Officer, U.P. Pollution Control Board Lucknow for information.
5. Chief Environmental Officer (Circle-2), U.P. Pollution Control Board Lucknow for information.
6. SDM Phoolpur, Prayagraj.
7. Pro. Sri. Jitendra Bera, Co-ordinator Centre for Environment Science & Eng. IIT Kanpur.
8. Dr. A.K. Gupta, Additional Director/Scientists 'D' MOEF Regional Office, Kendriya Bhawan, Fifth Floor, Sector-H, Aliganj, Lucknow.
9. Sri. J.P. Meena, Scientists 'D' CPCB, Regional Director, Picup Bhawan, Gomti Nagar, Lucknow.

Regional Officer

OTC

24/05/21

**REPORT OF THE JOINT COMMITTEE IN THE
MATTER OF O.A 04 /2021**

REPORT OF THE JOINT COMMITTEE COMPRISING OF MINISTRY OF ENVIRONMENT, FORESTS AND CLIMATE CHANGE, CENTRAL POLLUTION CONTROL BOARD, UTTAR PRADESH POLLUTION CONTROL BOARD AND PROFESSOR J.K. BERA, INDIAN INSTITUTE OF TECHNOLOGY, KANPUR, SUB DIVISIONAL MAGISTRATE, PHULPUR, PRAYAGRAJ IN THE MATTER OF O.A NO. 04/2021 SUBMITTED TO HON'BLE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI IN COMPLIANCE TO HON'BLE NGT ORDER DATED JANUARY 18, 2021

Submitted to

HON'BLE NATIONAL GREEN TRIBUNAL,
PRINCIPAL BENCH, NEW DELHI

1. Preamble

Hon'ble National Green Tribunal Principal Bench in response to the accident occurred at M/s IFFCO Phulpur, Prayagraj on 22.12.2020 and based on the news item published in Hindi Daily "Nav Bharat Times" on 24.12.2020 which reported the news about "Gas leak in IFFCO Plant, 2 officers dead" took Suo-Moto case and registered an Application No. 04/2021. The Hon'ble NGT, vide order dated January 18, 2021 constituted a joint committee of five-Member Expert Committee comprising representatives of MoEF&CC, CPCB, State PCB, IIT Kanpur, and District Magistrate, Prayagraj to ascertain the sequence of events, persons responsible, extent of damage, steps to be taken for restoration and other remedial measures. The State PCB will be the nodal agency for coordination and compliance. The District Magistrate, Prayagraj may extend all logistic support for functioning of the Committee.

2. Order of the Hon'ble National Green Tribunal Dated 18.01.2021

On the pattern of earlier proceedings issue of several incidents involving failure of Industrial Safety norms and required payment of compensation to the victims apart from taking steps for restoring the environment and taking precautions for future. The Hon'ble NGT, vide order dated January 18, 2021 constituted a joint committee of five-Member Expert Committee comprising representatives of MoEF&CC, CPCB, State PCB, IIT Kanpur, and District Magistrate, Prayagraj to ascertain the sequence of events, persons responsible, extent of damage, steps to be taken for restoration and other remedial measures. The State PCB will be the nodal agency for coordination and compliance. The District Magistrate, Prayagraj may extend all logistic support for functioning of the Committee. In compliance to Hon'ble NGT order, committee comprising of following members was composed

1. Sh. Yuvraj Singh, SDM, Phulpur (representative of DM, Prayagraj)
2. Prof. Jitendra Bera, IIT Kanpur
3. Sh. J.P. Meena, Scientist-D, CPCB, Regional Directorate, Lucknow
4. Dr. A.K. Gupta, Scientist-D MoEF&CC Regional Office, Lucknow
5. Sh. Pradeep Kumar Vishwakarma, UPPCB, Regional Officer, Prayagraj

Accordingly, we constitute a five-Member Expert Committee comprising representatives of MoEF&CC, CPCB, State PCB, IIT Kanpur, and District Magistrate, Prayagraj. The State PCB will be the nodal agency for coordination and compliance. The District Magistrate, Prayagraj may extend all logistic support for functioning of the Committee. The Committee may meet physically or by video conferencing and may also undertake visit to the site and give its report on the following: -

3.0 Scope of the Committee:

The Committee has been vested with the mandate to visit and inspect the site in question and vested with following scope vide the Order dated 18.01.2021:

- a. The sequence of events
- b. Causes of failure and persons and authorities responsible therefor
- c. Extent of damage to life, human and non-human; public health; and environment – including, water, soil, air
- d. Steps to be taken for compensation to victims and restitution of damaged property and environment, including the land, soil, groundwater and surface water, and the cost involved
- e. Remedial measures to prevent recurrence
- f. Any other incidental or allied issues found relevant.

The Committee may also consider reports furnished in the above incidents, available with the CPCB. The Committee may particularly mention whether frequency of mock drills needs to be increased in the light of the incident in question. The Committee will be at liberty to associate any other expert or institution. The Committee may interact with all concerned stakeholders. The Committee may give its report within two months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

4.0 Site visit by the Joint Committee:

The Committee inspected M/s IFFCO, Phulpur on April 12, 2021 and interacted with industry officials, personnel who were present during the incident on December 22, 2020. At the time of inspection one committee member Dr. A K Gupta Additional Director/Scientist 'D' MOEF Regional office, Kendriya Bhawan, Fifth floor, Sector-H, Aliganj, Lucknow was not present due to suffering from fever as informed by him rest.

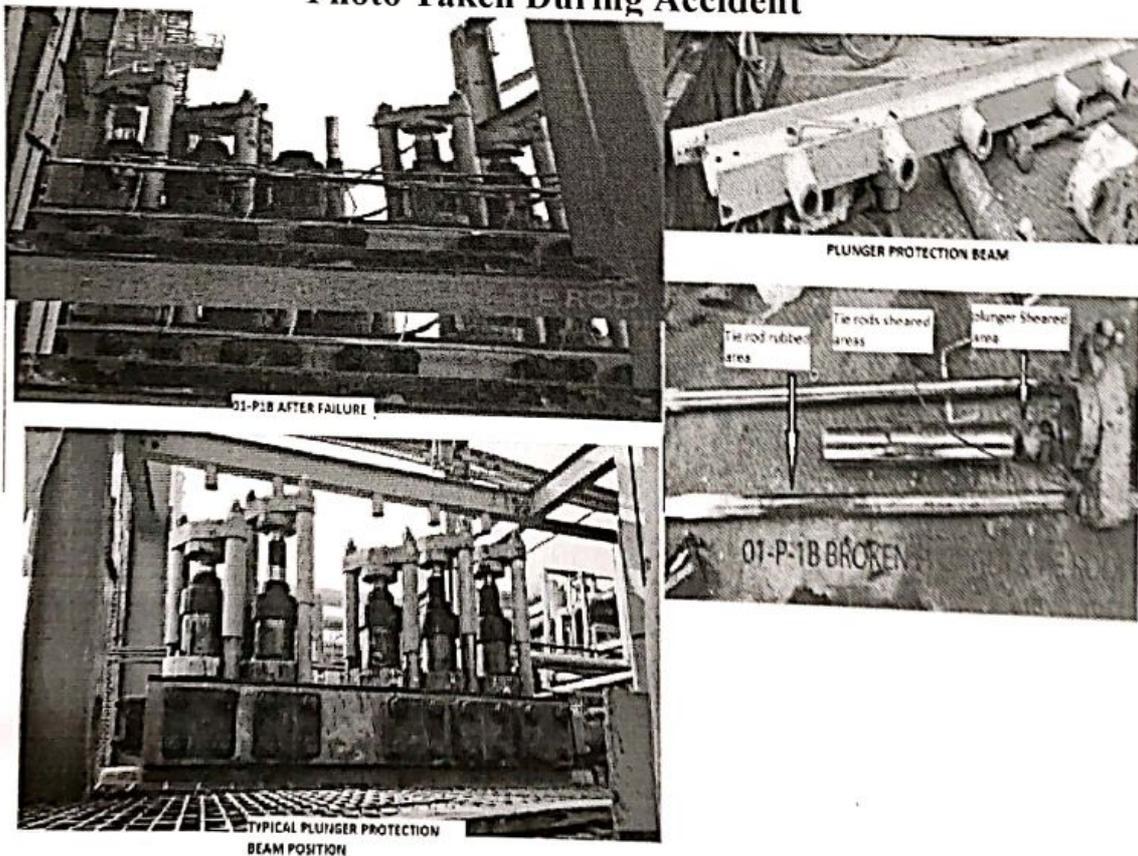
Committee members visited accident site -high pressure ammonia pump of Urea-I unit. In addition, members visited Control Panel and Fire and safety department to understand the response to the emergency situation in the plant premise. During the visit, the plant was found non-operational. In fact, the area was pristine and no reminiscence that such an accident of major level had happened. As reported by the unit head, the plant (unit-I) was shut down on 03/03/2021 for annual maintenance.

