DAP Revamp at Fauji Fertilizer Bin-Qasim Limited, Karachi, PAKISTAN

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1. INTRODUCTION

Fauji Fertilizer Bin Qasim Limited (FFBL) is operating Ammonia – Urea – DAP Fertilizer Complex in Karachi Pakistan and is the only DAP manufacturing facility in the country. FFBL was established in 1993, plant construction started in 1995 and commercial production declared in January 2000. Nameplate capacities of Ammonia/Urea/DAP were 1270, 1670 & 1350 tons/day respectively.

FFBL completed revamp of Ammonia Plant in 2007 for increasing plant capacity to 1570 tons/day. DAP Revamp Project was envisaged to increase plant load from 62 tons/hr to 93 tons/hr keeping in view the DAP requirement in the country.

Jacobs Engineering – USA was contacted and feasibility study was carried out in July 2005. Based on Jacobs report, it was decided to undertake DAP Revamp Project and convert the existing "AZF Double Pipe Reactor" process to Jacobs "Slurry Process with Dual-mole Scrubbing System".

As FFBL is the only manufacturer of DAP in the country, therefore FFBL declared this project of national interest as "FAST TRACK" and formalized a dedicated team of Engineers to handle the Project. On the basis of feasibility study, FFBL awarded "Engineering and Procurement Services" Contract to Jacobs in April 2006. Time frame of Basic & Detail Engineering was 8 months; however it was completed in 17 months.

This delay of 9 months was covered / minimized by de-linking of construction package from completion of Detailed Engineering. To save time, FFBL prepared Construction Package for bidding purposes. Contract was awarded to M/s Descon – Pakistan. Bulk material ordering was initiated in parallel by FFBL on estimate basis. Moreover, regular design reviews were also organized at Jacobs Lakeland office and at FFBL plantsite. Expediting visits to vendor workshops were also carried out to ensure timely supplies of critical equipment.

In addition to above, planning of the prolonged shutdown for Revamp Construction was gigantic task keeping in view country's DAP requirement. Detailed studies were conducted to decide on time frame and to minimize overall shutdown time. Meetings were held with M/s Comessa – France (Contractor for critical path Dryer modification job), to reduce the shutdown time from initially proposed 100 days to 84 days. This was achieved through splitting complete work in pre-shutdown and shutdown construction. All possible work was carried out during pre-shutdown time.

By the grace of Almighty, DAP Revamp project was successfully completed. Construction works were finished in 83 days and Design Production was achieved within a month of production resumption. Jacobs' representatives could not be present in construction and commissioning / start-up activities and FFBL on their own carried out these activities however Jacobs was available to provide technical support remotely.

This paper covers the details of DAP Revamp Project starting from engineering phase to the plant design production.

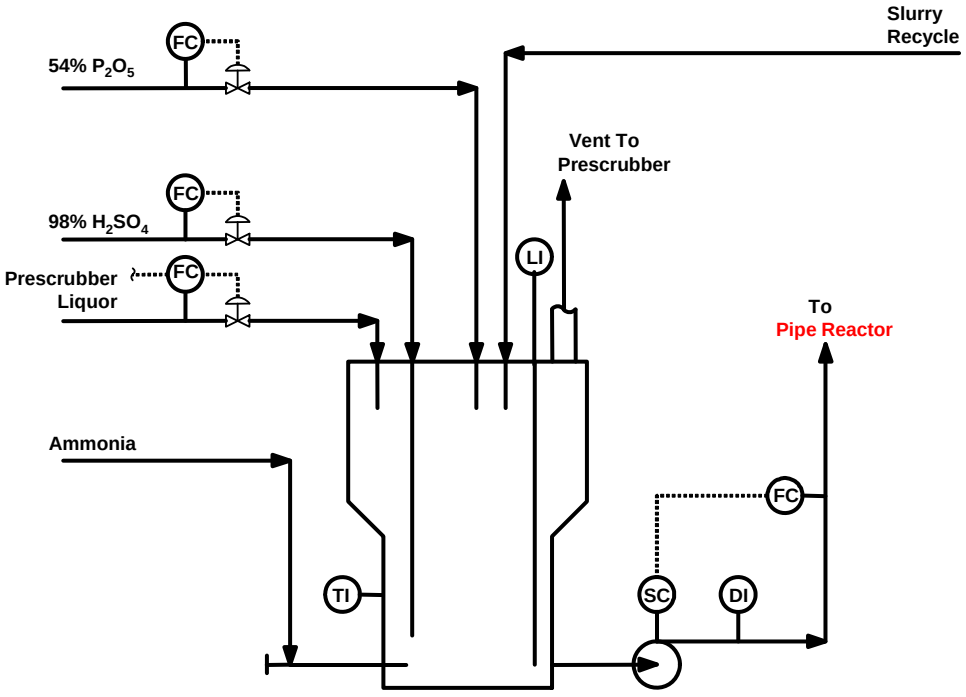
2. PROCESS MODIFICATIONS

The objectives of the project were to increase production from 62 to 93 t/h while reducing the dust in the plant and emissions from the stack. The major premise was the need to retain the large drum equipment, scrubbers and other major equipment and add or modify other equipment as necessary to achieve the goals.

The Granulator and Dryer were given more slope and increased speed. The Granulator internals were replaced and a Pipe Reactor added. The Dryer was reflighted. The internals of the Granulator Feed Elevator and the Screen Feed Elevator were replaced. The Recycle Belt was replaced and a recycle scale added to control recycle rate for optimum granulation. A second Polishing Screen was added to more closely control product size. A Preneutralizer was added to prepare the slurry which is sprayed on the Granulator bed through 3 or 4 large nozzles. Air Chillers were added to chill the air for the existing Fluid Bed Cooler by vaporizing ammonia. Equipment ventilation air was increased by replacing one of three 24,000 m^3/h fans with a relocated 66,000 m^3/h fan. All three fans are ducted to a new Bag House Dust Collector to remove solids from air recycled to the Hot Gas Generator. A Tailgas Vaporizer was added to vaporize ammonia for the Preneutralizer. Dual-Mole scrubbing was added to minimize emissions and a new Reactor / Granulator Venturi Cyclonic Scrubber was added.

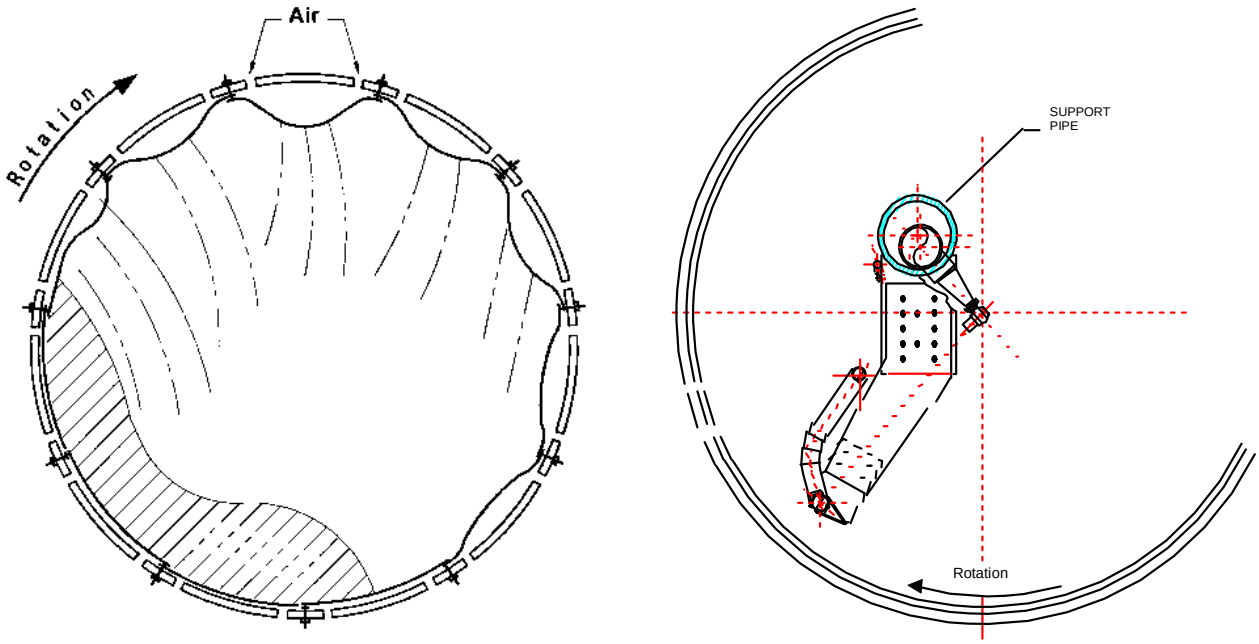
I. PRENEUTRALIZER

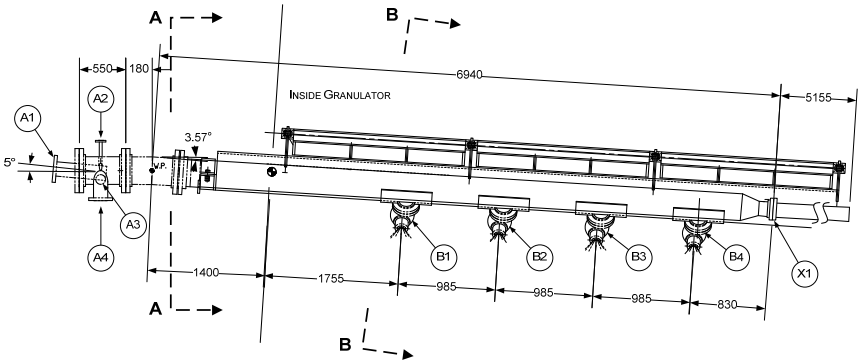
A preneutralizer was added with a 3.3 m diameter at the bottom an a 4.9 m diameter at the top to control CI losses and entrainment. An agitator is used to ensure ammonia dispersion and slurry mixing. Slurry is pumped to the pipe reactor with a variable speed pump. The following figures show the Preneutralizer.

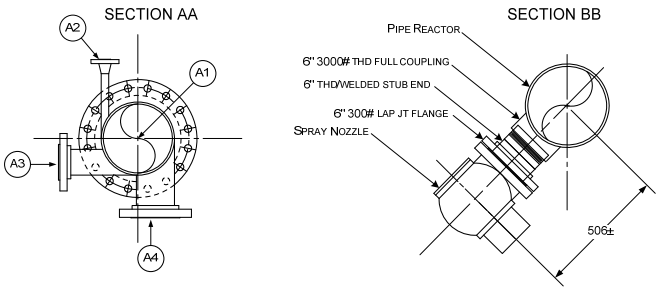


II. GRANULATOR

The Granulator internals were replaced with a Pipe Reactor which can be used as a slurry distributor with ammonia to the Pipe. An Ammonia Sparger for liquid ammonia was added. The Granulator internals are shown in the following figures:

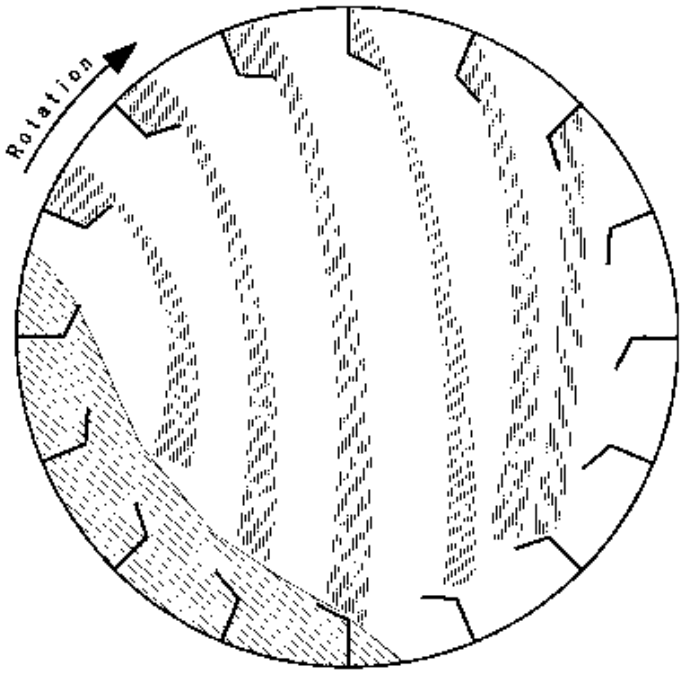


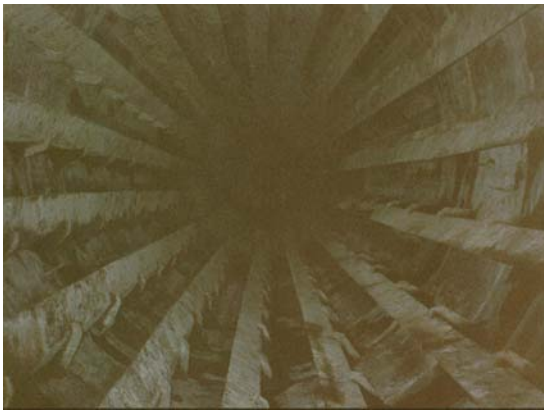




III. DRYER

The Dryer slope and speed were increased and the flights were changed to ensure good air contact. The dryer internals are shown in the following figure:





Inlet Flights

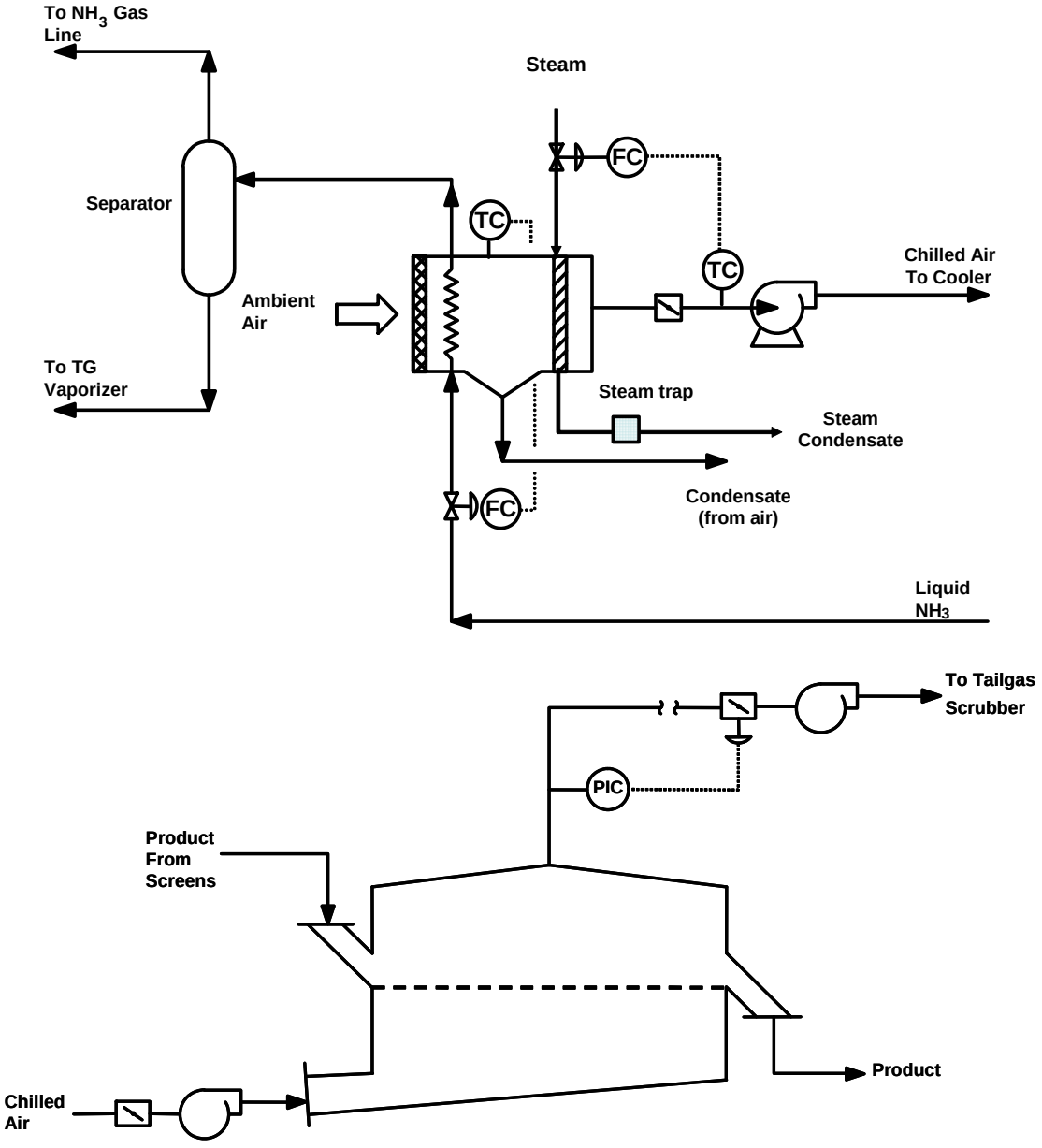
Outlet Flights

IV. DUAL-MOLE SCRUBBING

A Prescrubber was added to circulate high mole ratio scrubber liquor to scrub the Granulator and Preneutralizer gasses. A new Venturi Cyclonic R/G Scrubber scrubs the gases from the Prescrubber with low mole ratio scrubber liquor. The Dual-Mole Scrubbing System is shown in the last Flow Sheet in this chapter:

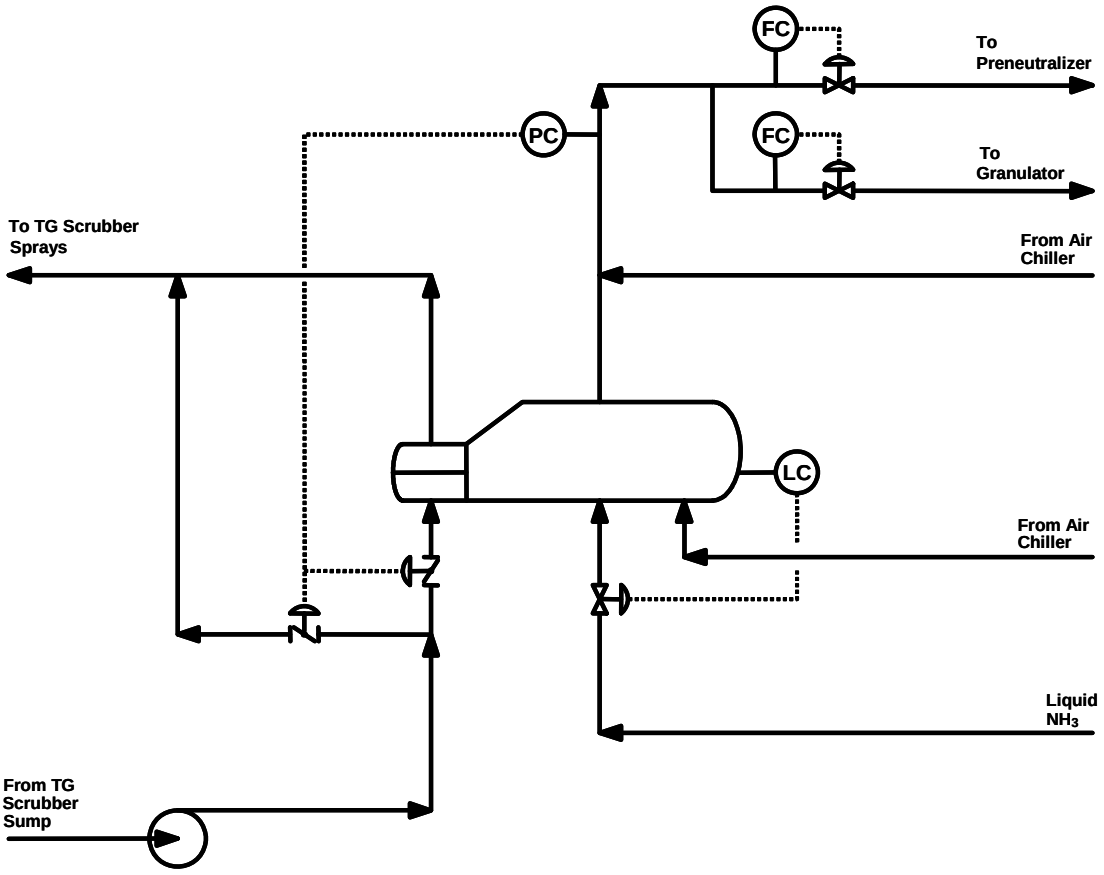
V. AMMONIA CHILLERS FOR COOLER AIR

Two Chillers were added to cool air for the existing fluid bed cooler. The following figures show the chillers and cooler:



VI. TAILGAS VAPORIZER

A Tailgas Vaporizer was added to cool Tailgas Scrubber liquor to vaporize ammonia. The following figure shows the Tailgas Vaporizer:



VII. POLISHING SCREEN

A J&H vibrating screen was added in parallel to the existing screen to ensure on specification product sizing.

VIII. RELOCATED EQUIPMENT VENTILATION FAN

The existing Granulator Fan was relocated as an Equipment ventilation Fan increasing the ventilation air to104,000 m^3/h.

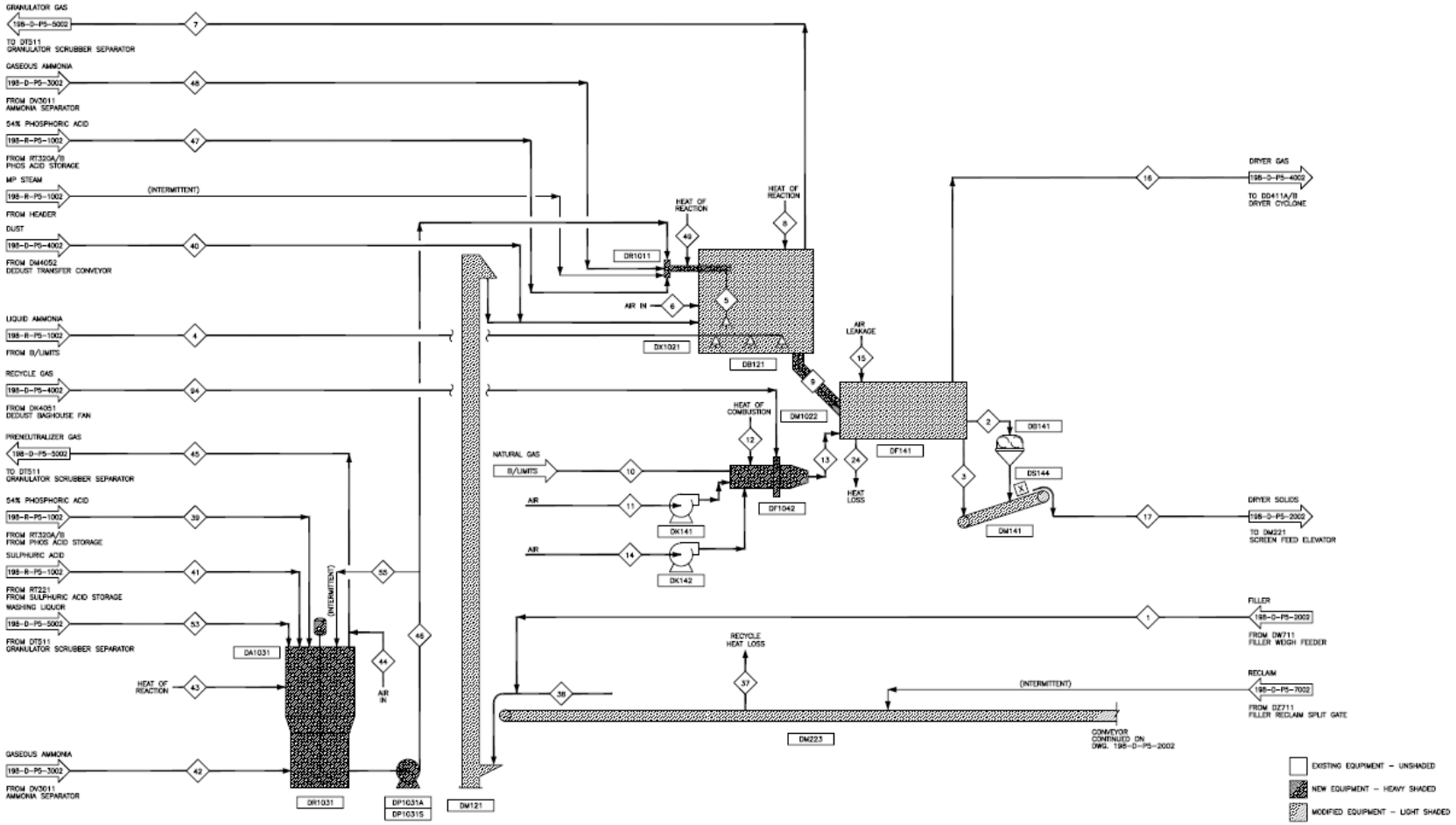
IX. VENTILATION SYSTEM BAG HOUSE DUST COLLECTOR

A new Bag House Dust Collector was added to remove solids from the air recycled to the Hot Gas Generator.

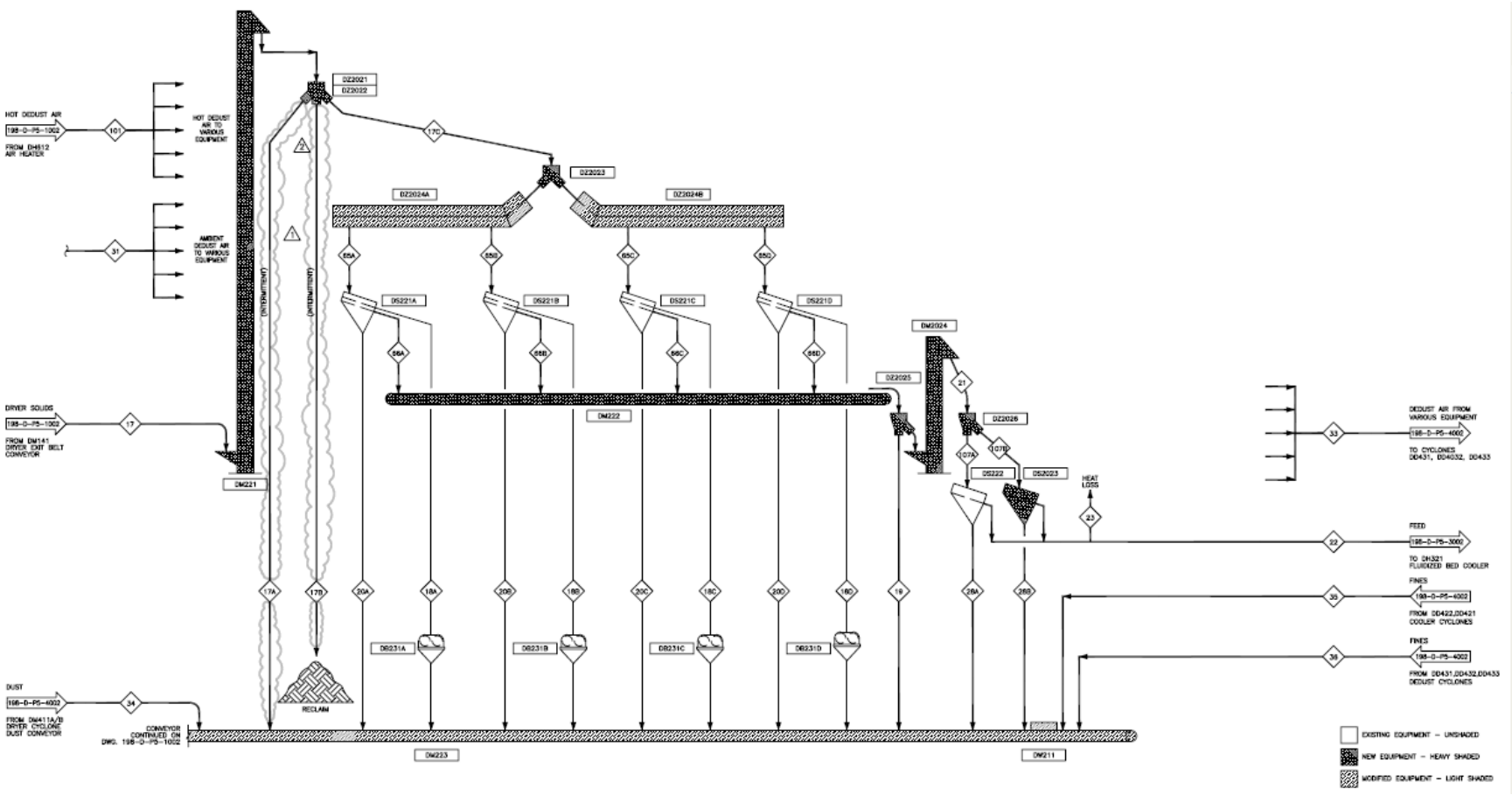
X. FLOW SHEETS

The following Flow Sheets show the added and modified equipment:

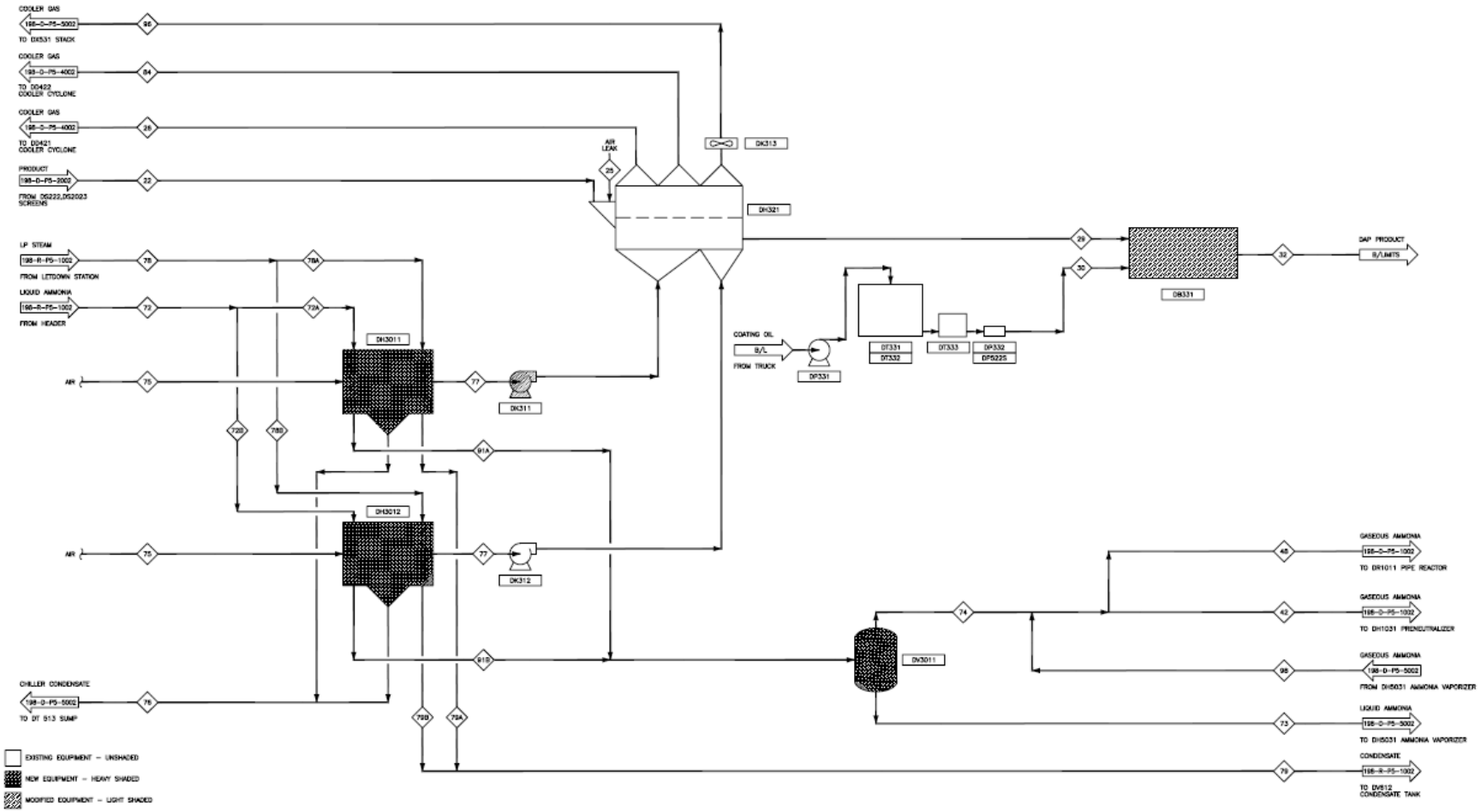
GRANULATION-DRYING (1002)



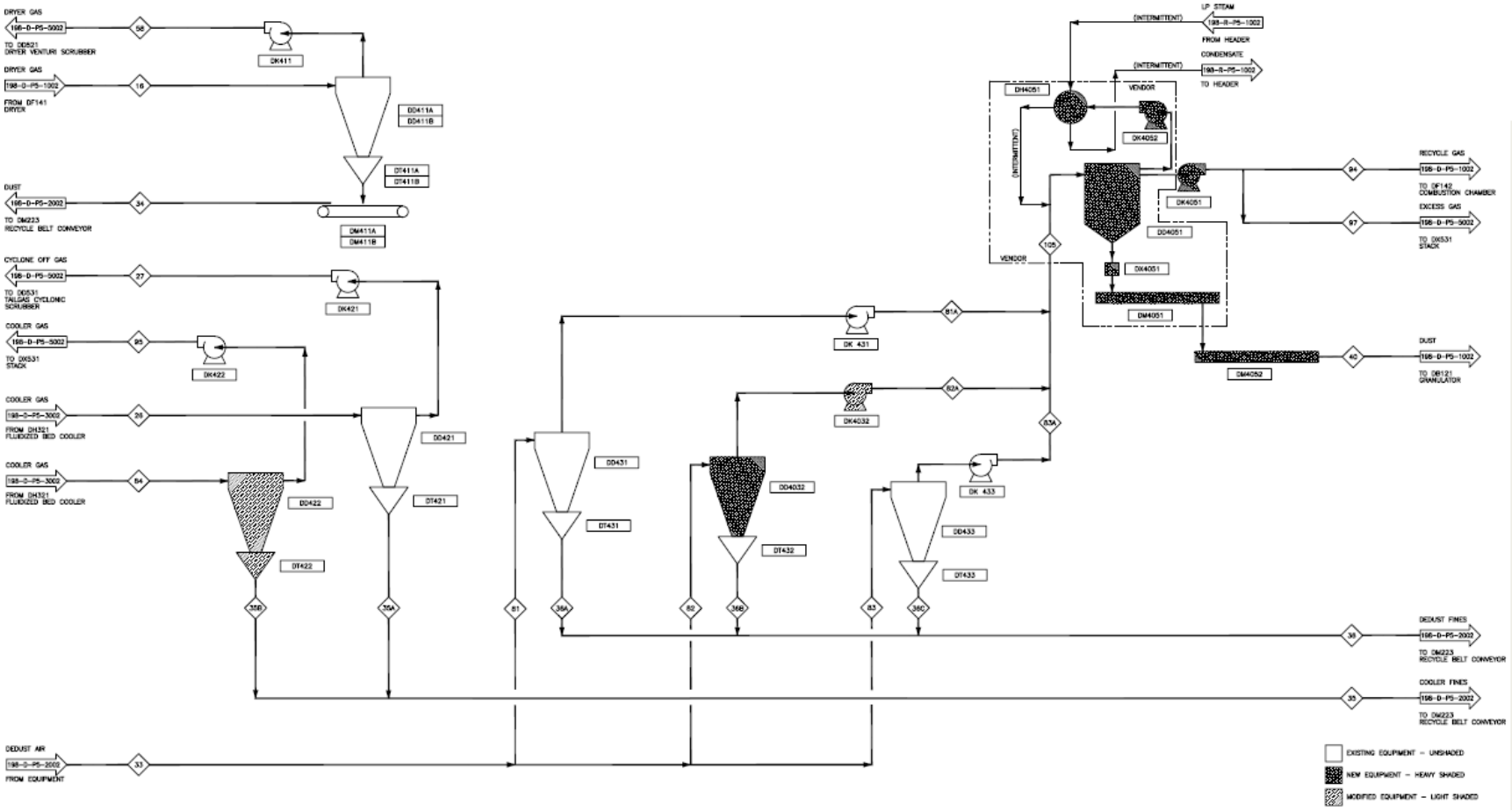
SCREENING/CRUSHING (2002)



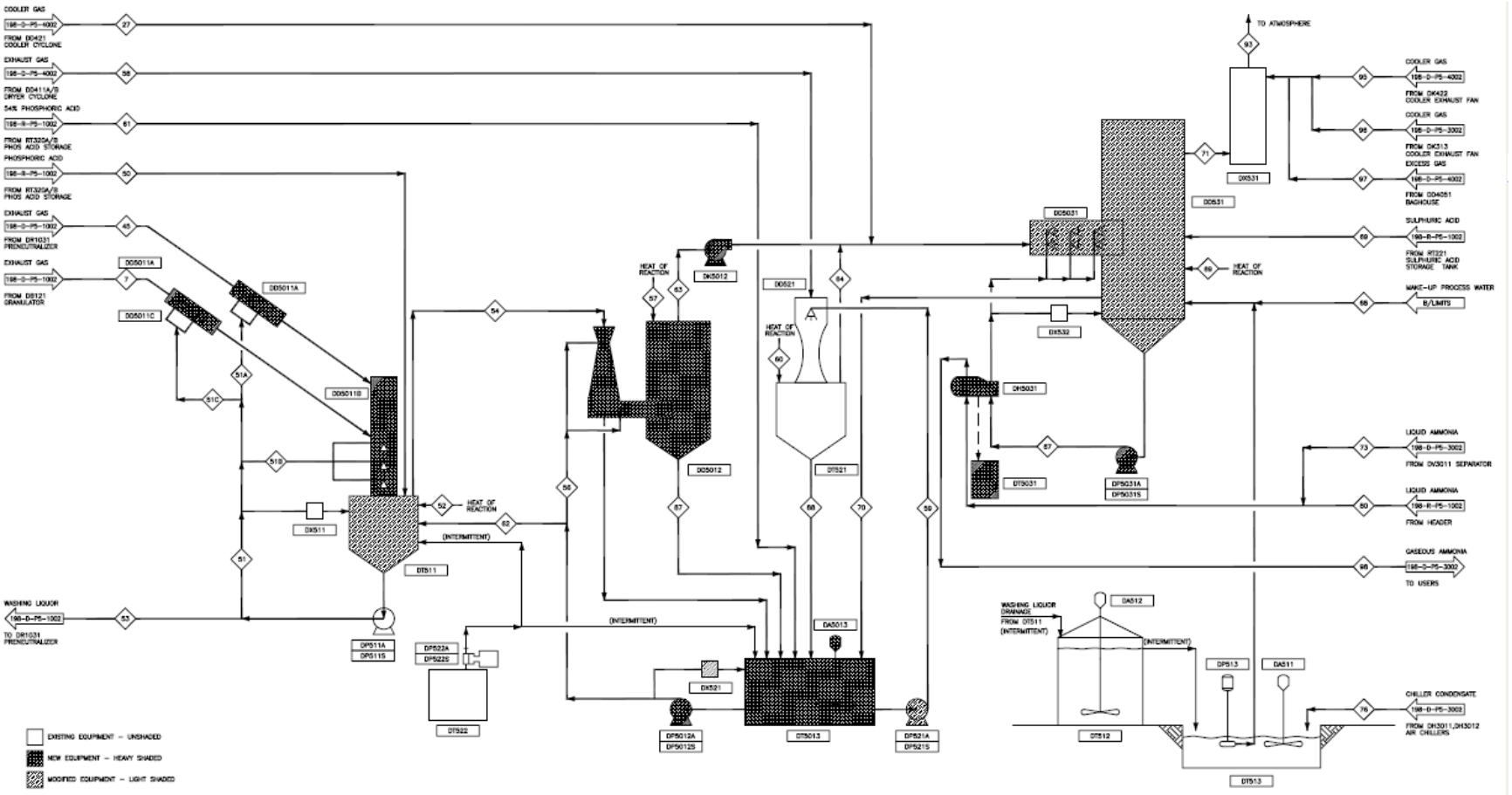
FINAL COOLING & COATING (3002)



DEDUSTING (4002)



DUAL-MOLE SCRUBBING (5002)



3. CONSTRUCTION ACTIVITIES

I. PRE SHUTDOWN ACTIVITIES:

FFBL is the only DAP plant in Pakistan and has major contribution in supply of DAP fertilizer for cereal crops. Accordingly, each day of shutdown has serious impact on country's agriculture situation. On the basis of above, task was assigned to reduce shutdown duration for modification works to minimum possible level. In order to achieve this gigantic challenge, FFBL planned for pre-arrangements and to cover all possible works during Pre-shutdown activities.

After receipt of major equipment and bulk materials, pre shutdown activities started on 13 September 2007. Following were the main areas covered:

- Inspection of all equipment / machines at site and address damages to make fit for installation.
- Inspection / verification of bulk materials.
- Civil works / foundations for equipment falling out of operating plant battery limit i.e. Baghouse, new Scrubbing Area (30x6.5 m) RCC area with antacid coating / tiling works.
- Mobilization of construction contractor with all pre arrangements.
- Prefabrication of Steel Structure (total 250 T)
- Prefabrication of Piping (total 5 km length / 17500 dia inch)
- Prefabrication of CS ducts and chutes (total 80 T)
- Prefabrication of FRP ducts and transition pieces.
- Prefabrication of in-house items e.g. seal pot, strainer baskets, polishing screen hopper etc
- Pre-arrangements and mock up exercises for successful execution of following heavy rigging activities:
  - Slope change and replacement of riding ring of dryer () and Granulator.
  - Installation of Ammonia vaporizer over slide-in roller arrangement.
  - Removal and installation of new Hot Gas Generator.
  - Installation of new Baghouse at level of 17 meter height from ground.
- Modification in MV switch gear, laying of MV / LV cable and prefabrication of cable trays, JBs etc.

As overall, DAP Revamp project was a FAST TRACK project, therefore, very less margins were planned to handle problems / surprises. Following were the problems faced during pre-shutdown works:

Problems	Remedies
Delay in Detailed Engineering Package and Issue For Construction (IFC) drawings to start with prefabrication works.	• Visit of FFBL team to Jacobs office for design review and issuance of IFC drawings. • Preparation of Construction Package by FFBL to start time consuming bidding process.
Delay in Bulk materials ordering	• Advance ordering on estimate basis. • Split ordering • Back up working for in-house alternates. • Day to day follow up to expedite.
Delay in tools / foreign workforce for dryer / granulator modification	Shutdown start date revised from 27 November to 10 December 2007.

