ENERGY CONSERVATION EFFORTS AT NATIONAL FERTILIZERS LIMITED, VIJAIPUR

नेशनल फर्टिलाइज़र्स लिमिटेड
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NATIONAL FERTILIZERS LIMITED

Presented by:

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&

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ABOUT NATIONAL FERTILIZERS LIMITED

- MISSION: NFL's mission is to be a market leader in fertilizers and a significant player in all its other business, reputed for customer satisfaction, reasonable reward to shareholders, ethics, professionalism and concern for ecology and the community.
- NFL is a Schedule-'A' & Mini Ratna- Category-I Company.
- NFL is 2nd largest producer of Urea in the country and produced 3.636 Million Tonnes of Urea during 2013-14.
- NFL is pioneer in producing Neem Coated Urea in the country. Application of Neem coated urea increases the yield by 5-6%.
- NFL's all Units are covered under ISO-9001 , ISO-14001 & OHSAS 18001. Corporate Office & Marketing division is also certified under ISO-9001.
- NFL contributes to 16% of the total urea production in the country

NFL'S PLANT LOCATION AND MARKETING TERRITORY

INTRODUCTION TO NFL, VIJAIPUR PLANTS

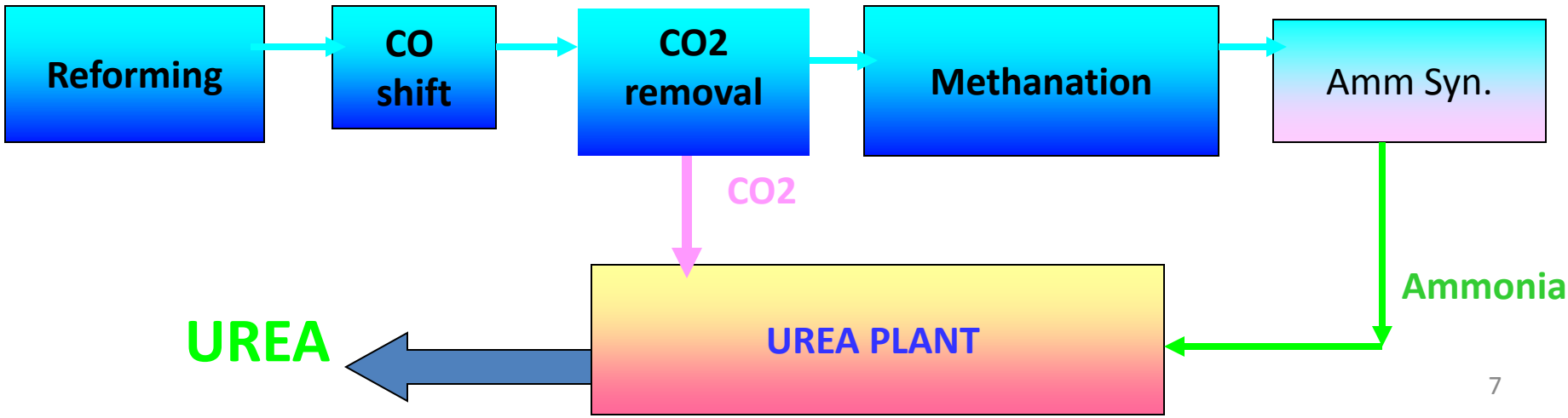
	Vijaipur - I	Vijaipur - II
Technology - Ammonia	Haldor Topsoe Steam reforming	Haldor Topsoe Steam reforming
Technology - Urea	Snamprogetti Ammonia stripping	Snamprogetti Ammonia stripping
Revamped capacity (MTPD)	A-I/U-I 1750/3030	A-II/U-II 1864/3231
Captive power	2 x 17.225 MW	1x 17.75 MW

INTRODUCTION TO NFL, VIJAIPUR PLANTS

- Vijaipur-I is country's first Inland gas based Fertilizer Plant Commissioned in 1987
- NFL Vijaipur contributes to around 10% of the total Urea production in the country.
- Vijaipur-II commissioned in 1997, Its Ammonia Plant has dual feed (NG + Naphtha) facility & is more energy efficient due to incorporation of a few energy saving features since inception; e.g. GT drive for Process Air Compressor & HRSG Boiler in co-generation, MP stripper, GV CO_2 Removal Process. Similarly, its Urea Plant CO_2 Compressor has more energy efficient 100 ata steam turbine drive.