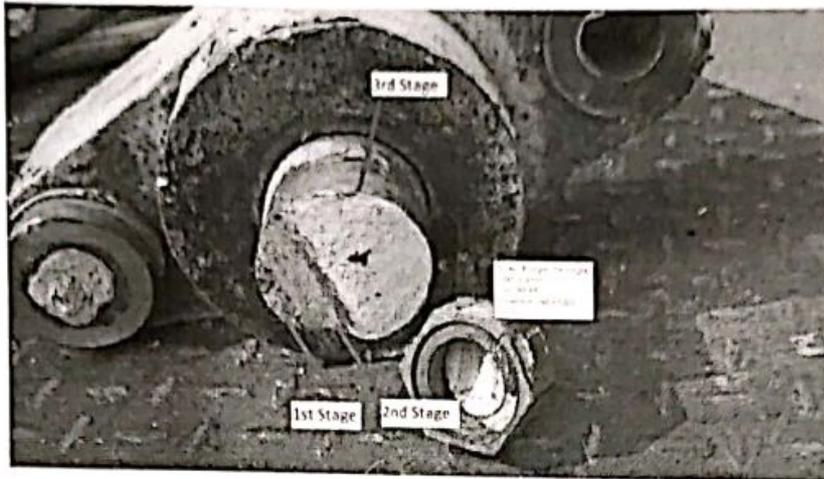
We got to know prior to our visit that another accident had happened at the same plant and there were fatalities. In fact, it was the same day that our visit was scheduled initially. Visiting these two sites in close proximity where two major accidents had happened within a few months is disheartening. The IFFCO authority must take a hard look on the overall safety aspects on the operation of this plant.

IFFCO Phulpur witnessed an incident of sudden release of high-pressure ammonia from HP Ammonia Pump (P-1B) in Urea-I plant on 22.12.2020. The release of liquid Ammonia resulted in the death of two employees. The leakage was caused by the failure of the Tie rods and Plunger

of High-Pressure Ammonia Pump (P-1B) of Urea-I plant with blow off of the plunger from barrel at IFFCO Phulpur unit at 22:14:41 hrs without giving any warning. HP Ammonia Pumps in Urea-I are vertical reciprocating pumps in operation since 1981. Its tie rods links bottom crosshead with upper crosshead and moves along with plunger / upper crosshead (bridge). Because of this reason, it is always under cyclic loading. The reason of the mechanical failure of P-1B pump is attributed to the failure of both tie rods and plunger because of experiencing continuous cyclic load / overload on uneven stress, when one of the tie rods failed due to fatigue. HP Ammonia Pumps have a history of tie rod failures. In order to safeguard against such type of failure, plunger protection beam was installed, which got blown up in this case. The plant was running steady at 107% load with all operating parameters in normal operating range before the failure incident. It was during the shift change time when the incident occurred. The severity of this emergency was such that the operating staff reported invisibility / impossibility to breathe condition in Urea -I plant and Control Room, which did not allow a single operator to perform actions suggested under SOP (Standard Operating Procedure) for such type of heavy ammonia leakage. The ammonia supply to P-1B could not be stopped and this led to a release of 73 MT of ammonia to atmosphere. The magnitude of ammonia leakage was so high that Urea-I plant entry was not possible until 23:50 hrs.

Photo Taken During Accident





Photograph 2

4.a Description of the Plant Operating Condition Preceding the Incident:

During the committee visit, the unit head informed that Plant was running normal load. Prior to the incident, the plant had been operating steadily and efficiently. All process conditions were 'normal' in the moments before the incident. No transient or unusual abnormal conditions were evident from any of the pump / machine. all pumps were running with 61.6 /62.6 /62.8 / 61.4 Ampere load and speed 100.4 / 102.8 / 100.3 RPM till 22:01:35 Hrs which was normal at this load. According to the information provided in the meeting with the IFFCO personals, all pumps were discharging properly as indicated by common discharge pressure which was running at 233.8 Kg/cm²g. The first deviation in process parameter, is observed at 22:01:40 Hrs that the speed of HP Ammonia Feed Pump P-1B is coming down. P-1B speed gradually came down to 79.7 RPM on 22:09:00 Hrs. Since along with the decrease in P-1B speed, common discharge pressure was also coming down, it clearly indicated speed actually coming down. It was an indication that there is something wrong with either the ammonia feed pump P-1B or its speed controller SIC-1B. In order to maintain the speed of P-1B, Control Panel Operator started increasing the speed signal. He increased the P-1B speed controller signal from 30% to 39.1%. Even after increasing the speed signal of P-1B, its speed continued coming down (73.5 RPM at 22:12:39).As it was the time of shift change over, Shift In-charge / Control Panel In-charge who had taken charge in "C" shift asked post operator Mr. Ghanshyam (who was the designated section in-charge of HP Pumps section in "C" shift) to check if there is any problem in Ammonia feed pump (P-1B).

At 22.14 PM, Urea plant control room heard a loud sound from the direction of Ammonia Feed Pump and there was instant white out – a very dense fog of ammonia droplet. Mr. V.P. Singh, Asst. Manager (Urea) was observing HP Ammonia feed pump P-1B at this point of time and could not escape. He was found examining the pump ("looking at the pump"), just few second before the incident. Mr. Ghanshyam had gone out of the control room towards the pump but returned immediately to the CCR after hearing the loud noise from P-1B pump and thick cloud of ammonia release from the pump.

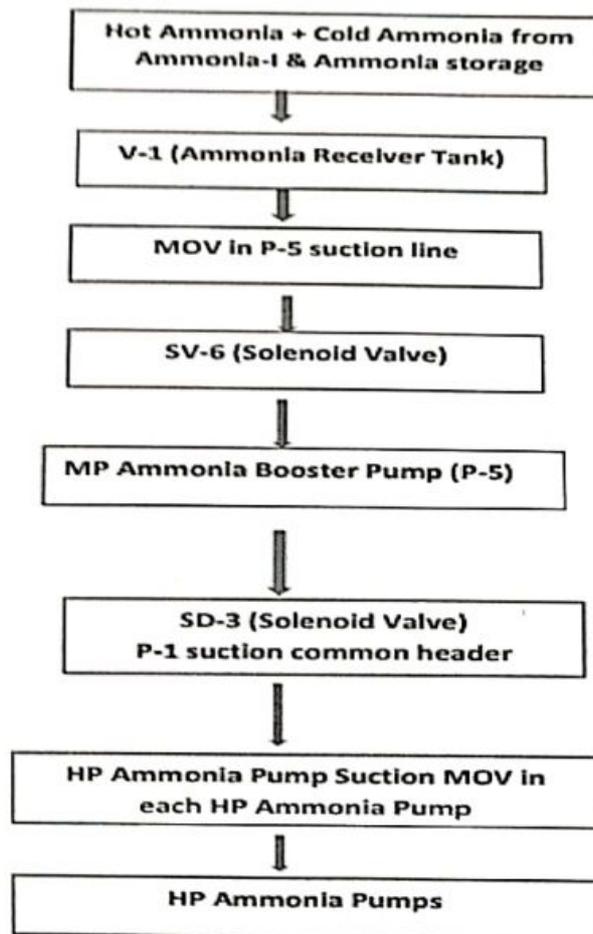
4.b Amount of Ammonia Released to Atmosphere: When the incidence took place at 22:14 Hrs, Urea plant was running normal at 107% load. Hourly ammonia consumptions rate was 54 MT/hr. At the time of incident, Ammonia receiver tank (V-1) level was 80.1%. As the volume of Ammonia receiver tank is 75 M³, it indicated 60 M³ of ammonia was stored in V-1. With the failure of HP ammonia pump P-1B tie rod & plunger entire ammonia receiver tank got connected to atmosphere through the opening create at the barrel of 3rd plunger. The ammonia release calculation report and fact of the ammonia release to atmosphere was provided by the unit, during visit.