II. SHUTDOWN CONSTRUCTION ACTIVITIES:

Shutdown for DAP Revamp construction works were planned for 84 days staring from 27 November 2007, however job completed in 83 days (10 Dec 07 to 01 March 2008) thru shear hard work, planning and effective pre-arrangements / prefabrication.

Following were the major works covered by 03 main contractors:

A. Civil works thru local companies
B. Dryer / Granulator / Coater modification thru COMESSA France / DLM Morocco
C. All other mechanical / Electrical / Instrument works by DESCON Pakistan.

A. CIVIL WORKS:

DAP plant is housed in RCC building with 05 levels / floors. For DAP Revamp, civil works includes modification / construction of ~ 50 RCC foundations and required at each level with major works as under:

- Partial demolition of huge existing foundations and construction of new foundations for modifications / slope change in Dryer with total RCC concrete ~ 263 cubic meters.
- Partial demolition of huge existing foundations and construction of new foundations for modifications / slope change in Granulator with total concrete ~ 15 cubic meter at 12 meter level from ground. Granulator civil works include special design of thru bolts to retrofit in existing roof for drive mechanism
- Special foundations of RCC beams on roof at level 17 meter with 0.85 meter high 60 meter cube RCC beams.
- Foundations / floor with anti acid coating / tiling for new Scrubbing area including major foundations of RG scrubber fan, Preneutralizer, Ammonia vaporizer and various pumps with total RCC concrete 390 cubic meter.

- Preparation of miscellaneous foundations at each level in existing plant.
- Modification in existing foundations / opening for installation of new / modified equipment.

B. COMESSA WORKS:

1. DRYER:

(4.2m diameter, 29 m long, carbon steel rotary drum for product drying with estimated weight of ~100 ton)

Existing Slope	2.5%
New Slope	5%
Existing RPM	2.2
New RPM	3.8

Modification in dryer was main critical path activity planned for 84 days and includes heavy rigging (rigging schematic is attached as Annex-I). Main modification works done are as under:

- Fabrication of temporary supporting steel structure columns of Dryer.
- Fabrication of steel structure for Riding Ring removal and installation.
- Disassembling of existing feed chute, inlet dam & outlet box.
- Removal of existing Dryer Pipe Reactor.
- Removal of existing hammering system and its steel structure.
- Disassembling of existing Internals (lifters, scrolls & grizzlies)
- Removal of steel structure of crusher at North side.
- Installation of temporary supporting columns below Dryer.
- Loading of Dryer over temporary columns with the help of hydraulic jacks.
- Removal of North side Riding Ring.
- Removal of supporting & thrust rollers and existing Drive system.
- Installation of new Riding ring.
- Installation / welding of new internals (lifters, scrolls & grizzlies)
- Modification in 03 civil foundations for new slope and drive system.
- Adjustment of slope of foundations sunk plates.
- Installation of new structure around foundations and structure for crusher.
- Installation of new drive system.
- Unloading and removal of temporary columns below Dryer and loading on supporting rollers.
- Installation of new Dryer Feed Chute
- Adjustment of HGG Duct at inlet of Dryer.
- Installation of new inlet dam and cone.
- Installation of new hammering system.
- Installation of outlet box after modification and of crusher.
- Installation of hydraulic system for door opening of feed chute.
- Mechanical Test with Empty Drum
- Punch List, Demobilization with cleaning and house keeping.

Challenges / Problems

1. As the Revamp jobs of Dryer also involved modification in civil foundations and removal of riding ring, load of Dryer was to be transferred on some structure / foundation. Temporary steel column type supporting arrangement was made for this purpose. There were 03 supports with two columns in each, placed at some distance. Load of drum was transferred with the help of hydraulic jacks on such columns.

2. Replacement of riding ring was also a problem particularly in the scenario when heavy indoor rotary equipment was involved. For this purpose, a sliding type structure was fabricated. This involved careful examination of the elevation level of the drum which was on the temporary columns (since clearance between drum and riding ring was not more than 10 mm). The structure was then slid over rails and pulled out of the plant where it was easily rigged out by crane.

3. There was lot of welding job involved inside Dryer. Total no. of 324 lifters of 2m & 2.6m length, 18 scrolls and grizzlies took loads of days to complete the job. Also, once the Dryer was loaded on supports, it was not possible to rotate the drum, hence overhead welding of lifters was carried out with quality work. The entire job was planned for 84 days, however same was achieved well before that i.e. in 70 days.

4. Due to involvement of huge concrete, gap appeared between sunk plate and top of concrete upon curing. Same was handled thru on time decision for change in conventional pouring technique to pump pouring. The gap was filled with epoxy non shrink grout thru injection.

2. GRANULATOR:

(4m diameter, 9m long, carbon steel rotary drum for Granulation with estimated weight of ~45 ton Installed at 12 m level)

Existing Slope	3%
New Slope	6.23%
Existing RPM	7-10
New RPM	9

Modification in granulator was 2nd longest activity planned for 78 days. Due to its complex design and location, delay occurred however job completed within overall project timeline (rigging schematic is attached as Annex I). Sequence of major activities is as under:

- Fabrication of temporary supporting steel structure for Granulator
- Fabrication of steel structure of Riding Ring removal and installation.
- Removal of existing rubber panels inside Granulator.
- Removal of Feed Chute, stationary plate and outlet box..
- Disassembling of Granulator internals (Ammonia sparger & GPR)
- Removal of existing grizzlies
- Installation of temporary structure below Granulator and loading of Granulator over it with the help of hydraulic jacks.

- Removal of existing riding ring.
- Removal of both supporting & thrust rollers and Drive system with frames / skids.
- Installation of new riding ring at east side.
- Demolition of 03 existing civil foundations.
- Construction of new 03 civil foundations and adjustment of new slope of sunk plate.
- Installation of new thrust rollers and reinstallation of existing supporting rollers.
- Reinstallation and installation of Main and Baring Drive systems respectively.
- Unloading and removal of temporary steel structure below Granulator and loading on supporting rollers.
- Installation of new rubber panels inside Granulator
- Installation of new outlet dam and grizzlies.
- Reinstallation of outlet box.
- Erection of new steel structure at both ends of drum.
- Fabrication and installation of new Stationary Plate at feed end.
- Installation of new Feed Chute
- Installation of new GPR with supporting pipe & wiper system, and Ammonia Sparger inside Granulator.
- Installation of Air bladder and cannon system for Granulator discharge chute.
- Mechanical Test with Empty Drum
- Punch List, Demobilization with cleaning and house keeping.

Challenges / Problem

1. During construction of new civil foundations, a problem occurred that there remained a gap of ~10 mm between sunk plate and concrete after curing. For the remedial action, additional holes were made in sunk plates in conjunction with designer, to fill out this gap with non-shrinkable epoxy grout.

2. As modification in all 03 civil foundations of Granulator was also the part of DAP Revamp, the load of the drum had to be transferred to some structure or with ceiling as well in the multi-storey plant. For this purpose, a saddle-type heavy structure was designed which was assembled in the field due to rigging constraints. The load thus transferred with the help of hydraulic jacks.

3. Replacement of Riding Ring was also a major culprit especially in the case when there involved a multi-storey plant. Special attention was given to that activity and all pre-measurements were taken that includes fabrication of temporary steel structure for installation and removal of heavy ring and its installation at 1st floor of the plant.

3. COATING OIL DRUM:

Replacement of existing friction tyre rolling drive system with new girth gear system on existing oil coating drum. The sequences of major activities are as under:

- Disassembling of Outlet box and outlet dam.
- Installation of new outlet dam.
- Removal of existing drive system

- Construction of 01 new foundation for new driving system.
- Installation of new Drive System.
- Installation of new Girth Gear.
- Reinstallation of outlet box.
- Mechanical Test with Empty Drum
- Punch List, Demobilization with cleaning and house keeping.

C. DESCON WORKS:

Descon scope includes all other works required for DAP revamp construction covering Mechanical, Electrical and Instrumentation works. Following are the key figures of Descon Scope:

- Piping (Metallic + PPFRP) : ~5 KM
- Total welding (Metallic + PPFRP) : 16,000 + 6500 dia inches
- Steel Structure : 250 tons
- Duct & Chute Work (CS+SS) : (75 + 7) tons
- FRP Ductwork : 600m2
- Electrical works : MV & LV switch gear mod
- Instrument works : New DCS + PLC mod
- Electrodes used : 13 Tons

1. MECHANICAL WORKS:

In addition to piping / duct work and structure works with quantum mentioned above, following is the break up for new and modified equipment:

Total Equipment before/after Revamp : 108 / 124
Break up as under:

- No Change : 67
- New Add-on : 39
- Existing Modified : 15
- Existing Relocated / Removed : 3 / 23

Key sequence for each equipment is given as under:

Ammonia Vaporizer (Wt. = 25259 kg)

- Preparation of Hammer Head type civil foundation.
- Fabrication and erection of temporary steel structure (rail arrangement) as per rigging strategy.
- Rigging of exchanger using 200 Ton crane.
- Final installation using hydraulic jacks and dollies arrangement.
- Hydro-testing of exchanger after final alignment and installation.
- Final box-up of exchanger.

Primary Scrubber Tank (Wt. = 5000 kg)

- Preparation of octagonal shape civil foundation.
- Fabrication and erection of temporary monorail (capacity = 10 Ton) on steel structure.

- Rigging of tank using 200 Ton crane upto monorail access location.
- Rigging of tank using Gear Trolley arrangement and tank shifting to its foundation.
- Use of chain block to set orientation of tank.
- Final installation of tank on civil foundation.
- Static test of tank with demineralized water.
- Installation of Agitator assembly and test run.
- Final box up of Tank.

Pre-neutralizer Reactor (Wt. = 15710 kg):

- Preparation of octagonal shape civil foundation.
- Rigging of reactor using 200 Ton crane.
- Adjustment/ alignment of tank on civil foundation.
- Static test of tank with demineralized water.
- Installation of agitator and test run.
- Tank insulation.
- Final box up of Reactor.

RG Scrubber (Cyclonic 11500 kg & venture section 6600 kg):

- Shifting of cyclonic and venture section to site.
- Rigging and installation of cyclonic section on steel structure using 200 Ton crane.
- Rigging and installation of venture section on steel structure using 200 Ton crane.
- Adjustment/ alignment of cyclonic & venture section.
- Tightening of supporting lugs and bolts.
- Final inspection of RG Scrubber.
- Insulation of RG Scrubber.

Air Chillers DH-3011 / DH-3012:

- Removal of existing Air chillers with demolition of foundation.
- Construction of new foundation for air chillers.
- Shifting & erection/installation of air chiller thru folk lifter at site.

Conveyor Belt Modification DM-223:

- Removal & installation of existing gearbox, motor & drum with new one.

Fluidize Bed Cooler Modification DM223:

- Removal of existing perforated plates (2mm round holes straight staggered) opening area 9%, with its supporting arrangement.
- Installation of new perforated plates (2mm round holes 45 deg staggered) opening area 10%, with new supporting arrangement.
- Decreasing of width of fluidized bed cooler from 1515mm to 1390mm, in order fluidization air velocity.

Granulator Feed Elevator Retrofit DM121:

- Removal of existing buckets (dim 1000x364x500-5mm thk), 74 Nos.
- Removal of existing chain with drive, return and tail shaft. Total weight of old parts to be removed was approx 16 ton.

- Installation of new drive, return & tail shaft with chain on existing casing.
- Installation of new buckets (dim 914x330x450-5mm thk), 121 Nos.

Screen Feed Elevator Retrofit DM221;

- Removal of existing buckets (dim 1000x364x500-5mm thk), 104 Nos.
- Removal of existing chain with drive, return and tail shaft. Total weight of old parts to be removed was approx 20 ton.
- Installation of new drive, return & tail shaft with chain on existing casing.
- Installation of new barring drive.
- Installation of new buckets (dim 914x330x450-5mm thk), 121 Nos.

Dryer Exit Belt Conveyor Modification DM-141:

- Removal of complete existing belt with rollers, drive, gear box, drums and structure support.
- To achieve the new slope of 15o (previous 12 o with the horizontal) by lowering the tail drum elevation down and keeping drive drum elevation fixed.
- Modification in existing support steel structure according to new slope.
- Installation of new rollers (45 o trough idler roller, existing 30 o).
- Installation of new drive drum, gear box, motor and new belt.

Hot Gas Generator (HGG) DF-1042:

- Removal of old HGG (including instrumentation, piping & ducting etc) using rail type rigging arrangement (as no direct access to crane was available).
- Construction of new foundation.
- Installation of new HGG with interconnecting piping, ducting & instrumentation.

Baghouse DD-4051 (NEW):

- Construction of new foundation on existing building (~17.5m from ground).
- Erection of steel structure for Baghouse support using crane.
- Assembling/installation of Baghouse different components like Hopper, clean chamber, dusty chamber, screw conveyor, duct work, recycle air heater & fan, Bags with cages etc.
- Installation of baghouse instrumentation.

Polishing Screen Elevator DM-2024 (NEW):

- Construction of civil works for new elevator.
- Shifting/installation of elevator casing (dim 940x1626x ~2.5m) in 06 halves (Total casing height 15.2m).
- Installation of drive shaft with sprocket, take up shaft & tail shaft.
- Installation of main driving system including gear box & motor.
- Installation of new chain & buckets (dim 406x330x450-5mm thk) 70 Nos.

Polishing Screen DM-2023 (NEW):

- Construction of pedestals for new polishing screen support steel structure.
- Erection of steel structure.
- Installation/assembling of polishing screen with hopper on steel structure.
- Installation of interconnecting chutes.

Baghouse Fan DK-4051 (NEW):

- Construction of civil foundation on existing floor @ level 20.5m from ground with reinforcement from steel structure section.
- Shifting/ installation of Fan with impeller diameter of ~2.5m.
- Shifting/ installation of motor (rated power 355KW)
- Installation of interconnecting ducts & electrical power cabling.

2. INSTRUMENTATION

DISTRIBUTED CONTROL SYSTEM:

A Distributed Control System (DCS) is installed at DAP plant as the strategic control system and is responsible for safe operation and control of plant process. This DCS is a proprietary system of M/s ABB(former Bailey).