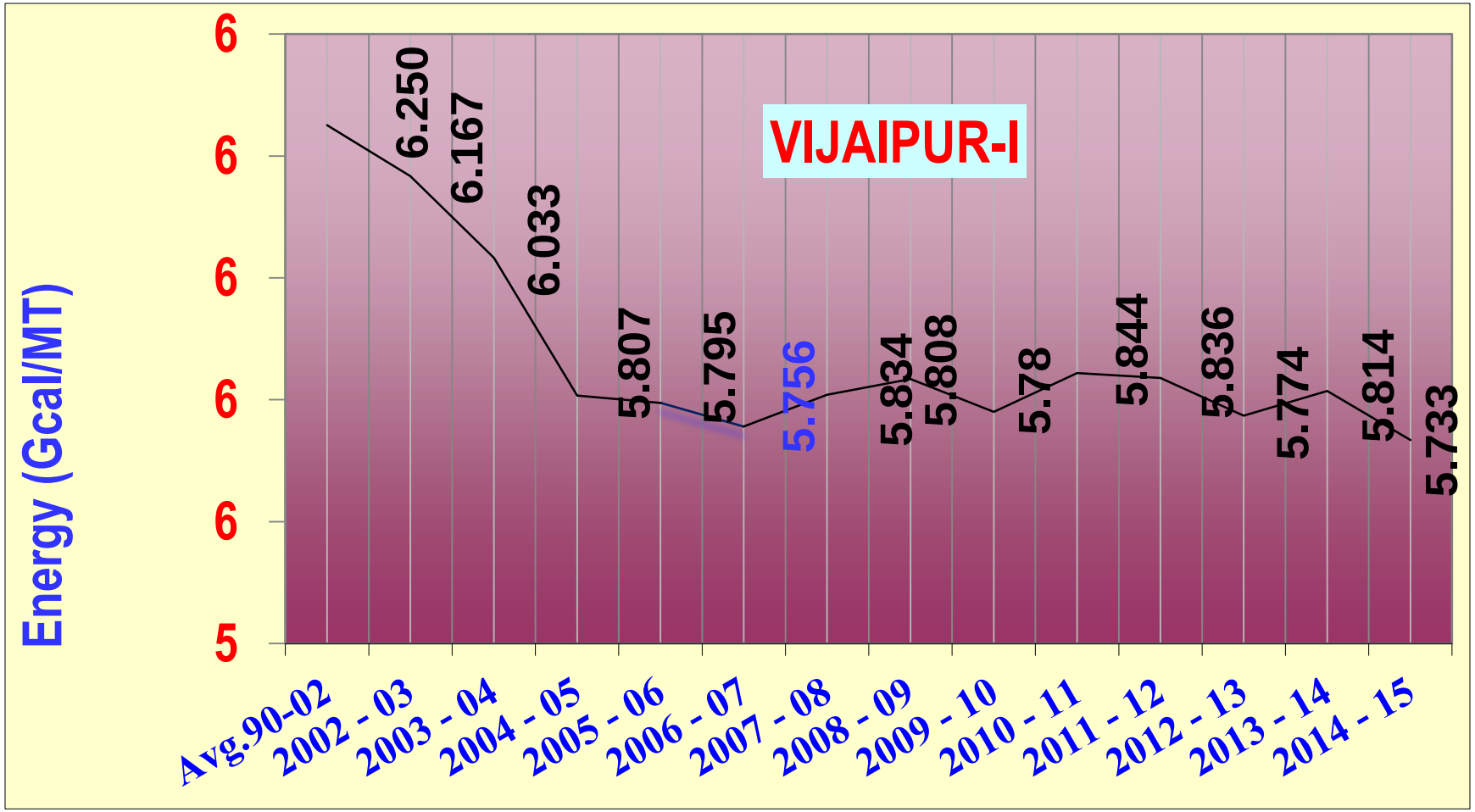
NFL,VIJAIPUR ISO 9001:2000 & 14001 unit

- Urea production is based on Snamprogetti's Ammonia Stripping
- Reaction involved: $2NH_3 + CO_2 \longleftrightarrow NH_2CONH_2 + H_2O$
- Ammonia & CO_2 are obtained from Ammonia plant based on HTAS' steam reforming of NG/ NG+ Naphtha.
- Ammonia plants are self sufficient in steam.
- Power is generated in Captive Power plant having 3 nos. (2 normal + 1standby) Gas Turbine Generators in Co- generation mode with steam generation from heat recovery units.



Specific Energy Consumption Vijaipur-I

(Gcal/MT Urea)



Specific Energy Consumption Vijaipur-I

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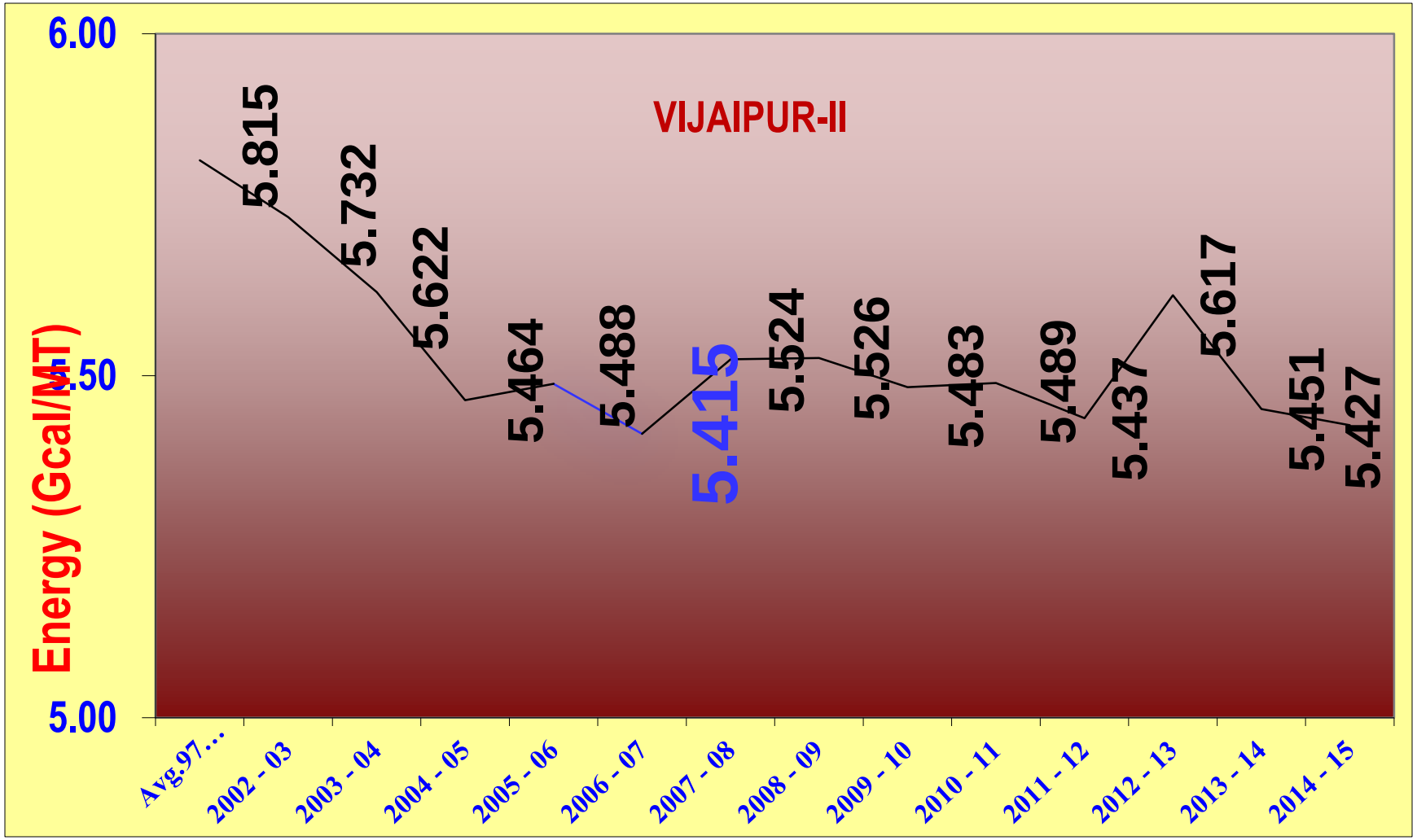


NAME OF ENERGY INPUTS

Name of energy input	Supplier	Source/Supply route
Natural Gas (NG)	M/s GAIL	Bombay High/ HVJ pipeline
	M/s RIL	RIL KG basin/ RGTIL Pipe Line/ HVJ Pipe line
Re-gasified Liquefied Natural Gas (RLNG)	M/S IOCL & BPCL	Dahej Terminal (Petronet LNG)/ HVJ pieline)

HOW TO IMPROVE ENERGY EFFICIENCY

Energy efficiency is inversely proportional to Specific Energy Consumption. Energy efficiencies can be improved by reduction in specific energy consumptions which can be achieved by:

- higher on-stream efficiency
- higher scale of operation
- less no. of tripping / reduction in
- unproductive energy consumption

HOW TO IMPROVE ENERGY EFFICIENCY

- optimization of steam and power
- optimization of plant parameters
- Reduction in steam leakages through steam traps and insulation
- waste minimization

The above factors can be achieved by means of monitoring plant performance, strict vigilance, analysis of tripping and equipment breakdown to avoid their recurrences, reduction in start-up time etc