Hot Ammonia from Ammonia-I (FR-25)		Cold Ammonia From Ammonia-I (FR3040)		Cold Ammonia from storage (FR-15)		Ammonia Receiver Tank	
Time	M.T	Time	M.T	Time	M.T	Time	M.T
22:14-22:29	5.77 M.T	22:14 - 23:13	22.23	22:14- 22:55	7.54	22:14-22:59	37.4
Total Ammonia Release: Ammonia in Ammonia Receiver Tank + Hot Ammonia to Urea-I till it was isolated + Cold ammonia from Ammonia-I till it was isolated+ Cold ammonia from Ammonia storage till it was isolated : 37.4 + 5.77 + 22.23 + 7.54 = 72.94 MT							

4.c AMMONIA LOOP FROM AMMONIA RECEIVER TO AMMONIA FEED PUMP

The unit is mainly receiving ammonia in urea plant of tank capacity 73 m³ through pipe line from main ammonia storage tank and it is stored (@ pressure 17 kg/cm²) in ammonia receiving tank of Urea plant. Further medium pressure ammonia is fed to high pressure ammonia pump (22-230 kg/cm²) to increase the pressure and fed to reactor for manufacturing the urea. As

informed, this high-pressure pump plunger and tie rod was broken a leakage of high pressure to atmosphere. During visit, the unit head reported about 72.94 Mt ammonia is released to atmosphere during accident.



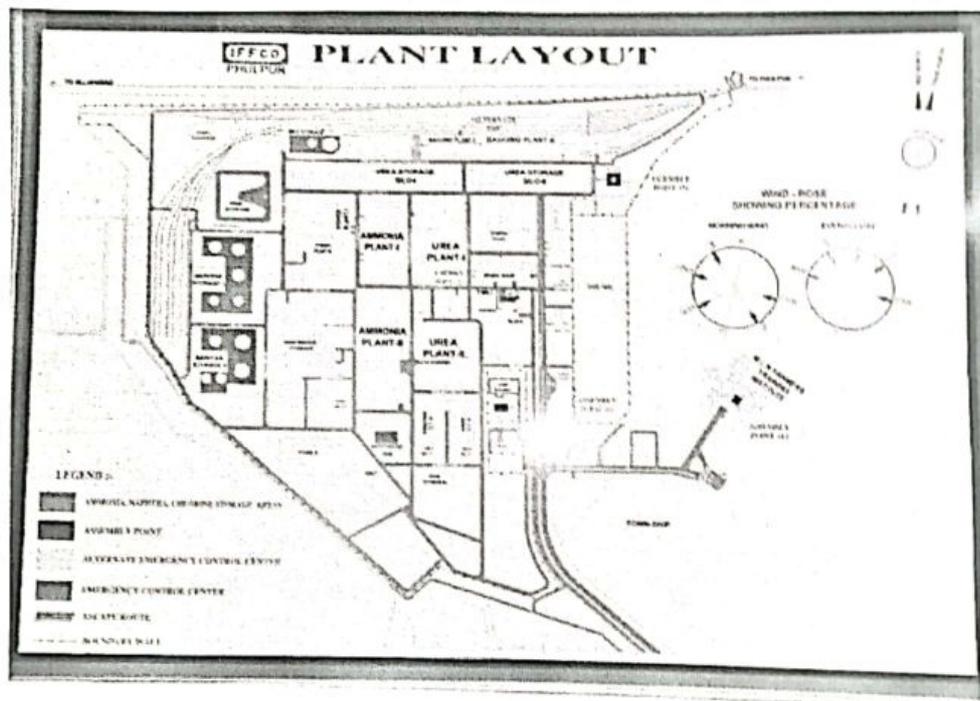
5.0 About M/s IFFCO, Phulpur

5.a General Information:

Indian Farmers Fertiliser Cooperative limited (IFFCO) is a leading producer and marketer of fertilizer in India. IFFCO-Phulpur Unit, a mega fertilizer Plant, has two state of the art Units engaged in manufacture of Urea. The site comprises of 1215 MTPD & 1740 MTPD Ammonia

Plants and 2115 MTPD & 3030 (1515 x 2) MTPD Urea Plants with other associated facilities, Unit-I was commissioned in the year 1981 and Unit-II was commissioned in the year 1997.

Both the Ammonia Plants are based on steam reforming Process. The Process Licensor of Ammonia-I Plant is M/s M W Kellogg, USA while the M/s HaldorTopsoe, Denmark is for Ammonia-II. Both Urea plants are based on Total recycle process for manufacture of Urea from Ammonia and Carbon dioxide, both available from Ammonia Plant. The Process Licensor of both Urea Plants is M/s Snamprogetti, Italy. M/s IFFCO is located at latitudes 25.5392°N; Longitudes 82°0502°E. The Kanpur -Varanasi Highway (Prayagraj Bypass) is 6 Km. approx. towards South- West from the IFFCO Phulpur.



The industry is surrounded by

North: Tissura, Dhokari, Ahiyapur, Dailapur and Sarai Abdul Malik

South: Bharauti, Ajehra, Pure Bhulai and Jafarpur Khurd

East: Beerkazi, Parasinpur and Sudi KaPura

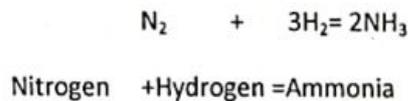
West: Mansi Khurd, Pali, Fazilapur and Chandauki

The industry has total of 1811 persons employed including 611 permanent workers and 1200 contract workers presently

All ammonia and urea plants are continuous operating plants and operated in three shifts of 8 hours, namely A-Shift starting from 06:00 AM to 02:00 PM, B-Shift starting from 02:00 PM to 10:00 PM and C-Shift starting from 10:00 PM to 06:00 AM.

5.b Production Process

Ammonia is produced using RLNG (Regasified Liquefied Natural Gas) as raw material. In the reforming section the RLNG is reformed with steam and air into process gas. The gas contains mainly of hydrogen, nitrogen, carbon monoxide (CO) and carbon dioxide (CO₂). In the shift section, CO is first converted into CO₂ and H₂ with steam (shift reaction), in order to facilitate the removal of the carbon oxides and to increase the H₂ content. The residual CO and CO₂ is converted into CH₄ using H₂, before the gas is sent to the ammonia synthesis loop. Pure synthesis gas from methanator is compressed by Turbine driven Synthesis Gas Compressor. Syn Gas is partially converted to Ammonia in Syn Gas Converter. Recycled gas (containing H₂ and N₂) leaving the synthesis converter re-joins the last stage of compressor. Ammonia Synthesis Reaction is as follows:

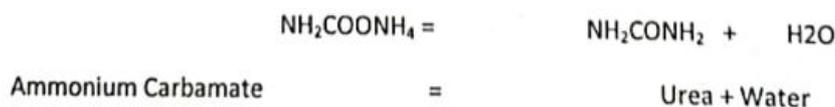
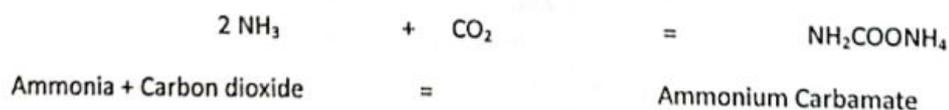


Product ammonia is recovered by cooling the compressor discharge stream in the series of Refrigeration Chillers where ammonia condenses. Liquid ammonia is purified by flashing at lower pressures and then sent to the urea plant or storage tanks.

5.c BRIEF PROCESS DESCRIPTION OF UREA PLANT:

Urea Plant is based on Snamprogetti's Ammonia-stripping process. CO₂ is compressed in a turbine driven, centrifugal compressor. In the Urea Reactor, ammonia reacts with CO₂ to form Ammonium Carbamate, a part of which dehydrates to Urea.

Urea Reaction is as follows:



Reaction products flow to a steam-heated stripper where most of the unreacted carbamate gets stripped off as gaseous ammonia and CO₂. In the high-pressure section, gases leaving the stripper are thoroughly mixed with the recovered carbamate from the medium pressure section and get condensed to ammonium carbamate in carbamate condensers. The heat of reaction is utilised to produce steam. The carbamate thus formed is recycled back to the reactor. Urea solution leaving the bottom of the stripper still contains some amount of carbamate. Purification of Urea takes place in the medium and low-pressure sections. Decomposition of carbamate takes place in the medium and low-pressure Decomposers. Ammonia and CO₂ present in the decomposed gases of medium and low-pressure sections are recovered in a series of condensers and absorbers. The solution leaves the low-pressure section at about 72 % concentration of urea. Vacuum concentrators are provided to concentrate the solution to 99.8 % in two stages. Urea melt from the concentration section is pumped to the top of the natural draft Prilling Tower and sprayed by means of rotating Prill Bucket. The fine droplets, while descending through the tower, come into contact with cold air and solidify to form prills. Product urea from the bottom of the Prill tower are sprayed with neem oil at conveyor belts to produce Neem coated Urea. After that final product Urea is sent to bagging plant for dispatch through rail and trucks. Traces of gases present in the condensate from Vacuum Section are removed in a distillation tower. Waste water from the bottom of the distillation tower is sent to the effluent system.