To implement logic modifications proposed by M/s Jacobs, expansion (addition of HCU to incorporate new analog / digital signals) under DAP Revamp project and up gradation/replacement of obsolete OIS & EWS of Infi-90 DCS system to fulfill the new state of the art operating requirements, was carried out by M/s ABB Pvt. Ltd.

Details of signals in new HCU are:

Analog Input Redundant (4 to 20 mA)	41 x 2
Analog Input Standard (4 to 20 mA)	50
Analog Output Redundant (4 to 20 mA)	20 x 2
Analog Output Standard (4 to 20 mA)	8
Digital Input Redundant	8 x 2
Digital Input Standard	02
Digital Output	60
Total I/Os for new HCU	**458**

EMERGENCY SHUT DOWN SYSTEM:

A Programmable Logic Controller (PLC) is installed at DAP plant as Emergency Shut Down System (ESDS) for safe shutdown in case of any process abnormality. This PLC is a proprietary system of HIMA, Germany.

The logic modifications proposed by M/s Jacobs required addition of PLC hardware.

M/s HIMA declared that installed system (H51-HS) is obsolete and is no longer in production. M/s HIMA also proposed up-gradation of PLC to latest available model (H51q-HS) and application software.

Hot Gas Generator – BMS:

The Burner Management System provide pilot and main flame detection, control and monitoring of burner startup and shutdown sequences including master fuel trip and purge.

The system include, a PLC (Programmable Logic Controller) remotely mounted in the DAP rack room and window based HMI with operational graphics, alarm management, event logging and first out indications.

3. ELECTRICAL

Electrical scope of work, associated with the "DAP Revamp Project", was not only related to the modifications / up-gradations / addition of electrical equipment and machines but also comprised of modification in Medium Voltage (MV) and Low Voltage (LV) switchgears and motor control centers.

In total two (02) new MV motors (DK-5012 & DK-4051) have been added, in addition to the up-gradation of one MV motor (DF-141). Moreover, operating philosophy of Granulator MV Drive (DB-121) has been modified to incorporate reverse rotation of the motor.

Due to these modifications / up-gradations, installation of new panels for DB-121 (02 Nos.) and modification in spare panels to incorporate new / upgraded MV motors (DK-5012, DK-4051 & DF-141) was carried out under the supervision of OEM M/s Areva Germany.

Medium Voltage power, control and instrumentation cables for above mentioned MV motors were also installed.

Under DAP Revamp Project, forty three (43) new LV motors were installed. The job scope includes provision and laying of power and control cables, their control stations etc. for these new motors.

Since, we have limitations in existing LV switchgear and Motor Control Centers (MCCs), to incorporate these new LV motors, extension of existing LV switchgear besides addition of new MCC was carried out. The same was also done under the supervision of Areva Germany.

In accordance with the operating philosophy of Pre-Neutralization pumps (DP-1031 A/S), which require variable speed control, two (02) new 90 KW Variable Frequency Drives (VFDs) have been added in the Substation Equipment. Similarly, VFDs (03 Nos.) for polishing screen motors and vibrating feeder motors have also been added.

In addition to above mentioned major jobs, improvement in electrical distribution, lighting, communication, fire alarm and grounding systems were also carried out.

In order to ensure smooth commissioning and operation of the Plant, overhauling of existing two (02) MV motors and thirty three (33) LV motors was also carried out.

All the jobs were executed as per plan and no major problem was experienced during the overall revamp / commissioning activities.

4. START-UP AND OPERATION

I. PRE-COMMISSIONING ACTIVITIES:

As per actual plan, pre-commissioning activities were planned from Mar 03 to 17, 2008 (refers Annex IV). However, availing the opportunity of machines and equipment availability, the pre-commissioning activities were reviewed with all concerned and it was decided to start some of the activities in parallel from **Feb 21, 2008**.

Following were the major Pre-commissioning activities:

1. Air Blowing and Water Flushing of lines.
2. Water run of Scrubbing Circuit.
3. Hydro testing.
4. Loop testing and checking of DCS.
5. Calibration & Testing of new and old Instruments.
6. Control Valves stroke checking.
7. Commissioning of MV / LV Switchgear.
8. Electric Motors checks.
9. Mechanical test runs of Equipment and Machines.

By doing some of these activities in parallel with construction activities, precious time was saved. Construction activities were completed on **March 01, 2008** and plant was handed over to Production for commissioning / start-up activities.

II. COMMISSIONING ACTIVITIES:

DAP plant commissioning activities were initiated on March 1st, immediately after mechanical completion. **(Jacobs representatives could not be present in the commissioning and start-up activities and FFBL on their own carried out these activities however Jacobs was available to provide technical support remotely)**.

Some of the activities are summarized below:

1. Pressurization of Utilities Headers;
Networks of utilities (Nitrogen, Steam, Instrument Air, Service Air, Industrial Water, Demin Water) pressurized and taken in service. No major abnormality faced during this activity; however some minor leakages were observed which were readily rectified.

2. Pressurization of Raw material networks:
Raw material headers (Ammonia, Phos. Acid, Sulphuric Acid) were charged with the respective chemical. Ammonia and air can form explosive mixture when Ammonia concentration is 15 – 28%. Therefore all Ammonia lines were purged with Nitrogen to ensure less than 13% O_2 concentration.
All other chemicals were also charged upto the block valves of equipments and systems were made ready to connect feeds.

3. DCS Logic Verification with Machines / Equipment In-Service:

During actual logic verification, lots of problems were faced. Especially in the logics of Granulator / Dryer.

Coordinated efforts were carried out to rectify these problems. Some of the loop sheets and Functional Logic Diagrams (FLDs) were modified according to the requirement.

4. Scrubber Section Filling:

Water filling of scrubbing tanks was started on March 3rd. Jacobs's start-up procedures were followed as per following sequence:

- Filling of PN (66 %) with water. Start agitation; introduce steam, checks for leakages.
- Filling of Tail Gas Scrubber with water.
- Filling of Primary Scrubber Tank (60%) with water and start agitation.
- Filling of Pre-Scrubber with water.
- Starting all pumps and establish the circulation.

5. HGG Refractory dry-out:

Refractory dry-out of new Hot Gas Generator was a major commissioning activity. Dry-out was carried out in the presence of Saacke – France VSMs. The activity was started on March 6th. HGG firing was started at low load and Saacke procedure was followed. Dry-out was completed on March 9th.

Some delays were occurred due to problems in NG pressure control valve, instrument testing and logic verification/ software configuration etc. Few interruptions were also faced, however the dry-out was successful and no abnormality found in refractory inspection done on March 10th.

6. Loop Filling and Load Testing of Equipment:

Filling of Granulation loop with DAP Product was started on March 11th at 0300hrs thru Filler Elevator via reclamation.

Excessive material overflowing occurred from both the Vibrating Feeders and hanging slings got damaged. Loop filling was suspended for few hours and adjustments in Feeders / Splitting Gates were carried out.

During loop filling, recycle weigh scale indication was found erratic. The recycle weight was estimated based on material volume on Recycle Belt Conveyor. Afterwards scale was re-calibrated in next available opportunity.

Loop filling was completed by 0300 hrs on March 12th. During filling, all the solid handling equipment and machines were load tested. Field adjustments / alignments were carried out as per requirement.

All the fans were started before loop filling and checked during the loop filling activity. De-dusting / hot air circuits were taken in service prior to loop filling. No abnormality was observed.

During loop filling, HGG was fired at minimum firing and gradually increased the dryer exit temperature to 86 C.

III. PLANT START-UP WITH PRE-NEUTRALIZER:

A. After completion of all commissioning activities, start-up was initiated on March 12th with the scrubbing liquor preparation. Phos Acid (52 %P_2O_5) was introduced to maintain specific gravities. Jacobs's start-up procedures were followed.
B. Plant was started with only PN. Three smaller (dia 3inch) nozzles were used at positions 1, 2 & 3 from feed end while the fourth one was blinded.

C. Pre-Neutralizer slurry preparation was started at 0300 hrs on March 12th by adding scrubber liquor from Pre-Scrubber to PN. Phos Acid was also introduced at the 65-70% of liquor rate. At 45% of PN level, liquor and Phos Acid was stopped.

D. Ammonia Vaporizer was taken in service by opening of inlet & outlet valves of washing liquor to Vaporizer. After stabilization of Washing liquor flow, liquid Ammonia was introduced into the Vaporizer

E. After availability of gaseous Ammonia, PN sparger was taken into service and Ammonia Gas flow rate was adjusted so as to achieve MR and specific gravity at around 1.4 / 1.53 respectively. Sampling was carried out after every 10 min and strict vigilance was maintained.

F. Upon achieving the desired MR at 0700 hrs, Ammonia and Phos Acid was stopped and PN Pumps was tried to start on recycle mode, however PN pump was not started due to wiring and signal configuration problem. Problem was rectified and PN pump was started at 1400 hrs. Feeds to PN @ of 70% load were connected at 1410 hrs and Production resumed at 1440 hrs on March 12th.

G. Since start, all DAP production was on-specs which were sent to Storage Area for dispatches.

IV. PROBLEMS FACED:

During initial phase of plant operation, problems were faced which are outlined below:

1. Frequent Tripping and over loading of Vibrating Feeders.
2. Splitting Gates excessive passing.
3. Frequent tripping of crushers.
4. Poor Granulometry problem.
5. Scaling and material build-up on Granulator rubber panels
6. Damage of Granulator Motor V-belts.
7. Recycle Belt outlet chute chocking.
8. High Ammonia losses through stack.
9. Frequent tripping of De-dust Baghouse.

These problems were attended with aggressive approach. Shutdowns were taken as per requirement to rectify these problems. Vibrating Feeders, Splitting Gates were adjusted on-line / off-line by supplier J&H VSM.

Most of the chocking problems were related to poor granulometry. With the better control of process parameters, product granulometry was improved resulting in better plant operations.

V. PLANT OPERATION AT DESIGN LOAD:

Plant load was gradually increased and Plant design production of **2232 MeT / Day** was achieved on **April 09, 2008**.

To date we have achieved **2309 MeT / Day** production which is **103.5% of design**.

Plant is only operated at PN mode. GPR is not taken in service. However, it is planned to take GPR in service in near future and collect the plant Performance Test data at the earliest.

Plant operating parameters and trends are attached in Annex V.

5. PROJECT ANALYSIS & LESSONS LEARNED

I. PROJECT ANALYSIS:

We faced lot of challenges during the implementation of DAP Revamp Project.
We have analyzed our weaknesses and strengths as below:

	ISSUES	ACTIONS
STRENGTH	Proactive approach	Monitoring and stringent liaison to address problems in advance.
	Management commitment and Team work	Close & consistent liaison within organization and companies worldwide to improve deliveries
	In-house engineering know-how	Effective design reviews and managed to mitigate delays. Overall delay in Engineering reduced from 36 to 12 weeks thru in house efforts.
WEAKNESS	Communication Gap	Communication problems / refusal from vendors, however, effects mitigated with management efforts.
	Project Management Skills	We had no requisite project management skills to handle such large scale projects. Crash courses attended.
OPPORTUNITIES	Boom in oil & gas sector started in 2005	Early procurement of materials right after Basic Engg.
THREATS (IMPEDIMENTS)	Inability of Process designer to visit	All out efforts put-in by FFBL and carryout commissioning / start-up on there own.
	Delayed supplies	Airlifts & efforts were employed to complete the job with minimum delays resulting in additional work load.
	Manufacturing issues with foreign vendors	Timely intervention and expediting trips to critical vendors.

II. LESSONS LEARNED:

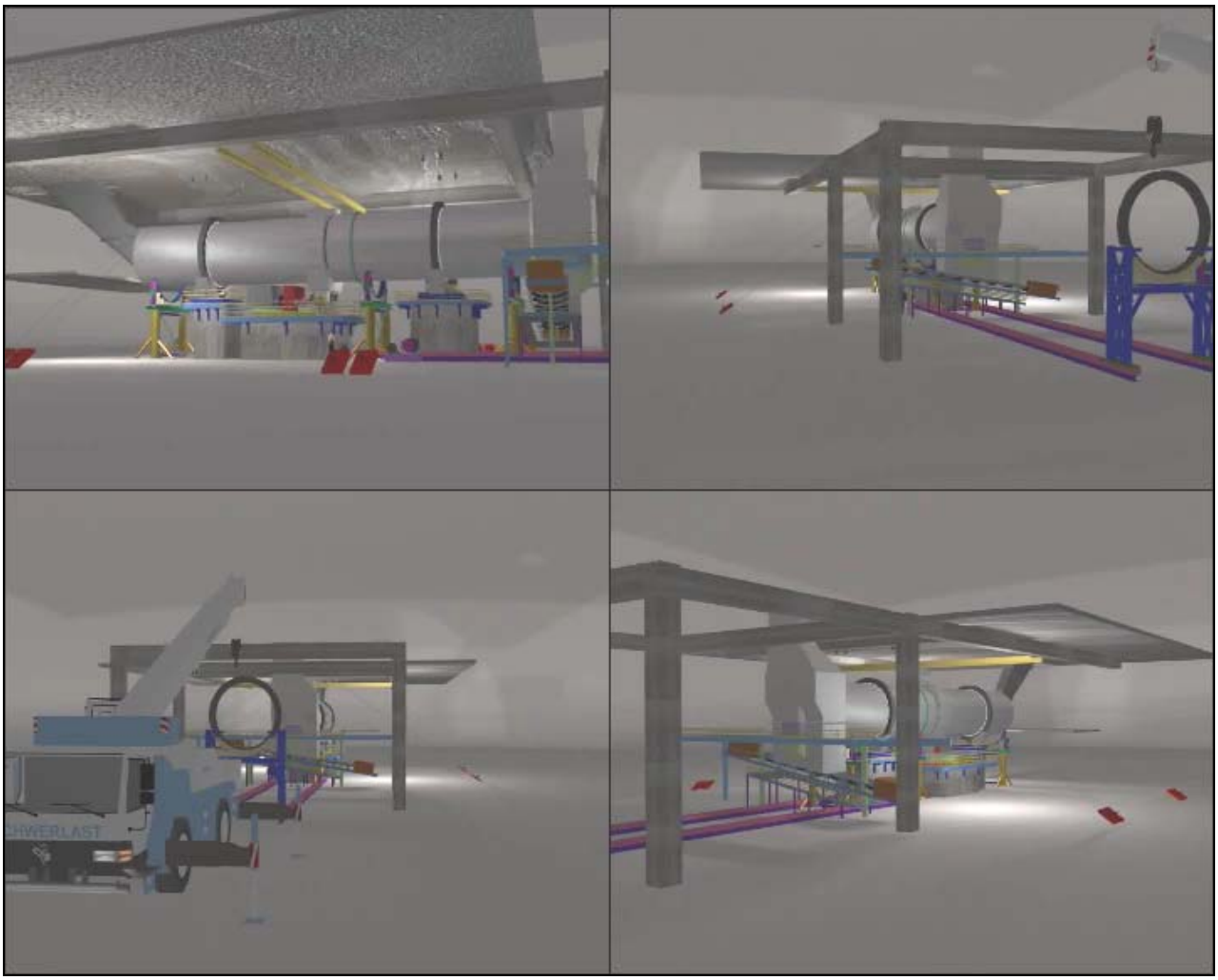
Every project has ups and downs, difficult situation, hurdles etc. But if we learn from our mistakes and problems faced during implementation, than eventually, it is a win-win situation