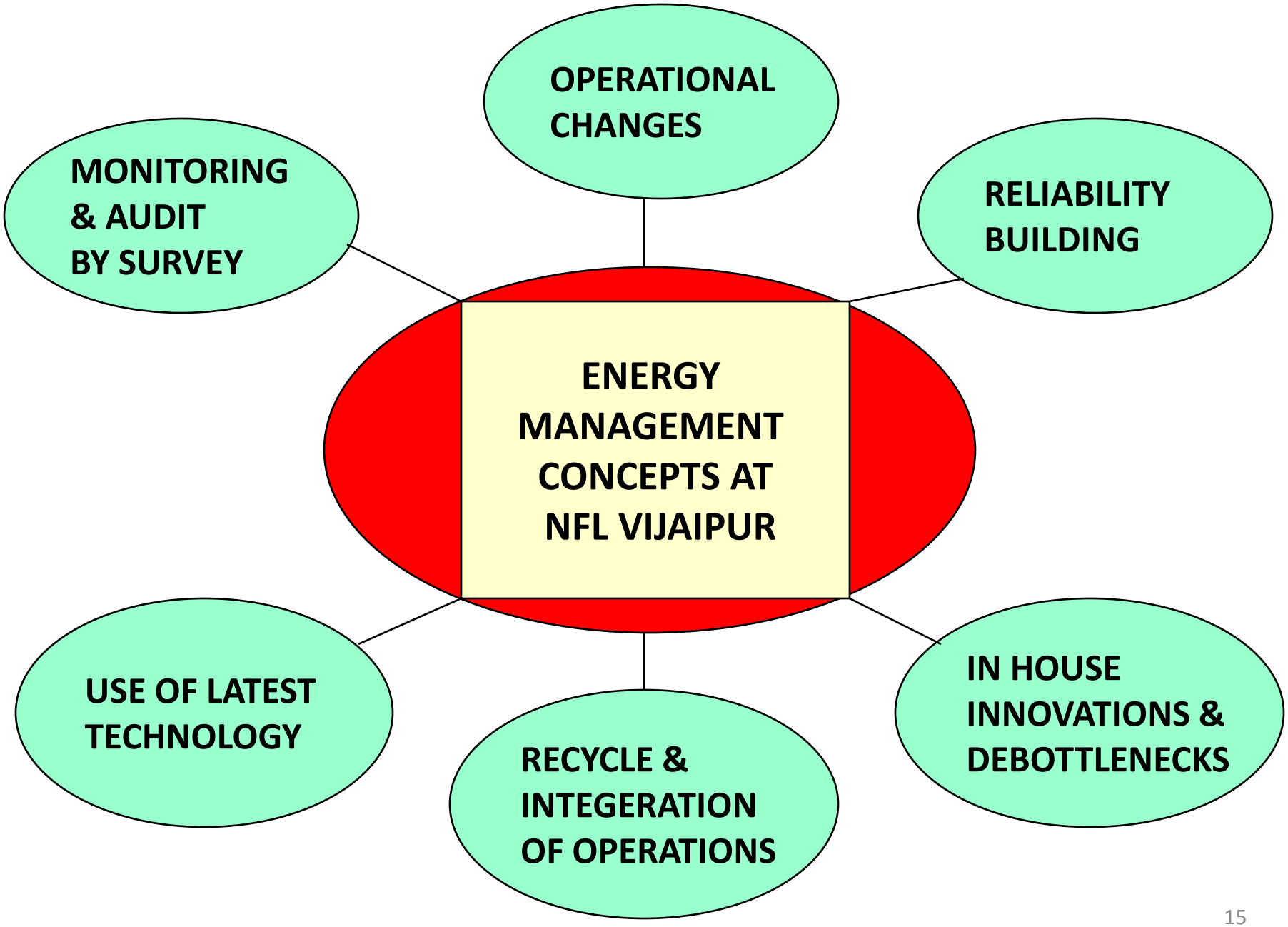
HOW TO IMPROVE ENERGY EFFICIENCY

Further reduction in specific energy consumption is possible by:

1. Technology up-gradation
2. Revamps/ Retrofits of plants
3. Recognition of ENCON options and implementation of economically viable Energy saving Schemes

TOWARDS FULFILMENT OF NATION'S OBJECTIVE -AN ENERGY EFFICIENT NATION

NFL, Vijaipur, is very much committed to Energy management. Considering that Fertilizer manufacturing is an energy intensive process, we have realized that a small step towards ENCON within the premises of NFL shall be a great leap in the energy front of the Country and shall help in materializing the Targets set forth under the Energy Conservation Act 2001.


OPERATIONAL CHANGES
MONITORING & AUDIT BY SURVEY
RELIABILITY BUILDING
ENERGY MANAGEMENT CONCEPTS AT NFL VIJAIPUR
USE OF LATEST TECHNOLOGY
RECYCLE & INTEGERATION OF OPERATIONS
IN HOUSE INNOVATIONS & DEBOTTLENECKS

ENCON PRACTICES

- Adoption of Energy policy in 2003.
- Internal norms setting and benchmarking.
- Stringent and close monitoring, analysis, review & follow-up action
- Good house keeping
- Increase in capacity utilization & On stream factors
- Optimization of Operation practices- Optimum utilization of electrical & thermal energies

GOOD HOUSE KEEPING MEASURES

- Periodic checking of steam traps
- Routine checking of leakages in plants by operating staff.
- Regular filling of check list by individual at various level to identify to identify trouble area/ gray point.
- Periodic checking of safety valve / vents.
- Monitoring of Insulation.

ENCON PRACTICES

- Conducting internal & External energy Audits
- Training & Motivation of employees by recognition of suggestions with suitable awards
- Formation of Energy Management Cell comprising of members from various discipline with Energy Manager as Co-ordinator
- Campaign on Energy Conservation to inculcate awareness amongst employees, school children, residents of township & nearby villages.

ENCON PRACTICES

- Reduction in Startup time of ammonia plant from 48 hrs to 30 Hrs by:
- Provision of suitable Interconnection between Vijaipur-I & Vijaipur-II plants.
- Time Optimization during startup by way of proper co-ordination and optimization of Startup procedure based on experience

ENCON PRACTICES

MONITORING & REPORTING SYSTEM

- Energy management flows from the Top.
- Active individual participation under the suggestion scheme
- Close monitoring & Review with Energy Manager as Coordinator. Weekly review under the chairmanship of Unit Head.
- Sp. Energy Cons per MT of Product for each Unit and Complex: Daily, Monthly & Quarterly & Annually with detailed break up for feed, fuel, steam & power