Major Raw Materials and Daily Consumption:

- ❖ R-LNG: 3.35 MMSCMD
- ❖ Coal: 350 MTPD
- ❖ Intermediate Product and Daily Output: Ammonia: 2955 MTPD (Ammonia is used as raw material for Urea Manufacturing)
- ❖ Final Product and Daily Output : Neem Coated Urea 5145 MTPD

6.0 Statutory Requirement:

All statutory requirements as per the respective Acts and Rules made there under of the concerned authorities. A brief assessment report of the same is as under:

S.No	Statutory Requirement	Status in Plant
1	Statutory requirements of MoEF&CC	IFFCO Phulpur has obtained EC from MoEF&CC vide Clearance Letter No.: J-11011/150/2006-IA. II(I) Dated 14.07.2006 for Capacity Enhancement/debottlenecking and LNG conversion project.
2	Statutory requirements of U.P. Pollution Control Board.	Air consent valid up 31/12/2021. - Water consent valid up 31/12/2021 Authorization under Hazardous Waste Rules 1989 (as amended) valid up to 23/07/2022

		Authorization under Bio-Medical Waste valid up to 07/02/2024.
3	Statutory requirements of U.P. Factories Rule- 1950	Factories license valid up to 31/12/2021.
4	Statutory requirements of U.P. Fire Prevention & Fire Safety Act Factories 2005	NOC from Fire Department obtained: Valid up to 06/10/2021
5	Statutory requirements of The Public Liability Insurance Rules, 1991	Public Liability Insurance valid up to 31/03/2021.
6	Statutory requirements of Petroleum & Explosives Safety Organization (PESO)	License No. G/CCUP/06/1069 (G18395) to store compressed gas in cylinders (Chlorine): Valid up to 30/09/2023. License No. S/HO/UP/03/520/(S41454) for Ammonia – II Nitrogen Vessel: Valid up to 30.09.2022 . License No. G/CC/UP/06/333 (G10325) to store compressed gas in cylinders (Nitrogen 100 nos., Calibration 10 nos., Argon 100 nos., Oxygen 100 nos., DA 60 nos. & Hydrogen 30 nos.): Valid up to 30/09/2029. - License No. P/HQ/UP/15/339(P7736) for HSD Tanks (P-I): Valid up to 31.12.2020. - License No. P/CC/UP/14/3175(P170299) for HSD Consumer Tank: Valid up to 31/12/2022.

7.0 SEQUENCE OF EVENTS IN PLANT

On 22.12.2020, an accident took place around 10:14 PM(Shift-C) at M/s IFFCO, Phulpur in which 2 officers died and 13 permanent employees of IFFCO along with three contractor workers were also exposed to Ammonia. They(the survivors) were sent for treatment and subsequently recovered after treatment apparently without any permanent disability. The sequence of events of the accident on 22.12.2020 are as follows:

Sequence of Event : IFFCO Phulpur Urea-I Ammonia Leakage Incidence

S.No.	Critical Event	Time	Remarks
	Date : 22.10.2020		
1	i. Plant running normal at 107% load. There was no change in plant operating load in C shift.	22:01:22	Normal
		22:01:35	
		22:01:37	
	ii. P-1B speed started coming down. No significant change in other Pump P-1A/ P-1C / P-1D speed no change. Initiation of first stage of plunger-tie rod failure. It started obstructing the movement of plunger.	22:01:40	
		22:01:43	
		22:01:44	
		22:03:01	
	iii. P-1B speed reduced indicating one of the tie rod sheared. (Full power not transferred). Other three pump (P-1A/C/D) running normal. Urea reactor & HP loop pressure normal.	22:03:56	The failure may be due to metal fatigue though such proposition must be proved inconclusively (there was no pre-indication of impending failure).
	iv. P-1B speed further reduced. P-1 common discharge pressure also coming down when other three pumps running at constant load. This indicates that P-1 is not delivering sufficient flow. Initiation of second stage of Tie rod / Plunger failure. Obstruction due to third plunger assembly moving in bent condition reduced the speed further.	22:05:39	Total load of fluid pumping power of 3rd plunger got shifted to another side tie rod. Complete top assembly got tilted and started running in bent condition. As there was obstruction in movement, speed came down.
		22:06:00	
		22:06:30	
		22:07:00	
		22:07:17	
		22:07:30	
		22:08:00	
		22:08:30	
		22:09:00	
		22:09:05	
	v. In order to increase the speed, instruction was given at Control Center to increase the speed, but the speed didn't improve to original RPM, probably because of the obstruction in pumps (one plunger moving in bent condition) .Other three pump (P-1A/C/D) running normal.	22:09:30	
		22:10:00	
		22:10:03	
	22:10:30		
	22:11:00		
	22:11:30		
	22:12:00		
	22:12:30		
	22:12:39		
vi. Initiation of third stage failure (break) of P-1B third plunger / other tie rod of third plunger. This shifted the power end load to other four plunger of the pump increasing the speed of pump.	22:12:50		
	22:13:00		

		22:13:10	
		22:13:22	
		22:13:30	
		22:13:34	
		22:13:45	
		22:13:55	
		22:14:00	
		22:14:05	
	vi. P-1B speed suddenly increased from 73 to 99.2 rpm indicating other tie rod and plunger failure but was still kept in position by plunger protection beam. Ammonia leakage started.	22:14:17	Due to uneven extra load and pump running in bend condition, both plunger and tie rod got sheared simultaneously.
	vii. P-1B speed increased to 144.6 rpm whereas its load reduced to 58 Amp. During the same time Booster pump P-5A load increased to 76 Amp. This indicates P-1B plunger blown away along with tie rods and ammonia leakage to atmosphere. Huge ammonia leakage.	22:14:30	Loud noise with dense Ammonia fog. As both tie rods and plunger had broken, upper crosshead was in free condition now fallen towards P-1C side and broken plunger came out of barrel releasing high pressure ammonia to atmosphere.
		22:14:33	
	viii. P-1B tripped from control room	22:14:41	
		22:14:50	
	Ammonia Receiver Tank level	22:14:33	80.40%
2	P-1B high speed	22:14:33	
3	P-1B tripped	22:14:41	
	P-1C tripped	22:15:47	
	P-1A tripped	22:15:41	
	P-1D tripped	22:15:47	
4	I-2 (HP loop trip) taken	22:15:47	
5	CO2 to R-1 control valve closed	22:16:19	
6	K-3 (Passivation Air Compressor)	22:15:48	
7	P-2C tripped	22:15:15	
8	P-2B tripped	22:16:04	
	P-2A tripped	22:16:10	
9	CO2 Compressor tripped (from 505E)	22:17:22	
10	KS to TK-1 (CO2 compressor turbine) MOV closed	22:17:24	
	Extraction MOV closed	22:17:24	
	MS to E-2 closed	22:17:24	
	Incident reported to Plant Incharge by Shift Incharge	22:17:00	
11	Hot Ammonia to V-1 stopped	22:28:40	
	Cold Ammonia to V-1 from Ammonia Storage stopped	22:54:56	
	Ammonia Receiver Tank level	22:59:13	0%
No action in field or control room because of extremely dense ammonia fog in field & control room			
11	SD-3V closed (in Ammonia booster pump P-5 discharge & Ammonia Feed Pump common suction line)	23:26:04	Mr. V.K.Shukla, Sr. Manager(Urea) reached inside Urea-I CCR with BA set.

12	SD-6V closed (In Ammonia booster pump P-5 common suction. It will isolate pumps from Ammonia Receiver Tank V-1)	23:26:07	
13	Ammonia booster pump (P-5B) trip	23:26:17	Could not stay more than 1 minute
No action in field or control room because of extremely dense ammonia fog in field & control room			
14	Ammonia leakage stopped	23:50:00	
15	Plant entry possible	After 23:50:00	It was found that the HP Ammonia Feed Pump P-1B, third plunger along with both tie rods were ejected from the barrel. Third barrel was found empty without plunger, plunger holding (bridge) and its protection beam.
16	MOV in P-1A/B/C/D individual suction line closed		
Date :24.12.2020			
17	HP loop draining started	20:00	

7.a Immediate Measures taken by IFFCO, Phulpur

After receiving the call at 22:14 PM in Fire and Safety control room, Fire tender UP70-CT-1459 left for Urea-I plant via the shortest route, via main canteen side at 22:15 PM.