Major lessons learnt from this fast track project are summarized below:

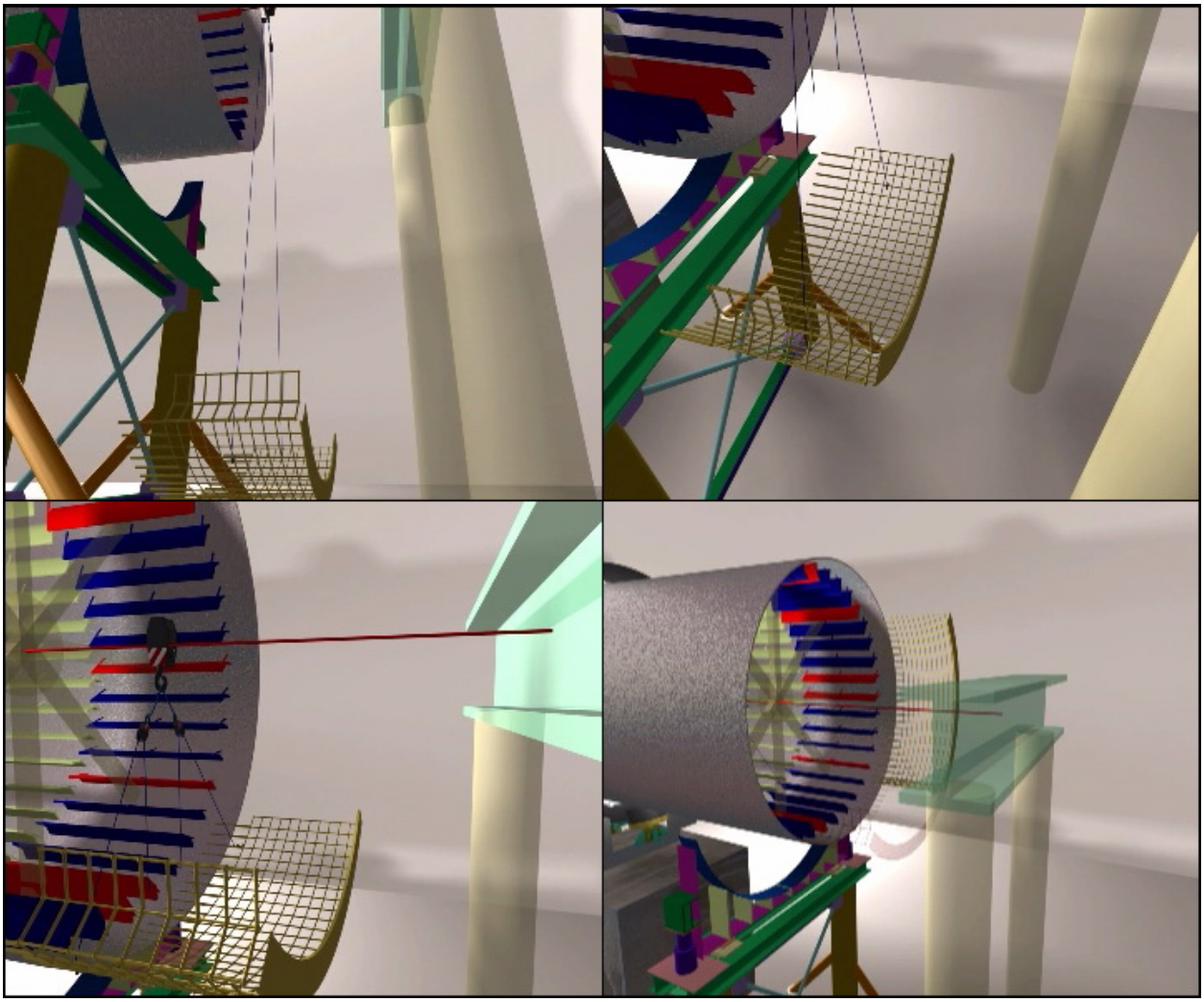
- Always establish Project Cost and implementation time after completion of Basic Engineering and receipt of quotes for Major Equipment. Consider reasonable contingencies in time and cost w.r.t project location.
- Workout fall back situations to avert material supply problems.
- Ensure complete understanding of job scope in totality for retrofit in existing system to meet new process requirements.
- Subletting by Engineering firms / vendors to be allowed after comprehensive review from all aspects.
- Try to avert problems related to vendor supplies by seeking the support of vendors Top Management.
- Address security concerns of vendors, by safety measures, projection of true picture and mitigating media hype.

6. ANNEXURES

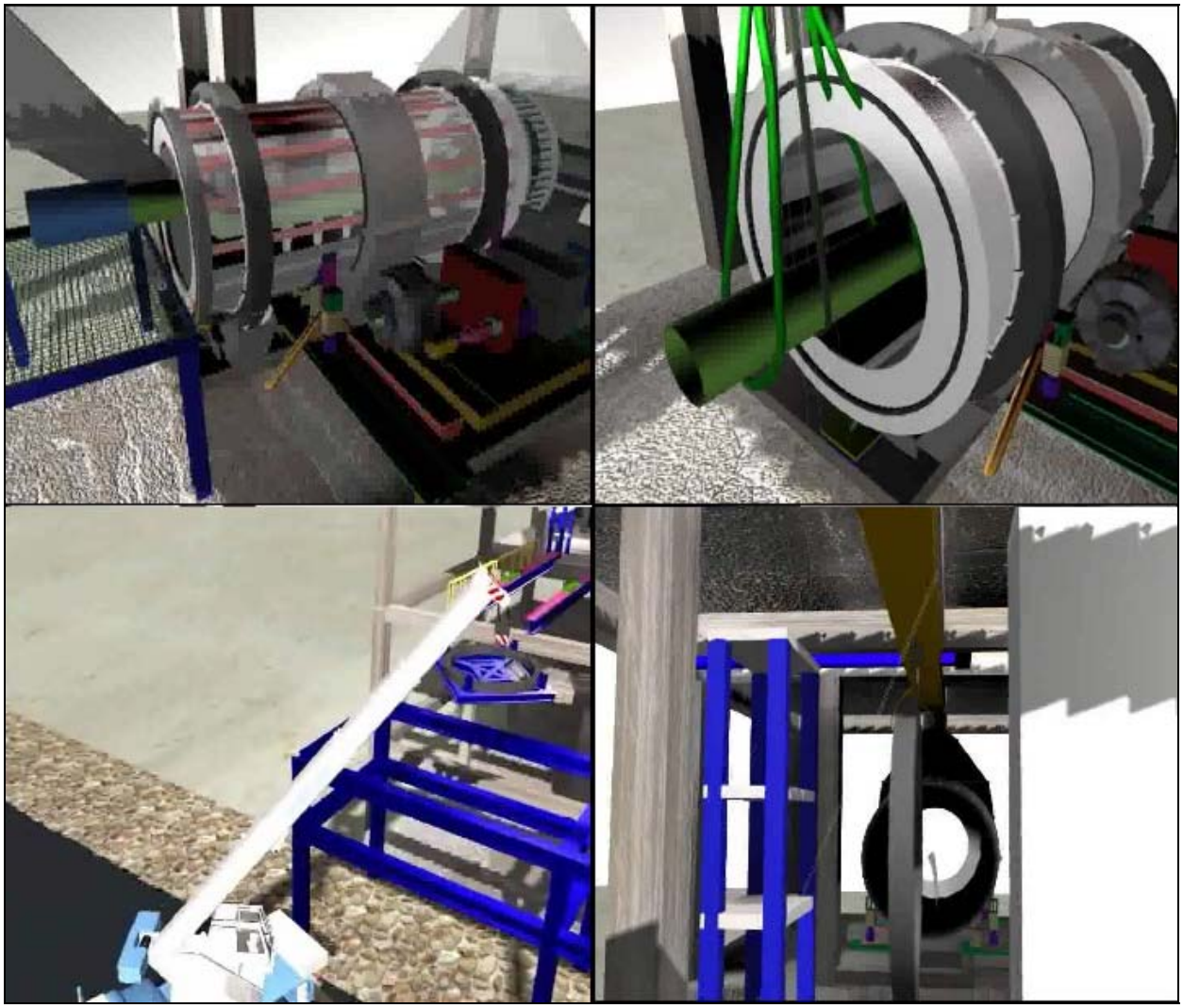
I. RIGGING SCHEMATIC



DRYER RIGGING ACTIVITY



DRYER RIGGING ACTIVITY

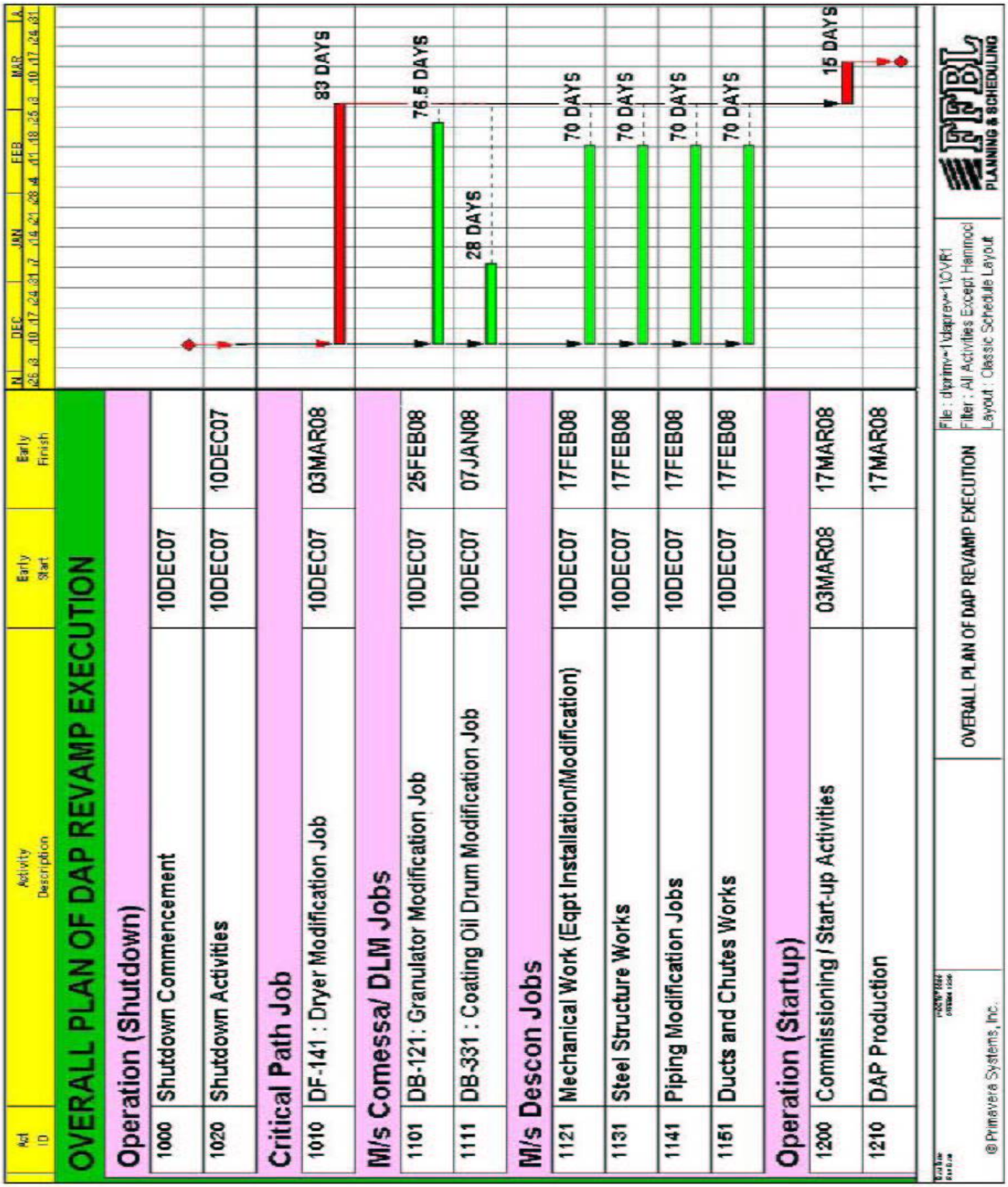


GRANULATOR RIGGING ACTIVITY

II. MATERIALS UTILIZED

Total orders (Foreign + local)	**168 (81 + 87)**
Piping (Metallic + PPFRP)	**~5 KM**
Total welding (Metallic + PPFRP	**14617 + 2828 dia inches**
Steel Structure	**250 tons**
Duct & Chute Work (CS+SS)	**(75 + 7) tons**
FRP Ductwork	**610 Sq Meter**
Civil Works (Concrete)	**~ 700 Cubic meter**
Electrical works	**MV & LV switch gear mod**
Instrument works	**New DCS + PLC mod**
Electrodes used	**13 Tons**