ENCON PRACTICES

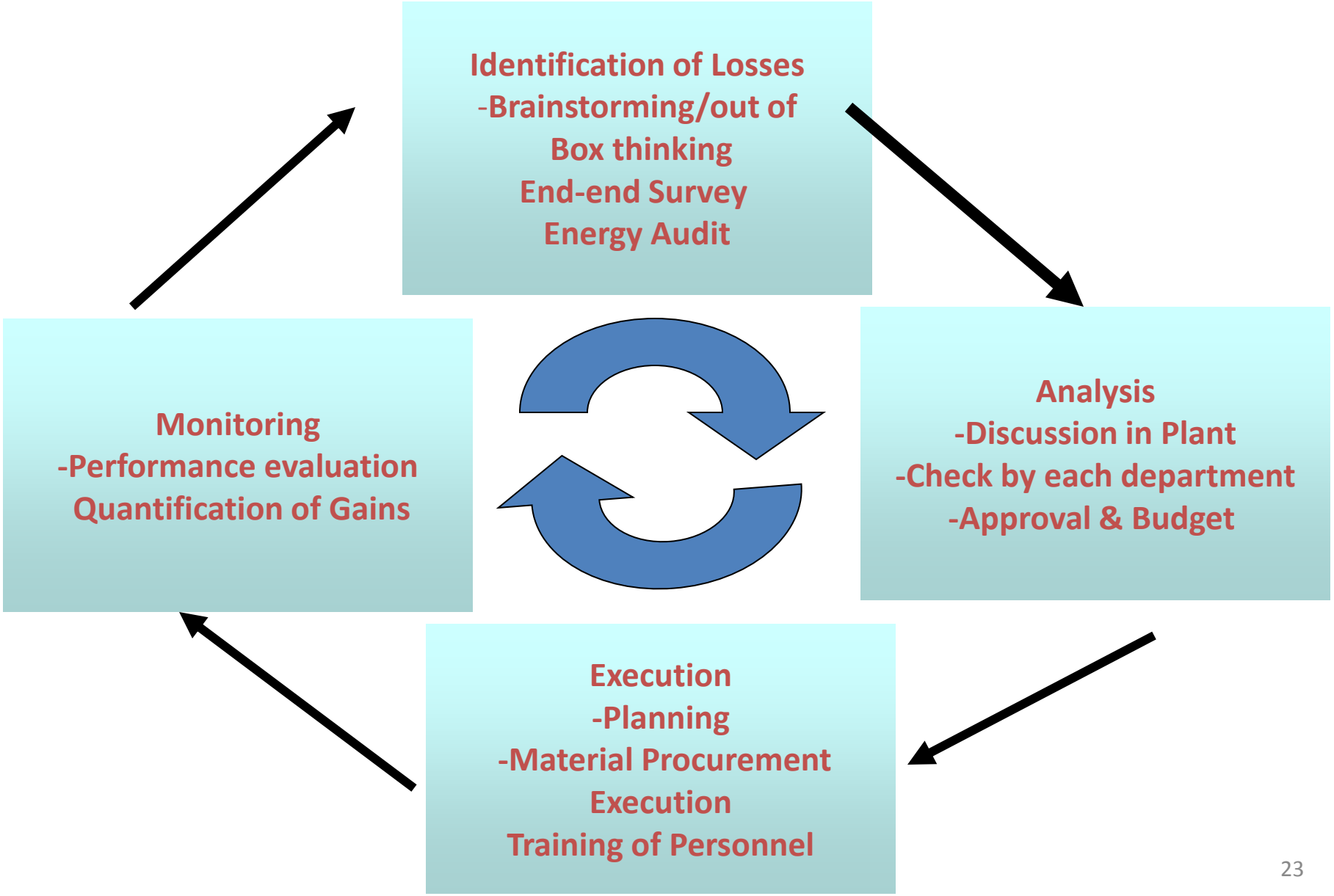
MONITORING AND REPORTING SYSTEM

- Sp Energy Cons for Steam & Power: Daily, Monthly & Quarterly & Annually
- Efficiency calculation of Equipment & machinery: Periodically as per schedule drawn up.
- Monitoring of: Stack temp., Critical plant parameters, Oxygen in flue gases, leakages from steam traps & vents.

BENCHMARKING

NFL Vijaipur is actively considering the technological advancements & Plant optimization options to bring down the Specific energy Consumption per MT Urea to comparable with best in the industry

ENERGY MANAGEMENT APPROACH



ENERGY POLICY OF NFL VIJAIPUR

To promote Energy conservation ideas, an Energy Policy has been adopted in 2003

National Fertilizers Limited, Vijaipur, a urea manufacturing unit, is committed for continual improvement in the energy performance. In order to accomplish this objective, it will strive for:

- Optimum utilization of natural resources.
- Maximum recovery of low grade and waste energy.
- Reducing breakdowns by detailed study of each failure & taking appropriate preventive measures.
- Benchmarking the energy performance with other energy efficient units.

ENERGY POLICY OF NFL VIJAIPUR

Continued

- Inculcating awareness for energy conservation among employees and encouraging through reward for initiatives taken by them.
- Conducting regular energy audits.
- Up-gradation of processes and equipment with latest technology.
- Implementation of energy saving schemes.
- To bring down energy consumptions as per targets given under “Perform, Achieve and Trade”

MAIN THRUST AREAS TO IMPROVE ENERGY EFFICEIENCY

- Higher on-stream efficiency
- Higher average plant load
- Less no. of tripping / reduction in unproductive energy consumption
- Optimization of thermal and electrical energy
- Recovery of low grade heat
- Utilization of gases being vented
- Optimization of plant parameter, Improvement of Operation & Maintenance practices
- Change in design
- Implementation of schemes for sustainable development

MAJOR ENERGY CONSERVATION SCHEMES AT NFL VIJAIPUR

MAJOR ENERGY SAVING SCHEMES IMPLEMENTED OVER THE YEARS AND RESULTANT BENEFIT

Brief Description of the scheme	Year of implement ation	Energy Savings (Gcal)	Investment (Rs. Lakhs)	Reduction in CO_2 emission (MT/Year)
Installation of Cryogenic Purge Gas Recovery Unit	1992-93	45000	500	11000
Low Grade Heat recovery from process condensate top vapor by installing DM water pre-heater in Ammonia-I (Shell & Tube HE)	1998-99	43200	150	10500
Low Grade Heat recovery from process condensate bottom liquid by installing DM water pre-heater in Ammonia-I (Plate type HE)	2004-05	43200	60	10500

MAJOR ENERGY SAVING SCHEMES IMPLEMENTED OVER THE YEARS AND RESULTANT BENEFIT

Brief Description of the scheme	Year of implementation	Energy Savings (Gcal)	Investment (Rs. Lakhs)	Reduction in CO_2 emission (MT/Year)
Replacement of Condensing steam turbine of Ammonia Cooling Water pumps with motor in Vijaipur-I	2004-05	45000	500	11000
Replacement of one condensing steam turbine of Urea Cooling water pump with motor in Vijaipur-II	2004-05	23300	70	5600