After assessing the situation, second fire tender UP70-HT-7422 left Fire station immediately from the opposite direction i.e., from bagging side at 22:16 PM.

Ammonia Cloud dilution operation started immediately on reaching the site at 22:18 PM. To dilute the cloud, 3 nos. of Fire hydrant, 1 no. of fixed monitor, Monitor of Fire tender UP70-HT-7422 were operated from Bagging side. 3 spray nozzles were operated from Urea-I Neem oil tank side.

Emergency Siren sounded at 22:25 PM

At 22: 30 PM, Quick Response Team consisting of one Security Supervisor and 9 Security Guards reported at site.

Situation was controlled and All Clear Siren sounded at 23:55 PM. Rescue operation was carried out by Fire and Safety team along with Quick Response Team.

13 employees of Emergency Response Group were present within the plant premises and were involved in rescue operations.

12 Breathing Apparatus (BA) set, 15 ELSA set and one Airline Trolley were used for the purpose of rescue operation.

7.b Immediate Measure Taken by IFFCO Medical Care Facility

22:15 PM: Pharmacist at Occupational Health Centre (OHC) received call from Ammonia-I control room regarding Ammonia leakage and people getting affected. He immediately intimated Township hospital for deputing the ambulances. He also intimated CMO and Dy. CMO of township hospital.

22:20 PM: CMO and Dy. CMO were informed by Pharmacist at OHC.

22:25 PM: First affected person was brought at IFFCO hospital. Subsequently as the rescue operation progressed, total of 18 persons were brought to hospital. Last affected person brought to hospital at 22:45 PM.

Considering the situation of affected persons, some of them were shifted to hospitals at Prayagraj.

Two employees Mr. VP Singh - Assistant Manager (Urea) and Shri Abhay Nandan - Deputy Manager (Offsites) lost their lives due to excessive exposure to Ammonia.

Shri VP Singh departed from Township hospital at 23:45 PM and reached Haridaya Hospital, Prayagraj at 24:20 AM on 23rd December 2020. Shri Abhay Nandan departed Township hospital at 23:55 PM and reached at Haridaya Hospital at 01:00 AM on 23rd December 2020. Both were declared dead at 01:30 AM on 23rd December 2020 at Haridaya Hospital, Prayagraj.

13 permanent employees of IFFCO along with three contractor workers were also exposed to Ammonia. They were sent for treatment and subsequently recovered after treatment without any disability.

7.c Immediate measures taken by the Local Administration, District Magistrate, Prayagraj

After assessing the situation, DM(Prayagraj) was informed at 10:50 PM.

At 11:15 PM, SDM and SP(RA) arrived at IFFCO Phulpur site.

At 11:45 PM, ADM (Finance) arrived at site.

8 nos. of Government Ambulances reached at site between 11:45 PM and 12:30 AM on 23rd December 2020.

05:05 AM: on 23rd December 2020 NDRF team arrived at site.

10:00 AM: on 23rd December 2020 representative from UP Pollution Control Board, Prayagraj, visited the site.

10:30 AM: on 23rd December 2020 Information was given to Director of Factories.

01:00 PM: on 23rd December 2020, Assistant Director of Factories reached at site. At 10:30 PM on 23rd December 2020 Director of Factories reached at site. Team from Director of Factories departed on 25th December 2020 after complete investigation of the incident.

Action to be Taken UPPCB Regional Office, Prayagraj:

UPPCB officials carried out inspection on 23/12/2020 after accident and submitted report. No action taken by UPPCB against the unit. UPPCB official neither monitored in and around ambient ammonia concentration monitoring nor taken samples of the ammonia dilution water effluent and soil accident location to assess the concentrations release into environment, during spillage of ammonia accident. On the day of inspection, UPPCB was observed that the unit-I was found non-operational.

8.0 CAUSE OF FAILURE AND PERSON AND AUTHORITIES RESPONSIBLE THEREFORE

CAUSE OF ACCIDENT

The accident occurred due to sudden failure of both the tie rods of the 3rd plunger of HP Ammonia Pump (P-1B) of Urea-I Plant at 10:14 PM on 22.12.2020. Subsequent failure of plunger leading to release of high-pressure ammonia to the atmosphere occurred. The effects of accident were restricted within the limits of plant and the leaked ammonia did not move to the surroundings or nearby village population. Although the effect of ammonia was evident in trees around the accident site. Apparently, as were informed, the water was found contaminated, but that has improved now. There was no pre-indication of any impending failure of HP Ammonia Feed Pump (P-1B) before 22:03 Hrs. The two employees lost their life in this incident. The reason for their death was their being engulfed by Ammonia when HP Ammonia Pump P-1B failed with 3rd plunger blown away.

It must be noted that an internal investigation team was constituted of very senior technical officers to find the cause of failure and to suggest improvement in the system to avoid similar occurrence in future. As reported by the unit head, some suspected employees/officers present during the accident were suspended. Since it is a serious matter, further investigation is needed. And it is better if an external agency is involved with specific objectives of finding out the persons responsible.

9.b Compliance of the Unit with SOP for Operating Ammonia Storage:

During the visit, the committee observed that the unit had SOP of ammonia storage, ammonia receiving tank and all Pump assembly etc as per the guidelines.

As reported, Breathing Apparatus (BA sets) / on line masks were not used in Urea-1 CCR, wherein online ammonia masks were firmly used by two Ammonia-1 CCR panel operators and 03 Urea-2 panel operators and they kept Ammonia-1 and Urea-2 plant running, though it was also engulfed in ammonia cloud. They averted further aggravation of this emergency.

Water curtain given for control room and HP pump area in Urea-1 plant could not function because its isolation valve was closed in the field.

Urea-I CCR Air-conditioner could not be stopped from CCR at the time of heavy ammonia leakage. It came into notice that AC trip switch was there in CCR earlier but it was removed to carry out certain modification in the CCR and was not re-installed.

During visit, it was informed to the committee that Urea-1 CCR control room double door sealing did not work perfectly

Urea-I has no automatic trip action which separate HP ammonia feed pump (P-1) from the main ammonia source in Urea Plant - Ammonia Receiver Tank (V-1). This pump has a history of tie rod failure. In order to safeguard, each HP Ammonia Pump has been provided with plunger protection beam. Too many actions were taken from the Urea-1 CCR but action which could have contained the ammonia / disconnected P-1B from main source Ammonia Receiver Tank, was not taken at the time of heavy ammonia leak i.e. closure of suction MOV of P-1B pump from CCR. Standard Operating Procedure for this type incident (SOP for HP Ammonia Pump Major Leakage was not found satisfactory in place). This SOP must be reviewed and a reliable SOP must be established to handle such type of emergency.

During the visit, it was informed to the committee that the leakage took place at the time of shift change. On control panel, there was only one operator in "B" shift and other panel post was vacant since the operator was on leave. "B" shift panel operator got relieved from one "C" shift panel operator and the other panel operator could not reach CCR in time before the leak since he comes from Allahabad and was walking from plant gate to Urea-1 plant. He was not to relieve anybody since Panel-2 post was vacant in "B" shift.

It should be noted that many of the operating staffs reside in Allahabad which require almost an hour of travel from the city. This may lead to a situation where several units remain 'unmanned' for a significant time during shift-change. It was actually the case on the date of accident.

Operational Negligence, less manpower, Lack of Standard Operating Procedures (SOPs), no auto cut-off valve, are the causes for accident. The employees and Management of the unit, both are responsible for the accident. The immediate trigger to the accident was improper installation at

CCR (not in compliance with instrument manual) which lead continues release of ammonia to atmosphere.

During visit, Committee observed that the unit installed manual on/off valve to stop the ammonia fed into the higher-pressure pump, but there were no alarm system to alert the staff on critical operational parameters. The unit has not installed ammonia sensor to assess the leak of ammonia. Committee also visited the distributed control system (DCS) of the same system and observed that the unit has not provided master auto lock tripping system of the Ammonia Booster pumps, which feed to the HP ammonia feed pumps directly from the control room. The unit has not prepared separate safety manual for the equipment along with the accidental management plan.