III. OVERALL PLAN

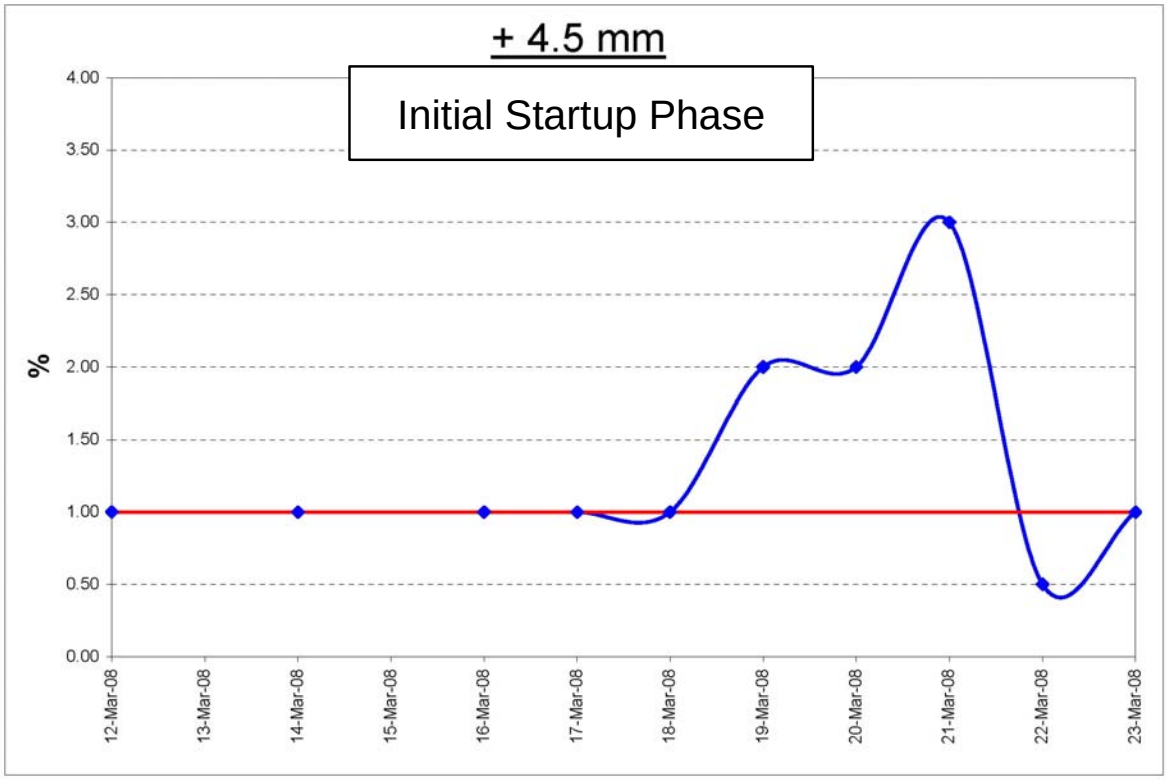


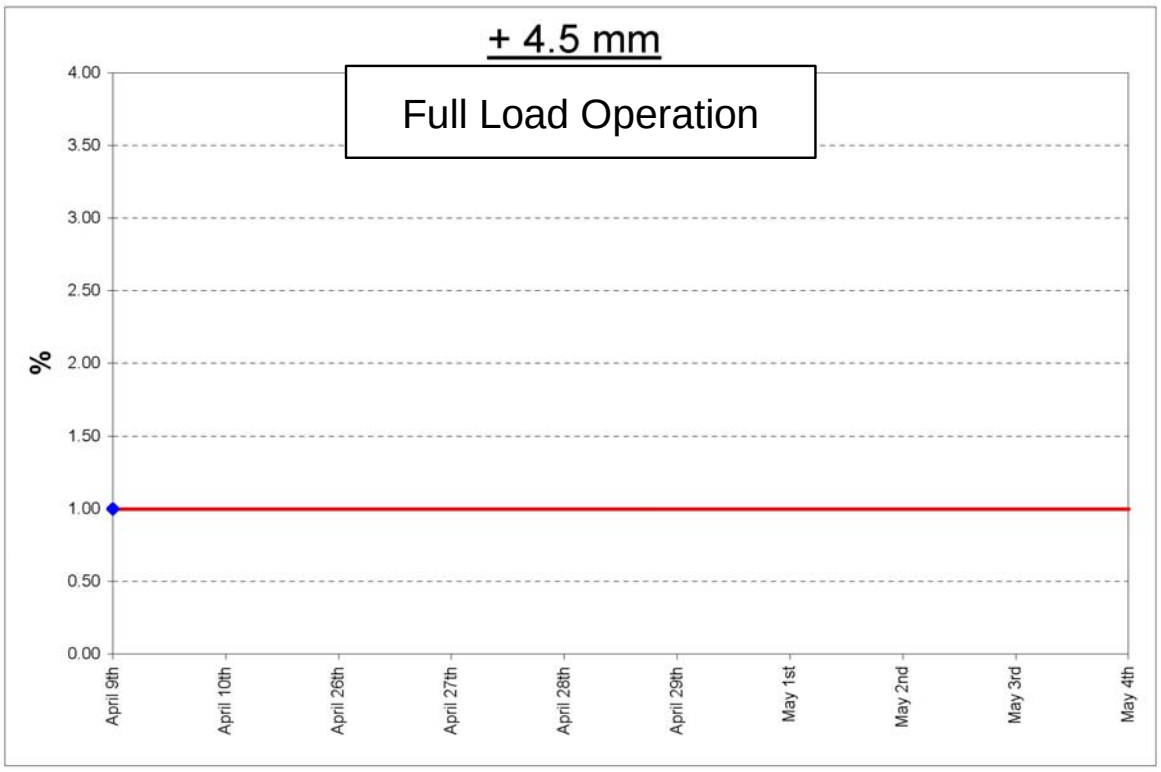
IV. OPERATIONAL DATA & TRENDS

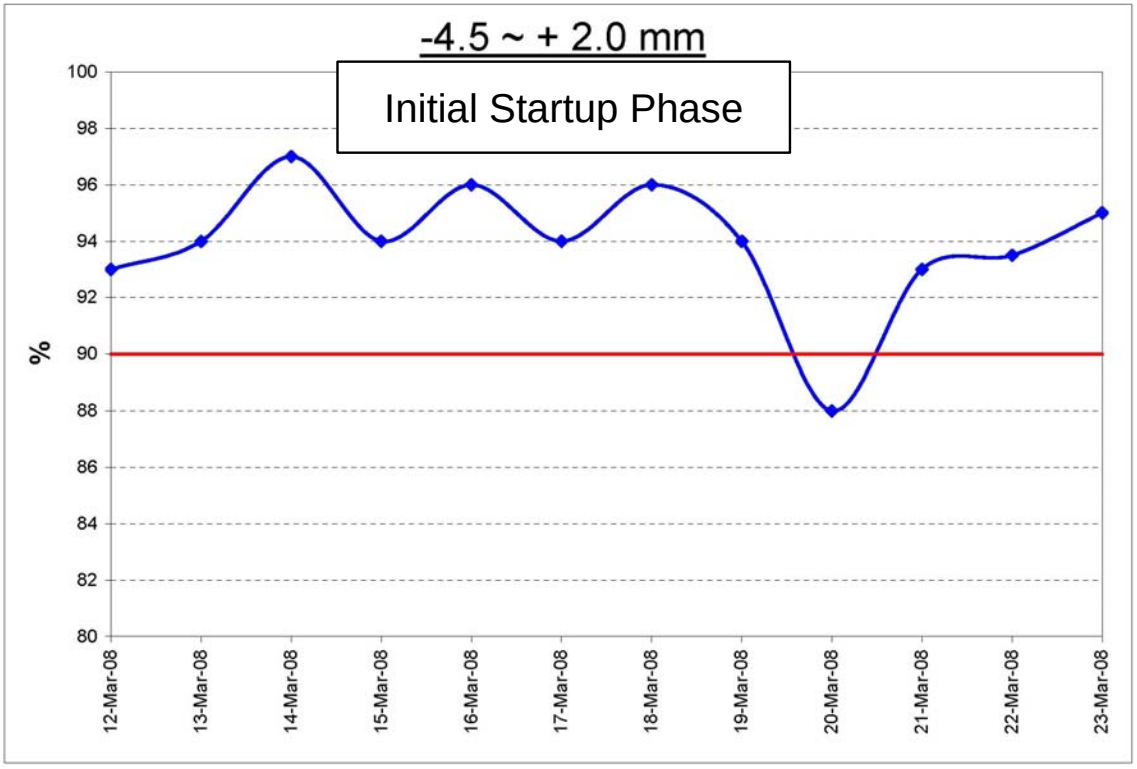
A. PRODUCT SIZE

DAP PLANT PRODUCT SIZE ANALYSIS (INITIAL START-UP PHASE)			
DATE	SIZE		
	+4.5	-4.5 ~ +2.0	+1.0
12-Mar-08	1.00	93.00	6.00
13-Mar-08	ND	94.00	6.00
14-Mar-08	1.00	97.00	2.00
15-Mar-08	ND	94.00	6.00
16-Mar-08	1.00	96.00	3.00
17-Mar-08	1.00	94.00	5.00
18-Mar-08	1.00	96.00	3.00
19-Mar-08	2.00	94.00	4.00
20-Mar-08	2.00	88.00	8.00
21-Mar-08	3.00	93.00	4.00
22-Mar-08	0.50	93.50	6.00
23-Mar-08	1.00	95.00	4.00

DAP PLANT PRODUCT SIZE ANALYSIS (DESIGN LOAD PHASE)			
DATE	SIZE		
	+4.5	-4.5 ~ +2.0	+1.0
April 9th	1.00	96.00	3.00
April 10th	ND	96.00	4.00
April 26th	ND	95.00	5.00
April 27th	ND	97.00	3.00
April 28th	ND	91.00	8.00
April 29th	ND	94.00	6.00
May 1st	ND	95.00	5.00
May 2nd	ND	95.00	5.00
May 3rd	ND	92.00	8.00
May 4th	ND	93.00	7.00


+ 4.5 mm
Initial Startup Phase
%
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
12-Mar-08
13-Mar-08
14-Mar-08
15-Mar-08
16-Mar-08
17-Mar-08
18-Mar-08
19-Mar-08
20-Mar-08
21-Mar-08
22-Mar-08
23-Mar-08


+ 4.5 mm
Full Load Operation
%
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
April 9th
April 10th
April 26th
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th


-4.5 ~ + 2.0 mm
Initial Startup Phase
%
100
98
96
94
92
90
88
86
84
82
80
12-Mar-08
13-Mar-08
14-Mar-08
15-Mar-08
16-Mar-08
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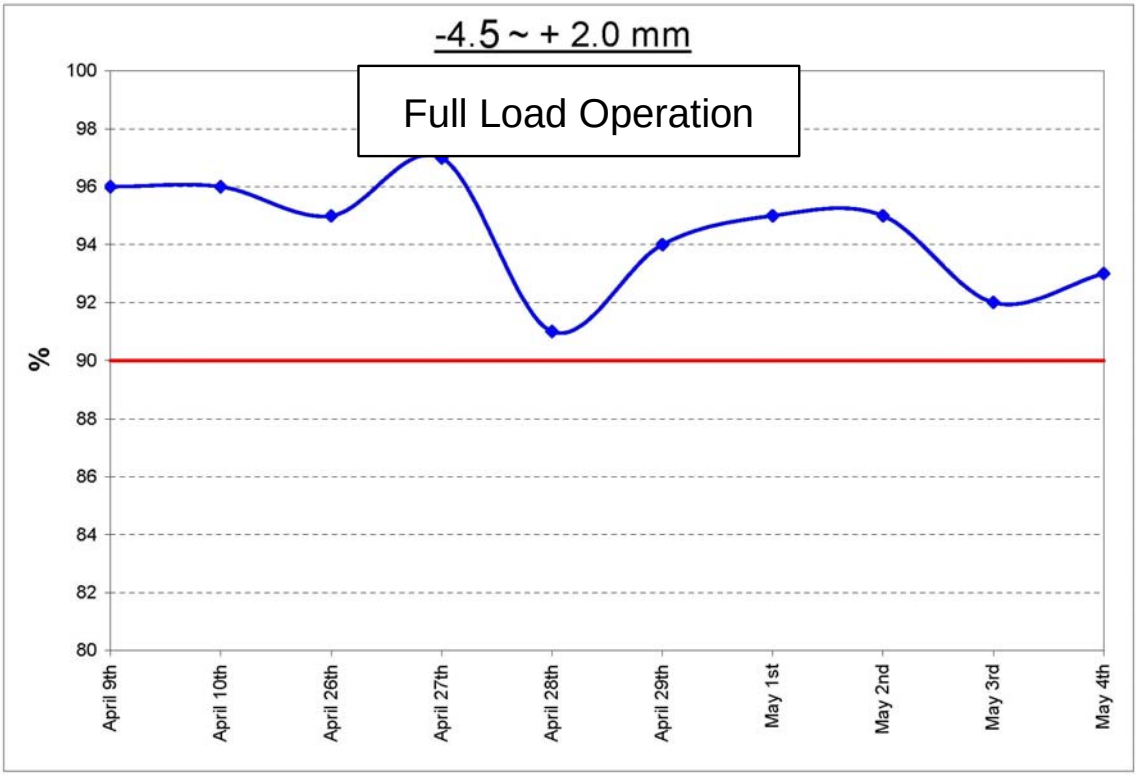
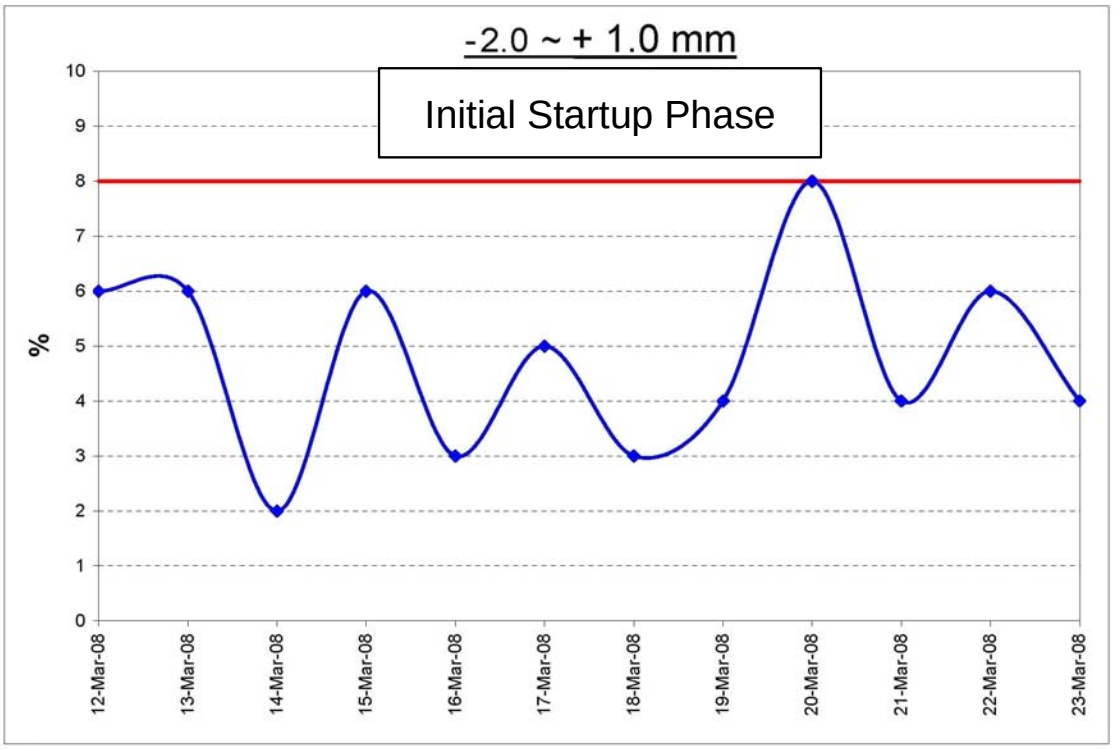
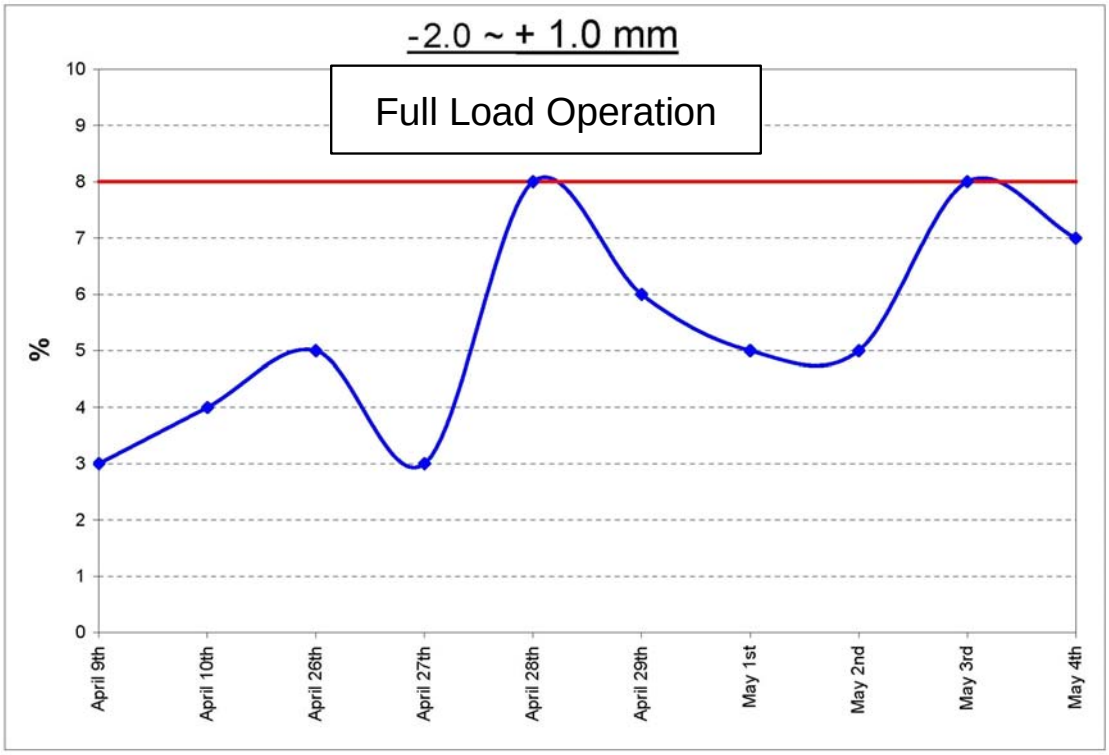
19-Mar-08
20-Mar-08
21-Mar-08
22-Mar-08
23-Mar-08