MAJOR ENERGY SAVING SCHEMES IMPLEMENTED OVER THE YEARS AND RESULTANT BENEFIT

Brief Description of the scheme	Year of implementation	Energy Savings (Gcal)	Investment (Rs. Lakhs)	Reduction in CO_2 emission (MT/Year)
Installation of 05 no. additional high efficiency sieve trays in all four streams of Urea plants & modification in existing trays to increase CO2 conversion efficiency	2004-05 (VP-1) 2005-06 (VP-II)	35000	200	8400
Installation of Pre-concentrator in both the streams of Urea plant in Vijaipur-I (Low Grade Heat Recovery) for partial utilization of heat of carbamate vapors which otherwise was getting wasted in cooling water	2006-07	103700	900	24900

MAJOR ENERGY SAVING SCHEMES IMPLEMENTED OVER THE YEARS AND RESULTANT BENEFIT

Brief Description of the scheme	Year of implementation	Energy Savings (Gcal)	Investment (Rs. Lakhs)	Reduction in CO_2 emission (MT/Year)
Recovery of C-3 off gases from VP-I Urea plant and using it as fuel in CPP Boilers	2011-12	23190	82	23500
Recovery of C-3 off gases from VP-II Urea plant and using it as fuel in CPP Boilers	2012-13			
Revamp of Vijaipur-I	2012-13	140000	65000	33600
Revamp of Vijaipur-II		53300		12800
Carbon Dioxide Recovery Unit				99000

MAJOR ENERGY SAVING SCHEMES IMPLEMENTED OVER THE YEARS AND RESULTANT BENEFIT

Brief Description of the scheme	Year of implementation	Energy Savings (Gcal)	Investment (Rs. Lakhs)	Reduction in CO_2 emission (MT/Year)
Energy Saving coating in casing of 03 no. cooling water pumps	2014-15	125	9	30
Replacement of Cooling Tower fan blades with FRP blades (Reduction in power by 25% with increase in air flow)	2014-15	3100	31	740

SUSTAINABLE ACTIVITIES

Besides implementation of energy saving schemes, NFL Vijaipur is always committed to sustainable development schemes e.g. small energy saving schemes by implementation of modification & suggestion schemes, water recovery schemes, usage of renewable energy etc.

- As a small step towards use of renewable energy and reduction in consumption of nonrenewable energy / fossil fuels, we have implemented sloar lighting in factory main gate, solar water heater at NFL hospital and NFL Guest House.
- Lighting in the control rooms has been changed to energy efficient LED lighting. Replacement of the old lamps with LED lighting is being carried out in phases.

SNAPSHOTS OF SOME OF THE ENERGY SAVING SCHEMES IMPLEMENTED

RECOVERY OF LOW GRADE HEAT-

RECOVERY OF HEAT FROM BOTH TOP & BOTTOM PRODUCT IN PROCESS CONDENSATE STRIPPING SECTION IN AMMONIA PLANT OF VP-I

HEAT RECOVERY FROM PROCESS CONDENSATE BY INSTALLING DM WATER PRE-HEATER IN AMMONIA-I

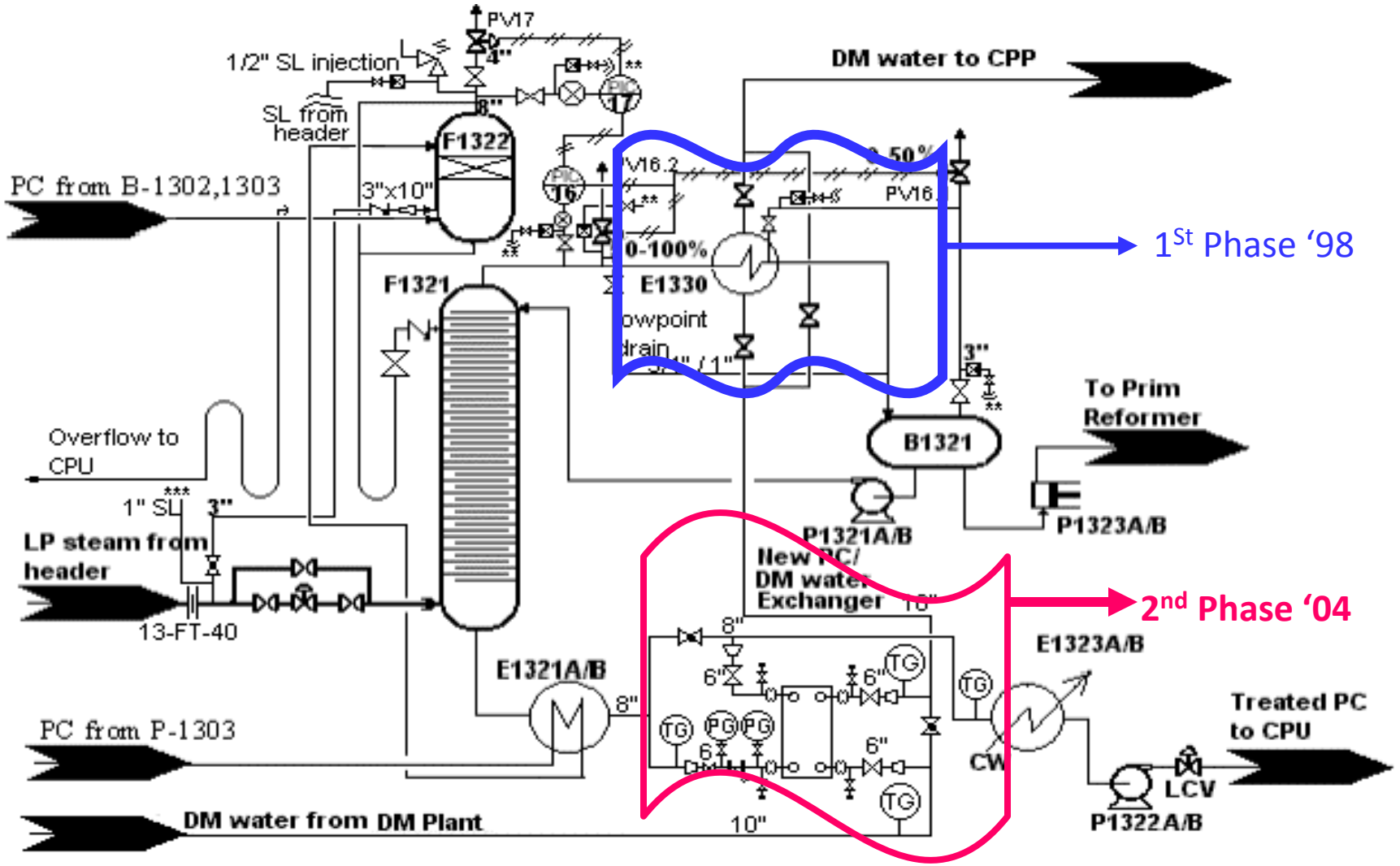
Process Condensate generated in the plant was earlier stripped with low pressure steam to remove ammonia, methanol, CO2and other unwanted volatile compounds from the process condensate before sending to the polishing unit. In this section, for condensing the over head vapours, Air Cooler was provided as there was no scope for preheating DM water (consumed in the Ammonia plant), which was already getting fully heated in the Benfield Section.