There had been history of breakage (malfunction) of Tie rod. It was noted by the staff and appropriate action was taken to contain the massive ammonia leakage. This time, for reasons that are not clear at this point, the whole system (Tie rods, Plunger and the Safety bridge) blew off that resulted in release of high-pressured ammonia. However, the situation could not be contained which caused the death of two persons and ammonia gas exposure to several personals. The complete lack of containment and the resulting fatality is likely due to many reasons –

1. The Control Center is too close to the accident site and the ammonia entered the Control Center fast that made decision making and execution inside the Control room impossible;
2. The plant is not set up to shut-off ammonia by a single-switch. The shutdown protocols appear to be complex. There is no evidence that regular drills were conducted to familiarize the Control Room operators with the shut-down procedures
2. Many of the safety procedures that were meant to isolate the Control room were not functional/did not work;
3. Too few personals inside the Control Room to manage and contain the situation;
4. It didn't appear that personals inside the Control Room at the time of the accident or the ones who could enter the Control Room after the ammonia gas had subsided were fully aware of the safety issues and the safety apparatus available or their use.

9.c Qualification & Experience of Deceased/ Injured Employees:

Eighteen employees were present at the time of accident on 22.12.2020, 2 IFFCO officers and 13 permanent employees IFFCO along with three contractor workers were present at the spot of accident ammonia leakage. Two officers Mr. VP Singh - Assistant Manager (Urea) and Shri Abhay Nandan-Deputy Manager (Off sites) have lost their lives due to excessive exposure to Ammonia. 13 permanent employees of IFFCO along with three contractor workers were also

exposed to Ammonia. They were sent for treatment and subsequently recovered after treatment without any disability. The qualification, designation, experience of these eighteen employees is given in below Table

S.No.	EMP. Code	Name of the Employee	D-O-B	Date of Joining	Designation	Educational Qualification	No. of years experience in Unit
1	109346	DHARM VIR SINGH	02-01-81	11.08.1999	SrOptr(Amm) Gr I	B. Sc.	21 years 8 Months
2	106947	AJEET KUSHVAHA	24-05-76	14.02.1999	Dy.Mgr.(Ammonia)	B. Sc.	22 years 2 Months
3	106589	RAKESH KUMAR	16-01-68	08.09.1994	Dy.Mgr.(Ammonia)	B. Tech. (Mech.)	21 years 7 Months
4	106955	A K KAITHWAS	15-03-76	23.02.1999	Dy. Mgr.(Inst)	Dip. (Electronics)	22 years 1 Month
5	106975	SHIV PARASAN RAM	15-07-74	16.04.1999	Dy.Mgr.(Ammonia)	B. Sc.	22 years 0 Months
6	106939	KASHI SINGH YADAV	06-07-72	14.02.1999	Dy. Mgr.(Urea)	M. Sc.	22 years 2 Months
7	106489	BALWAN SINGH YADAV	31-03-70	12.12.1992	Ch. Optr(O/S) Gr II	Inter Sc.	21 years 4 Months
8	106921	V P SINGH	20-03-73	28.09.1998	Asstt.Mgr.(Urea)	M. Sc.	22 years 2 Months
9	105726	ABHAY NANDAN KUMAR	05-07-63	06.11.1988	Dy.Mgr.(O/S)P SG	B. Sc.	Joined Phulpur on 02/11/2015. Experience in present Unit 05 years 1 month.
10	107028	CHANDRA SHEKHAR YADAV	15-07-75	23.07.1999	Asstt.Mgr. (Amm.)	B. Sc.	21 years 8 Months
11	106171	R R VISHWAKARMA	01-01-69	17.04.1990	Sr. Mgr.(Urea)	B. Tech. (Mech.)	31 years 0 Months
12	106447	NARAYAN DAS	05-01-69	30.06.1992	Sr.Mgr.(Amm.)	M. Sc.	28 years 9 Months
13	107016	NARENDRA YADAV	03-07-73	23.07.1999	Dy.Mgr.(Ammonia)	AMIChe	21 years 8 Months
14	106393	P C DIWAKAR	28-09-68	30.06.1991	Dy.Mgr.(Urea)	B. Sc.	29 years 9 Months
15	106949	GAURANG SINHA	16-12-73	15.02.1999	Dy.Mgr.(Urea)	B. Sc.	22 years 2 Months
16	NIL	AJAY YADAV, Contractor Labour	06-08-90	16.11.2018	M/s LKL CONSTRUCTIONS, Phulpur, Allahabad	Skilled Worker	2 years 5 Months
17	NIL	LALJI YADAV, Contractor Labour	01-01-76	01.05.2019	M/s Mazdoor Enterprises, Phulpur,	Unskilled Worker	1 year 11 Months

					Allahabad		
18	NIL	HARISH CHANDRA, Contractor Labour	05-12-77	01.04.2019	M/s Mazdoor Enterprises, Phulpur, Allahabad	Unskilled Worker	2 years 0 Months

From the qualification, experience of the employees and by interaction with these employees, the committee is of the opinion that the unit had employed qualified staff and were also experienced. The committee suggests that the plant management shall depute experienced manpower at critical operation location and also suggest high risk allowance to the engaged these locations.

10. EXTENT OF DAMAGE TO LIFE, HUMAN AND NON-HUMAN; PUBLIC HEALTH; AND ENVIRONMENT – INCLUDING, WATER, SOIL, AIR

The details of the casualties & damage as reported by the unit head that during accident, 2 IFFCO officer and 13 permanent employees IFFCO along with three contractor workers were present at the time of accident ammonia leakage. Two officers Mr. VP Singh - Assistant Manager (Urea) and Shri Abhay Nandan-Deputy Manager (Offsites) have lost their lives due to excessive exposure to Ammonia.

13 permanent employees of IFFCO along with three contractor workers were also exposed to Ammonia. They were sent for treatment and subsequently recovered after treatment without any disability.

10.a Loss of Vegetation: The committee did not observe any physical damage or damage to properties/ vegetation during the visit. During inspection, burnt trees were not observed. As reported by the unit representative that some leaves of plants burnt but a few days after these are survived. the committee has suggested to the unit for developing green belt at Urea-1 plant open space which minimized the spreading of the gases. During visit, no soil contamination was observed that these areas having concrete floor.

10.b Public Health: During committee visit, was not interacted with local villagers surrounding the plant villages due CoVID-19 pandemic situation. However, local administration Sub Divisional Magistrate (SDM), Phulpur also member of the Committee informed that no ammonia exposure to the surrounding village, during the accident. Further the unit head reported the calm wind velocity and low temperature due to the exposure of the ammonia was confined this area and no dispersion of the pollutant outside of the plant area. During committee visit observed that the unit has developed dense green belt around the plant premise.

10.c Environment

As reported by the unit head, the sudden release of liquid ammonia to atmosphere which was restricted to the confined area by providing water curtain within the plant premises. During committee visit reported that water spraying the ammonia gas dissolved in water and thereby the impact was minimized. As informed that Ammonical water is blocked into the all-storm water drains and then sent to ETP (guard pond) for treatment. As reported by the unit head about two times of water required to dilution & dispersion of the ammonia gas.

During visit, as informed by the unit representative that, five manual ambient air quality monitoring stations have been already setup in consultation with UPPCB at locations suggested by Regional Officer, UPPCB, Allahabad. Ambient air quality monitoring data (PM-10 & 2.5, NH₃, SO₂, NOX) is submitted monthly to UPPCB, Lucknow & Regional Office, MoEF&CC, Lucknow. All values are within limit. The unit has installed hand pump near the Chromium sludge disposal pit and Guard Pond area to monitor the ground water quality. Ground water monitoring is done on monthly basis and reported all are within norms.

During committee visit, the unit has provided the self-monitoring report of the air, water, ground water which indicates there was not significant change in the surrounding environment due to spillage of the ammonia.