In 1998, the Air cooler was replaced with a Heat Exchanger for preheating DM water from 35ºC to 70ºC, required for the Offsite Boilers. In order to balance the surplus LP steam, the motor driven pump in the Benfield section was taken in line and one of the backpressure turbines BFW pump was stopped.

HEAT RECOVERY FROM PROCESS CONDENSATE BY INSTALLING DM WATER PRE-HEATER IN AMMONIA-I

In the second phase, a new plate type heat exchanger was installed to recover the heat of the treated process condensate which earlier used to get cooled by CW in the final cooler from about 90ºC to 40ºC by exchange of heat with DM water. The pressure of PC stripper has been raised from 0.6 kg/cm²g to about 1.3 kg/cm²g to make the extra heat recovery possible.

PRE-HEATING OF DM WATER



COST BENEFIT ANALYSIS

Annual Energy saving realized = 66.5 Million

Investment = 6 Million

Payback Period =1 Month

CHANGES CARRIED OUT IN APRIL 04:

1) Installation of Plate Type Heat exchanger to Recover Heat from Bottom Product. The treated process condensate was earlier cooled by CW in final cooler from about 90ºC to 40ºC. This available heat of PC is being recovered by exchanging heat with DM water in a New plate heat exchanger (E-1331)

2) The pressure of PC stripper has been raised from 0.66 Kg/Cm²g to about 1.5 kg/cm²g to make the extra heat recovery possible.

Parameters	Before Installation of Plate type HE	After Installation of plate type HE
Operating Pressure	0.6 kg/cm²	1.3 kg/cm²
Stripper top temperature	92˚C	107˚C
Stripper bottom temperature	107˚C	120˚C
Steam flow to Condensate Stripper	20 Te/Hr	20 Te/Hr
DM Water flow	230 Te/Hr	230 Te/Hr
DM Water temperature at inlet & Outlet of Ammonia-I	35/71.4˚C	38/99˚C
Heat recovered by DM water	8.4 Gcal/Hr (1998-2003)	14.1 Gcal/Hr (After 2004)
Net heat recovery after installation of Plate type HE		5.7 Gcal/Hr