11. STEPS TO BE TAKEN FOR COMPENSATION TO VICTIMS AND RESTITUTION OF DAMAGED PROPERTY AND ENVIRONMENT, INCLUDING THE LAND, SOIL, GROUNDWATER AND SURFACE WATER, AND THE COST INVOLVED

11.a Compensation of the Deceased Employees: That details of casualties & damage as per the official record two experience officers of IFFCO Mr. VP Singh - Assistant Manager (Urea) and Shri Abhay Nandan-Deputy Manager (Off sites) have lost their lives due to excessive exposure to Ammonia. The IFFCO has paid compensation on account of death amount of Rs 1,64,16,271.81 to Mrs. Meera Devi W/o Late Abhay Nandan Kumar and amount of Rs 1,38,12,109.86 to Mrs. Vimlesh W/o of late VP Singh. And other financial aid for the deceased employee. The compensation detail provided by the unit is presented below in tabular

STATUARY PAYMENTS & COMPENSATION ON ACCOUNT OF DEATH			
Sr. No	Head of Payment	Mrs. Meera Devi W/o Late Abhay Singh Nandan Kumar	Mrs. Vimlesh W/o Late V.P Singh
	Years of service performed	35 years 01 month 18 days	22 years 09 months 27 days
		Rs	Rs
1.	Provident Fund	7713382.00	4944812.00
2.	Gratuity	2865365.00	1941061.00
3.	Benevolent Trust Insurance	200000.00	200000.00
4.	LIFE insurance (Rs 200000)	200000.00	200000.00
5.	GPA Insurance	1946250.00	1788750.00
6.	Superannuation Fund Insurance	500000.00	500000.00

7.	Superannuation Fund Corpus	938682.81	570707.86
8.	HBL if taken, waived off (Covered under HBL Insurance of IFFCO members)	0.00	1870745.00
9.	EI Encashment and Shift allowance if any after deduction of any Loan (Conveyance/ Education /Salary Advance)	1452592.00	1196034.00
10.	EDLI	600000	600000
11.	Total	16416271.81	13812109.86
In addition to above there will be other Heads in Full & Final Settlement			
1.	Widow Pension of Rs. 10000 per month from Benevolent Trust (84 months or Date of Retirement whichever is earlier.	31 months	84 months
2.	Medical Card for hospitalization (10 laks per annum)		
3.	Productivity incentive for FY 2020-2021		
4.	Employment to one family member on compassionate grounds.		
5.	Superannuation Pension fund corpus and interest for FY 2020-2021		
6.	Widow and children pension from EPFO		

Financial Aid: As per the Group Personal Accident policy which covers the employees 24 / 7 irrespective of occurrence of place of accident. The Policy premium is completely borne by IFFCO.

Compassionate Employment: As a special case one family member of each of the deceased employees is being offered permanent employment in IFFCO, as informed by the unit head

For Injured Employees

- ❖ As reported by the unit head, the cost of treatment has borne by IFFCO and they will be getting up to Rs 6000 per week.

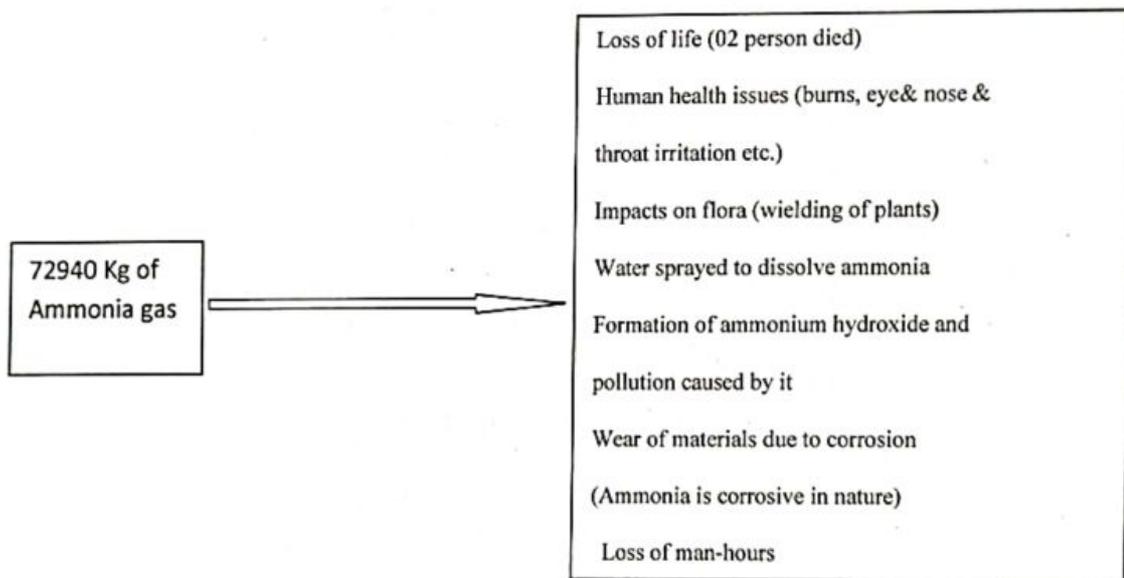
For Contractor's Labours :

- ❖ Three (3) contractor labours who were injured in the gas leak incidence of 22.12.2020 were hospitalised for less than 48 hours. Their hospitalisation bills were borne by IFFCO. Additionally, they were granted special leave with wages for the period of their absence from duty.

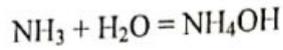
During visit, committee opinion that the expenditure incurred for injured employees and contractual labour (13+3) towards testing and monitoring shall be completely borne by the unit. The six-monthly health reports of these (13 Employees +3 Contractual Labour) shall be submitted to district administration. Further the health profile of the employees may be reviewed annually by a Government Doctor.

11.b Valuation of environmental damages due to Ammonia release:

The damage caused and the level of impact due to ammonia release is expressed in monetary terms by the committee which is one of the ways by which the scale of impact can be communicated. In order to quantify the impacts in monetary terms, it is essential to understand the mechanism by which the impact happens. The impact pathway reveals, how emitted pollutants lead to different adverse outcomes on human wellbeing and other natural environment. The committee has used both market price method and opportunist cost method to express the damage in monetary terms.



For valuation of NH_3 , UK-Department for Environment, Food and Rural Affairs (Defra) values have been taken for calculating the monetary value of damages. UK-defra values are converted into Indian values using suitable conversions. The Indian values per tonne of emission hence arrived are used for valuation of damages.



- ❖ 17 g NH₃ reacts with 18 g of H₂O to give 35 g of ammonium hydroxide.

But the solubility of ammonia gas in water is 31% w/w at 25°C.

- ❖ 1 g of ammonia needs: 2.226 ml of water.
- ❖ 72940 Kgs of ammonia = 162364.44 litres of water = 233852.74 litres of ammonium hydroxide is formed as per stoichiometry.
- ❖ Actual water sprayed to dissolve and control the situation is likely to be double the stoichiometric requirement = 324728.88 Lts. The excess water so used shall dilute the NH₄OH so formed.

Valuation of environmental damages due to ammonia release	=	Pricing of 72940 Kg Ammonia released
	=	a *
	=	874 INR/kg x 72940 kg
	=	63767795
	=	6,37,67795/- is pricing for impact to environment excluding compensation to injured and deceased Rupees Six crore thirty-seven lacs sixty seven thousand seven hundred ninety five only
a *	=	UK-Defra lower values are adopted considering nature of impact = € 10 / Kg of ammonia = €10 X INR exchange rate + inflation rate in 2020 = 10 X 84.6028 + 10 X 84.6028*3.34/100 = 874 INR/Kg of ammonia using Ref: Environmental Prices Handbook, EU28 version published in October, 2018. https://www.cedelft.eu/en/publications/2191/environmental-prices-handbook-eu28-version Ref : Report of the Joint Committee in the matter of OA No. 107/2020 (PB) was accepted by the Hon'ble NGT

12. Suggestions for Restoration of Environment:

1. The committee did not observe any physical damage or damage to properties/ vegetation during the visit. As reported by the unit head detailed investigation of failure is being taken up in consultation with M/s PDIL, M/s Rotodyne Engineering and M/s Deep Metallurgical Laboratories. These following works were made carried out after accident informed the Unit -I Plant was in shut down 13 days from 22/12/2020 to 04/01/2021. After Unit-I plant was restarted on 5th Jan.-2021.

2. The quantity of ammonia sensors has been increased from one nos. to two nos. in HP Ammonia Pump area.
3. An interlock has been provided to ensure shut off of motorized isolation valve at suction of HP ammonia pump when pump trips.
4. Artificial intelligence-based sensors have been provided in all plungers of HP Ammonia Pump to predict any propagation of crack/ fracture in tie rods and plunger.
5. Central air conditioning system tripping switch has been provided in the control room itself.
6. Water curtain testing frequency has been increased from fortnightly to weekly.
7. After the repair work is completed, it shall be verified by a strength pressure test followed by a tightness test and leak test.
8. Additional plate along with proximity sensors should be fixed upon the bottom portion of the plunger protection beam These proximity sensors indications may be provided on DCS / ESD for regular monitoring through WIFI / instrument cable. These proximity sensors shall read the gap displacement between upper crosshead and plunger protection beam. Alarm received from these sensors is proposed to be included in the trip interlock of HP Ammonia Pump to stop the pump and close the MOV at the suction.
9. A schedule for replacement of Side rods (Tie rods) and Plunger must be made based on past failures and recommendations of OEM. Before Changing of material of any parts of the pump, consent for suitability must be taken from OEM.
10. All other reciprocating pumps shall be examined and reviewed against the possibility of loss of mechanical containment.
11. Complete record of hazardous equipment (formal inspection report / maintenance work report / failure report) shall be maintained and reviewed periodically for predictive / preventive and scheduled maintenance.

13. REMEDIAL MEASURES TO PREVENT RECURRENCE

Suggested remedies to avert such accidents in future

1. Preparation of master trip logic (Emergency) for extreme ammonia leakage condition so that safe shutdown can be ensured automatically with minimum operator intervention. Provision of one dedicated hard-wired plant emergency trip switch when pressed shall ensure all action envisaged under the extreme ammonia leakage emergency condition. It should stop the plant with the operation of that switch.
2. Standard Operating Procedure (SOP) shall be prepared for all industrial activities handling hazardous chemicals. The pressure test and leak test must be ensured after replacement of valves, pipes, joints etc. as per the instrument manual or as per standard established procedure.

3. Mock drills must be conducted regularly to the employees in controlled environment on actions to be taken during failures, gas leakage etc.
4. Provision of forced air blanketing system at the entry gate of CCR.
5. Provision of dedicated solenoid / motor operated firewater nozzle just above ammonia feed pumps (in addition to the existing water curtain) to reduce the impact of ammonia leakage in extreme emergency.
6. Water curtain system / AC system needs to be linked with the high ammonia alarm received from ammonia sensor in field / control room. Whenever high ammonia content alarm is received from ammonia sensor, it should start water curtain system and stop CCR AC system.
7. Reducing the level being maintained in Ammonia Receiver Tank to 50%. (Existing practice 80%). This will reduce the release volume during extreme ammonia leakage.
8. Installation of ammonia sensor in CCR. On higher ammonia content, AC units shall be made to trip automatically.
9. The unit shall conduct comprehensive safety & hazard audit, identify the non-compliances and take corrective actions for the non-compliances identified. Emergency plans shall be established to deal with leaks. The risk assessment should identify the control measures necessary in an emergency. These are likely to include, for example instructions to identify the leak and close key valves. Such valves should be marked and identified on drawings. Regular checks of such valves should be undertaken to ensure correct operation. A clear documented emergency procedure should be drawn up which details the precise duties of all staff and arrangements for evacuation, rescue, first aid, resuscitation, plant isolation etc.
10. The plant where the ammonia receiver tanks and ammonia High pressure pump assembly are placed is very congested and during any unwarranted situations, it is difficult to escape. The unit shall re-design ammonia receiver tank as well as ammonia high Pressure assembly to have more working space for the personnel. Adequate means of escape and rescue shall be provided.
11. To install Emergency warm water showers and eyewash stations in locations where ammonia is handled for decontamination. They allow workers to flush away ammonia that can cause injury.
12. To install automatic tripping system during pressure build-up, leaks etc.
13. All pipework containing ammonia shall be identified by colour coding or labelling and positioned and protected to prevent damage. It is good practice to uniquely identify part of the system that contain gas or liquid and the direction of flow.
14. The unit shall install ammonia sensor and emergency ventilation may be interlinked with ammonia sensor.

15. To install check valves, relief valves at appropriate locations. Flow meters, sensors, measuring devices have to be regularly calibrated. Vents from relief valves shall be directed to a safe place
16. Seals, glands and gaskets shall be regularly inspected, without dismantling. Leak test should be conducted in all piping, valves, seals, flanges, and other pertinent equipment at least four times a year. Some methods that can be used for leak testing are Sulphur sticks, litmus paper, or a portable meter equipped with a flexible probe.
17. All ammonia carrying piping should be periodically inspected for failed insulation/vapour barrier, rust, and corrosion. Ammonia piping underneath failed insulation should be carefully inspected for corrosion. Damaged and deteriorated ammonia piping should be replaced. All uninsulated piping should be cleaned, primed, and painted with an appropriate coating to protect the pipe from corrosion as well as being consistent with the colour coding scheme.
18. Only fully trained and qualified operators shall be permitted to operate ammonia systems. The operator is required to take refresher training at least every 3 years to ensure the employee understands and adheres to the current operating procedures related to the process. To impart training to all employees on SOP's, product process, safety aspects. The employees shall be given hands on experience with the product process under the supervision of senior employees. The units only after ensuring that adequate training is imparted to its employees will engage the employees for independent works. Overall, the industries should be prepared for emergency response readiness & effectiveness in terms of major & minor accidents.
19. To install suitable gas sensors and alarm system in the unit at appropriate locations where emission of gas is suspected so that any gas leaked is detected and the employees are immediately alerted. In sensitive areas of the unit where gas leakages are suspected, the unit shall work out an emergency prepared plan to vent out the gases safely.
20. The unit shall provide essential Personnel protective equipment like nose mask, Helmets, Safety Shoes, Safety Glasses, chemical Proof Gloves, chemical proof body suit/ clothing, self-contained breathing apparatus to all its employees and make it mandatory that the employees have to wear PPE's during working hours.
21. The safety measure including valve regulated system shall be regularly checked and the concerned workers involved in the activity shall be properly trained.
22. The industries shall update the comprehensive safety audit, on-site and off-site emergency plans and risk analysis reports periodically as per the protocol and ensure that the reports are furnished to Zonal Office.
23. Portable Ammonia masks needs to be kept at critical locations (like HP pump area / Ammonia receiver tank area / MP Ammonia absorber area/ LP carbonate solution tank V-3 area) for use in any emergency.

24. A Safety mock drill on failure of tie rods/ plunger of HP ammonia pump should also be taken up as soon as possible. During safety mock drill, it should be made imperative if the concerned employee are using BA set / on line mask or not.
25. Hazard identification and evaluation in a local community, preparation of Guiding Principles for Accident Prevention, Preparedness and Response for onsite and offsite emergency plans has to be reviewed.

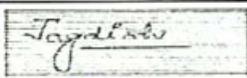
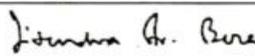
Concluding Remarks

1. The committee suggested that each State shall take responsibility in implementing the chemical Disasters Management, Protocol (March 2009 publication) and MHDC remedial measures and submit Action taken report.
2. The role of factories and inspectors to be specified and their inspection protocol are to be assessed Pan-India. Since safety aspects are part of their mandate an independent audit is required in the light of many accidents reported due to failure of safety measures and lack of training.
3. The committee humbly submits that the industries have to ensure self-compliance and the industry and its personnel are solely responsible for this negligent act which resulted in the accident. The committee humbly submits that the regulatory authorities can not involve & check on the day-to-day activities of the industries. It shall be the primary responsibility of the industries to ensure compliance. Self-monitoring and Self Compliance shall be enforced by all the industries. The Regulatory Authorities shall exercise periodic check & review of the industries as per the mandate. The sole responsibility of recruiting competent staff, imparting Industrial, Environmental and Safety training to the staff, conducting safety audit, onsite and off-site emergency preparedness. The Regulatory Authorities shall immediately take action against the industry as per prevailing Rules if any non-compliances are noticed.
4. The industry should conduct public awareness programmes in the surrounding villages about do's & don'ts during emergency.
5. The mock drills shall be conducted as per the protocol and the dates shall be intimated to UPPCB Regional Office/Local administration one week in advance without fail.
6. The committee humbly submits that the action taken against the industry and levying of EC from the unit will strengthen "Polluter Pay Principle" and will also be a lesson to other industries that they have to ensure self-monitoring, self-compliance and comply with statutory guidelines, safety measures, MOEF&CC, CPCB, UPPCB, Directorate of Factories etc.
7. The committee suggests that Chief Inspector of Factories shall verify the compliance of the unit, safety of installations and after ensuring compliance by the regulatory authorities, unit may be permitted for operation.

8. The committee suggest local administration /factory of directorate should keep stringent surveillance to avoid such kind of accident and environment damage.
9. The committee humbly submit the design of the existing high pressure (Reciprocating liquid Ammonia system on the plant) have past failure experience in various plant. The committee suggested that each plant shall be implementing state-of-the-art technology to avoid such type of the accident in future across the PAN India level.
10. A plant round of the combined group of Maintenance and Production persons should be taken up on daily basis to see any abnormality of any equipment; it may also be discussed in the Production meeting on daily basis.
11. Periodic inspection of equipment and machineries could prevent failures and shutdowns in the plant resulting in improved performance. Further, periodic training, motivation and feedback from operating personnel are most important and should be followed in right spirit to improve the performance of plant.

Joint Committee Members: (As per order of Hon'ble National Green Tribunal, Principal Bench, New Delhi Dated 18.01.2021)

COMMITTEE MEMBERS

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