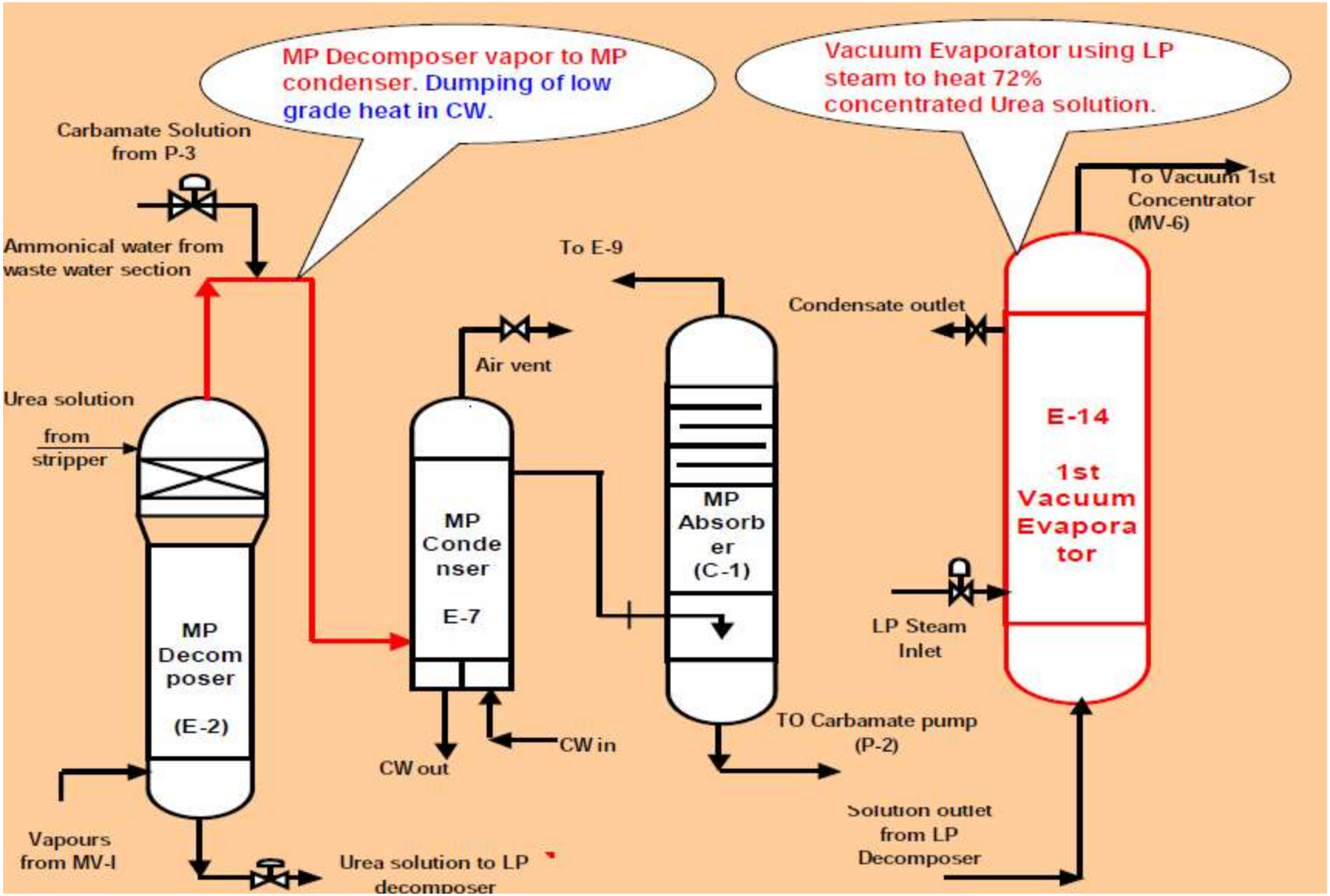
RECOVERY OF LOW GRADE HEAT-
INSTALLATION OF
PRE-CONCENTRATOR IN UREA PLANT

INSTALLATION OF PRE-CONCENTRATOR IN UREA-I PLANT

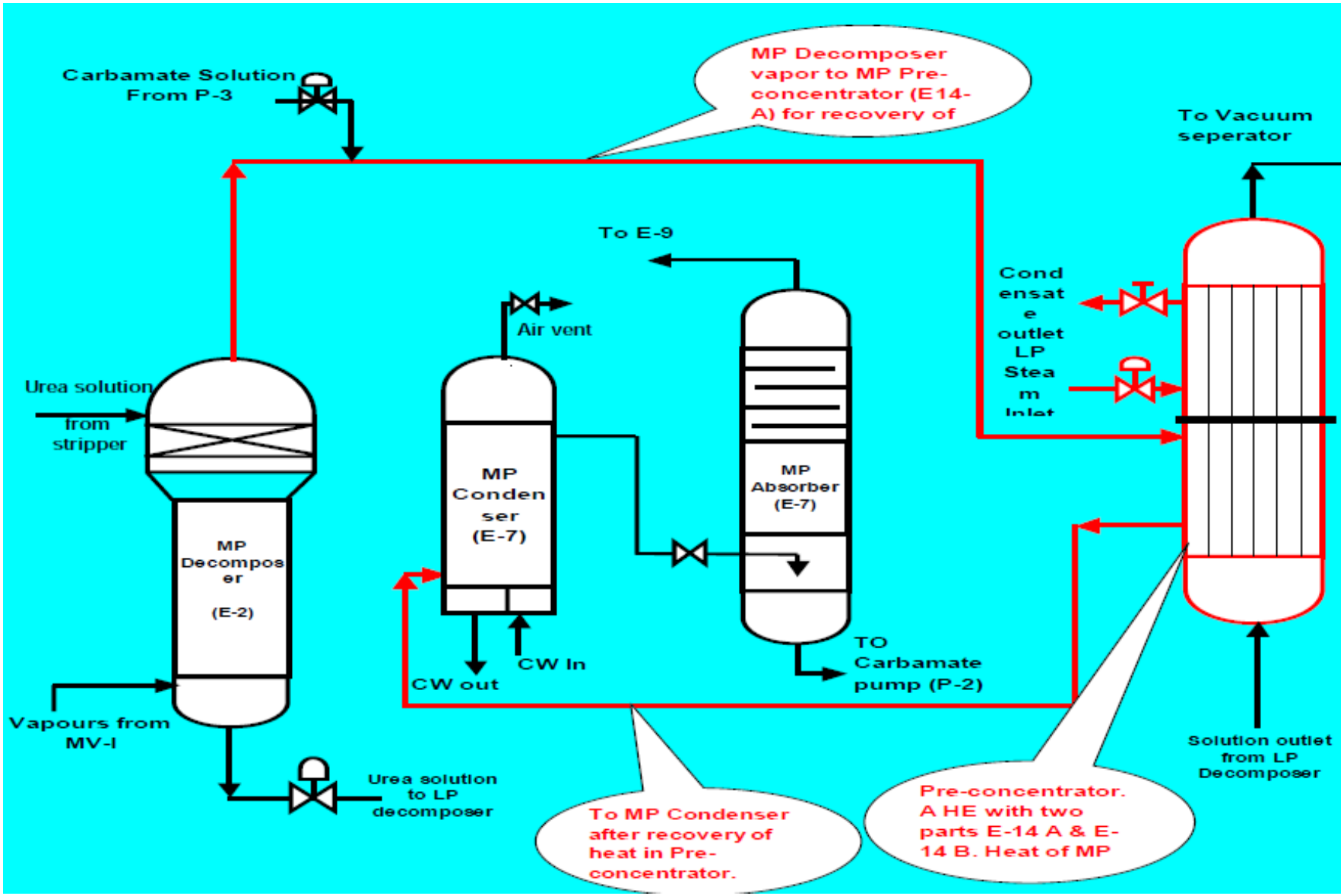
Pre-concentrator is an additional vacuum stage utilizing heat of condensation of carbamate vapors from MP decomposer which otherwise is wasted in CW. Under this retrofitting:

- Major part (60%) of the low grade heat (approx. 9.396 Gcal/h) that was otherwise dumped in circulating Cooling Water in Medium Pressure Decomposition stage, is recovered in the first stage (E-14A) of Urea Concentration Section.
- In this process around 22 te/h of Low Pressure Steam, otherwise being required in this Urea Concentration Section is saved.

ORIGINAL SCHEME WITHOUT PRE-CONCENTRATOR



MODIFICATION WITH CASALE PRE-CONCENTRATOR



- Saving of LP Steam (saturated) @ 210Kg/MT of Urea has been achieved against guaranteed saving of 195 kg/ MT of urea with the installation of Pre-Concentrator.
- The saving of energy is @ 0.12 Gcal/ MT Urea, offering benefit of @ Rs. 5.0 crores per annum
- The pay back period works out to be @ 22 months with total project cost of @ Rs. 9.0 crores.
- Prills quality of Urea has also improved.
- The scheme has been implemented in 21 & 11 streams in Sept.'06 & May'07 respectively.

OPTIMIZATION OF THERMAL & ELECTRICAL ENERGY

REPLACEMENT OF CONDENSING TURBINE OF COOLING WATER PUMP IN AMMONIA I PLANT WITH MOTOR

Savings:

30250 Gcal/Annum

Investment:

Rs 84 lakhs

REPLACEMENT OF CONDENSING TURBINE OF COOLING WATER PUMP IN UREA-II PLANT WITH MOTOR

Savings :
22500 Gcal/annum

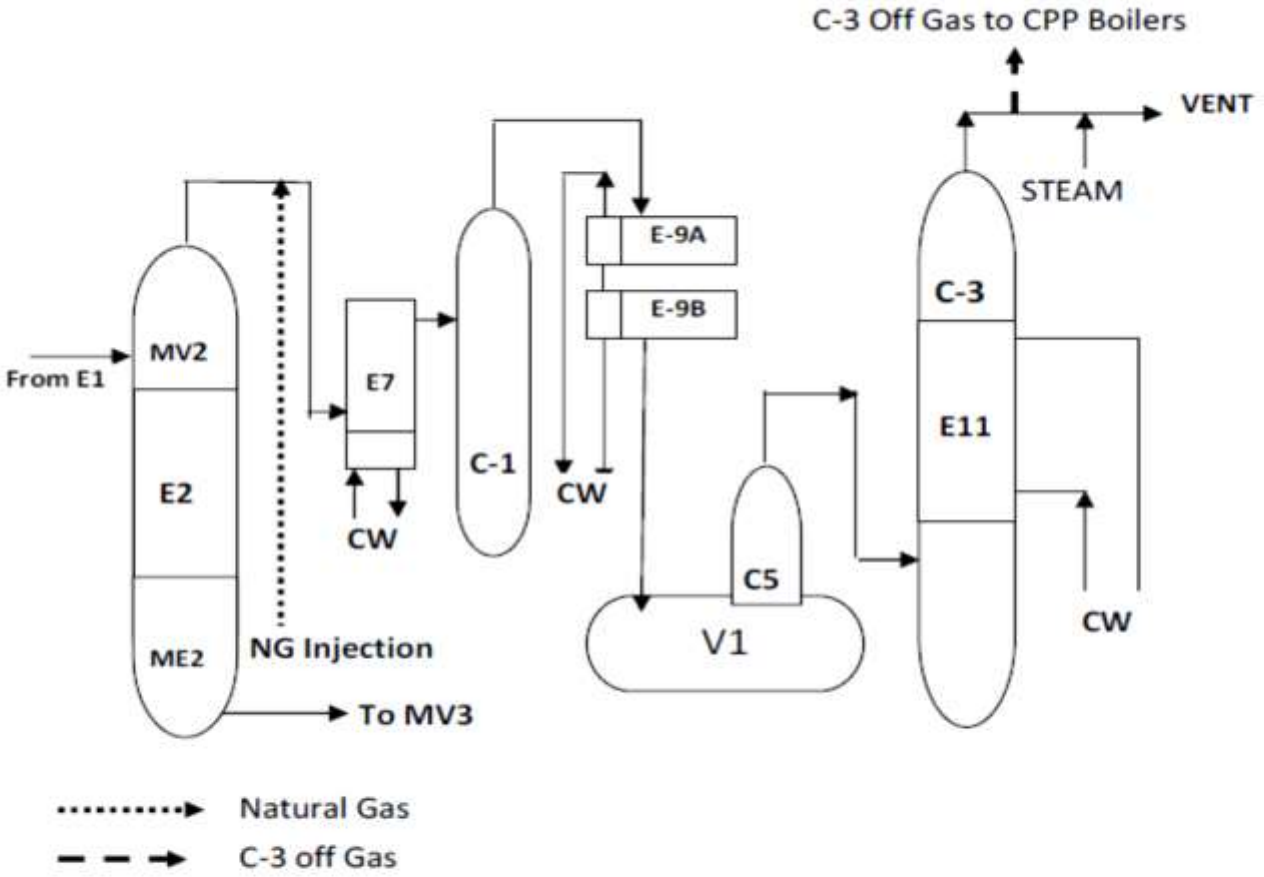
Investment:
Rs. 70 lakhs

RECOVERY OF HEAT FROM VENTED GASES(C-3 OFF GAS)

RECOVERY OF HEAT FROM C-3 OFF GASES:

In Urea plant, C-3 off gases is being vented to the atmosphere continuously to control the loop pressure. Each stream of Urea Plant generates around 700 Nm^3/h of C-3 off gases, so total generation of C-3 off gases is around 2800 Nm^3/h. C-3 off gas comprises Hydrogen, Methane, Ammonia, Nitrogen & Oxygen in the ratio of 25- 30%, 7-10%, 2.5-12%, 50-55% & 6-10% respectively. Considering the heating value of C-3 off gases, it was proposed to utilize these gases in HRU-I &II as supplementary fuel.

SKETCH FOR UTILIZATION OF C-3 OFF GASES AS SUPPLEMENTARY FUEL IN CPP BOILERS



E1- HP STRIPPER
MV-2/E2/ME2 –MP DECOMPOSER
E7 – MP CONDENSER
C-1 – MP ABSORBER
E9A&B – NH3 CONDENSER
V1 - AMMONIA RECEIVER

C-5 - INERT WASHING COLUMN
C-3/E11-MP INERT WASHING TOWER
CW - COOLING WATER

BENEFITS OF RECOVERY OF C-3 OFF GAS

- **Specific Energy Consumption:** Saving of 300 Nm^3/h corresponding to saving in specific energy consumption to the tune of 0.013 Gcal/MT Urea
- **Energy Savings:** 2.94 Gcal/Hr (Considering a heating value of 1464 kcal/Nm^3 and off gas flow of 2000 NM^3/Hr).
- **Green House Gas Emissions:** Environment benefits of reduction in annual CO2 emission by 23500 MT CO2 emission per annum and comparatively lower NOx emission as compared to usage in Primary Reformer. The reduction in CO2 emission is comparatively higher due to the fact that direct venting of methane in the off gas is being avoided.
- **Investment: Rs. 82 Lakhs**
- **Savings:** Rs. 5.12 Crores / Annum .
- **Pay-back period:** 1.6 Months (Considering energy cost as Rs.2200/ Gcal)


C-3 off gas to HRU burners
30 12 2014

C-3 off gas to NG Line to HRU burner fuel

ENERGY SAVING BY REVAMP OF VIJAIPUR-I & VIJAIPUR-II PLANTS

1. Energy Saving and Capacity Enhancement project in Ammonia-I & Urea-I Plant
2. Energy Saving and Capacity Enhancement project in Ammonia-II & Urea-II Plant
3. Installation of 450MTPD Carbon-dioxide Recovery (CDR) plant for partial recovery of CO2 from flue gases of Primary Reformer of Vijaipur-I Ammonia Plant and utilization for conversion of surplus ammonia generated in the complex.

REVAMP OF AMMONIA-I PLANT

Major energy saving schemes implemented

- Replacement of existing Combustion Air Preheater to SS Plate type combustion Air Preheater
- Conversion of Benfield CO2 removal section to GV CO2 removal section
- Installation of S-50 Ammonia converter along with new Waste Heat Boiler
- Installation of Parallel Air Compressor
- Addition of one new cooling tower cell & pump

REVAMP OF UREA-I PLANT

- Installation of MP Pre-Decomposer
- L P Steam Booster Ejector for MP Pre-decomposer
- Modification of Existing 1st & 2nd stage Vacuum system
- Installation of Additional Ammonia pump of smaller Capacity
- Replacement of trays in distillation tower
- Installation of additional Hydrolyser pre-heater
- Bulk flow Urea Prill Cooler
- Addition of one cell and a pump in cooling tower

REVAMP OF AMMONIA-II PLANT

- Replacement of Combustion Air Preheater with plate type heater
- Up gradation of Synthesis gas compressor
- Installation of S-50 additional converter & WHB in Synthesis loop
- Replacement of Primary Reformer burners
- Replacement of Secondary Reformer burner nozzles
- Replacement of packings in GV tower

REVAMP OF UREA-II PLANT

- Installation of Pre-concentrator with vacuum system
- Installation of MP Pre-decomposer
- Steam booster Ejectors/ Stripper steam condensate separator
- Revamp of CO2 compressor and turbine
- Modification in 31/41 ME-5 vacuum system
- Replacement of distillation tower (C-2) trays
- Additional small capacity HP Ammonia feed pump in 31 and 41 streams
- Replacement of HP Carbamate pumps, Carbamate electors & other small pumps
- Bulk flow Urea Prill Cooler

ENERGY SAVING BENEFITS OF REVAMPS

- Energy saving in Vijaipur-I : 140000 Gcal/annum
- Energy saving in Vijaipur-II: 53000Gcal/MT Urea
- Total reduction in CO2 emission: 145000MT per annum

ENERGY SAVING SCHEMES IN THE PIPELINE

- Installation of Purge Gas Recovery Unit in Ammonia Plant of Vijaipur-II: Investment: Rs. 30 Crores; Energy saving: 61000Gcal/annum; Reduction in CO2 emission: 14600MT / annum
- Installation of two Cooling Tower Cells in Vijaipur-II: Investment: Rs 11 Crores; Energy saving: 37000Gcal/annum; Reduction in CO2 emission: 8900MT / annum

Further more, schemes for bringing down specific energy consumption of Vijaipur-I are also under study

AT NFL VIJAIPUR

THERE IS CONTINUOUS ENDEAVOUR TO CONSERVE ENERGY

❖ ***Our efforts are to remain one amongst the best operating fertilizer plants contributing to Humanity's cause.***

Thank You