-4.5 ~ + 2.0 mm
Full Load Operation
%
100
98
96
94
92
90
88
86
84
82
80
April 9th
April 10th
April 26th
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th

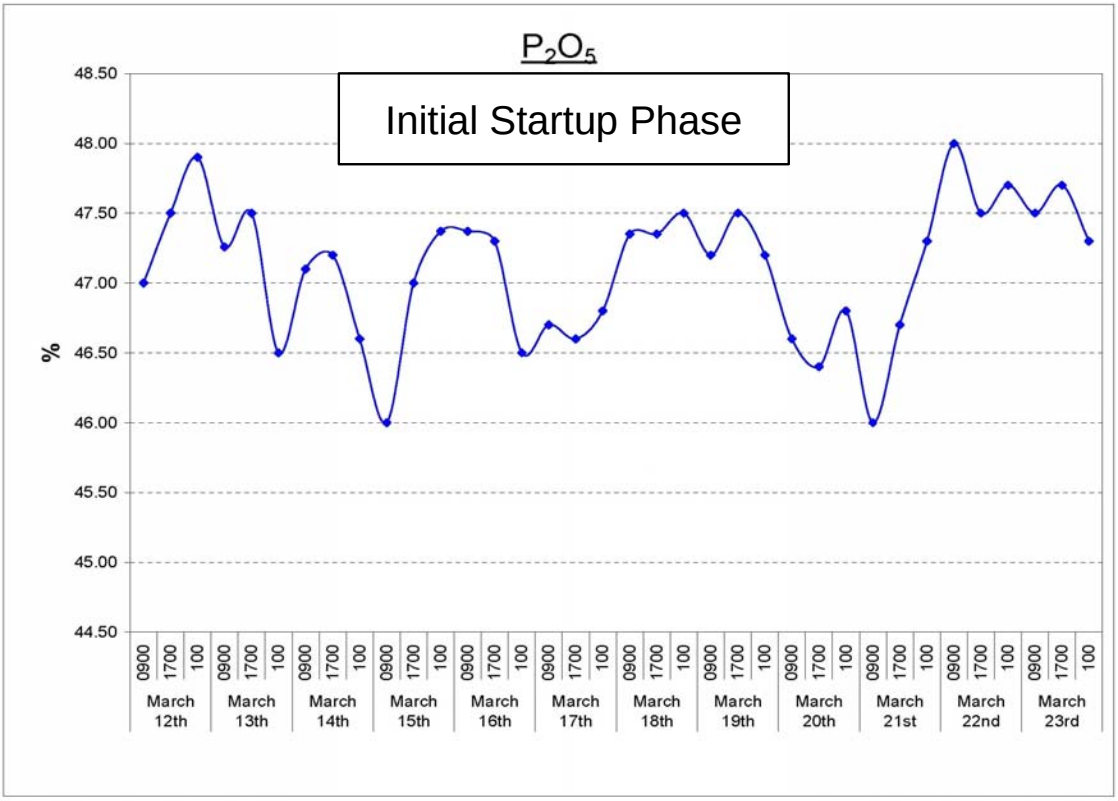

-2.0 ~ + 1.0 mm
Initial Startup Phase
%
0
1
2
3
4
5
6
7
8
9
10
12-Mar-08
13-Mar-08
14-Mar-08
15-Mar-08
16-Mar-08
17-Mar-08
18-Mar-08
19-Mar-08
20-Mar-08
21-Mar-08
22-Mar-08
23-Mar-08

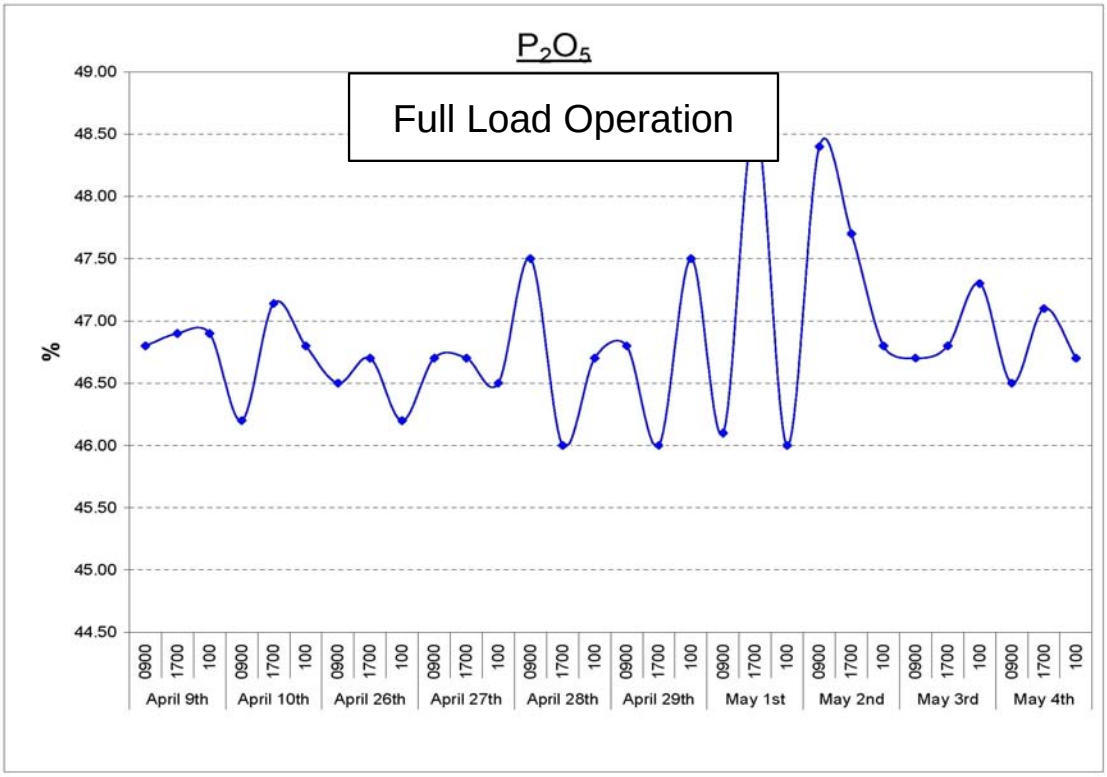

-2.0 ~ + 1.0 mm
Full Load Operation
%
0
1
2
3
4
5
6
7
8
9
10
April 9th
April 10th
April 26th
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th

B. PRODUCT QUALITY

INITIAL START - UP PHASE					
DATE	TIME	P_2O_5 %	N_2 %	H_2O %	
March 12th	0900	47.00	19.00	0.91	5.50
	1700	47.50	18.80	1.04	
	0100	47.90	18.36	0.91	
March 13th	0900	47.26	18.50	1.10	
	1700	47.50	18.30	0.80	
	0100	46.50	18.80	1.13	
March 14th	0900	47.10	18.40	1.10	5.28
	1700	47.20	18.80	1.26	
	0100	46.60	19.00	1.18	
March 15th	0900	46.00	18.60	1.15	5.85
	1700	47.00	18.40	0.99	
	0100	47.37	18.50	1.00	
March 16th	0900	47.37	18.50	1.00	
	1700	47.30	18.90	1.25	
	0100	46.50	18.30	1.46	
March 17th	0900	46.70	18.60	1.30	5.50
	1700	46.60	18.70	1.23	
	0100	46.80	18.70	1.15	
March 18th	0900	47.35	18.50	1.50	
	1700	47.35	18.50	1.50	
	0100	47.50	18.50	0.97	
March 19th	0900	47.20	18.30	1.05	4.98
	1700	47.50	18.50	0.97	
	0100	47.20	18.30	1.05	
March 20th	0900	46.60	18.50	1.10	5.60
	1700	46.40	18.10	1.08	
	0100	46.80	18.10	1.10	
March 21st	0900	46.00	18.10	1.31	5.25
	1700	46.70	18.50	1.19	
	0100	47.30	18.30	0.70	
March 22nd	0900	48.00	18.70	1.13	5.45
	1700	47.50	18.80	1.20	
	0100	47.70	18.90	1.06	
March 23rd	0900	47.50	18.50	1.12	5.32
	1700	47.70	18.50	1.10	
	0100	47.30	18.40	0.99	

DESIGN PHASE					
DATE	TIME	P_2O_5 %	N_2 %	H_2O %	Crushing Strength
April 9th	0900	46.80	18.70	1.46	5.60
	1700	46.90	18.50	1.37	
	0100	46.90	18.50	1.19	
April 10th	0900	46.20	18.80	1.15	5.26
	1700	47.14	19.00	1.20	
	0100	46.80	18.70	1.18	
April 26th	0900	46.50	19.30	1.31	5.17
	1700	46.70	18.40	1.43	
	0100	46.20	18.60	1.48	
April 27th	0900	46.70	18.60	1.54	5.27
	1700	46.70	18.80	1.30	
	0100	46.50	18.40	1.51	
April 28th	0900	47.50	18.60	1.30	5.30
	1700	46.00	18.50	1.30	
	0100	46.70	18.50	1.33	
April 29th	0900	46.80	18.50	1.36	5.15
	1700	46.00	18.70	1.30	
	0100	47.50	19.30	1.42	
May 1st	0900	46.10	18.30	1.48	4.88
	1700	48.60	19.80	1.33	
	0100	46.00	18.70	1.35	
May 2nd	0900	48.40	19.10	1.31	5.16
	1700	47.70	19.00	1.45	
	0100	46.80	18.40	1.42	
May 3rd	0900	46.70	18.60	1.35	5.26
	1700	46.80	18.40	1.46	
	0100	47.30	18.70	1.40	
May 4th	0900	46.50	18.60	1.46	5.20
	1700	47.10	18.80	1.35	
	0100	46.70	18.50	1.31	


P_2O_5
Initial Startup Phase
%
48.50
48.00
47.50
47.00
46.50
46.00
45.50
45.00
44.50
0900 1700 100
March 12th
March 13th
March 14th
March 15th
March 16th
March 17th
March 18th
March 19th
March 20th
March 21st
March 22nd
March 23rd


P_2O_5
Full Load Operation
%
49.00
48.50
48.00
47.50
47.00
46.50
46.00
45.50
45.00
44.50
0900 1700 100
April 9th
April 10th
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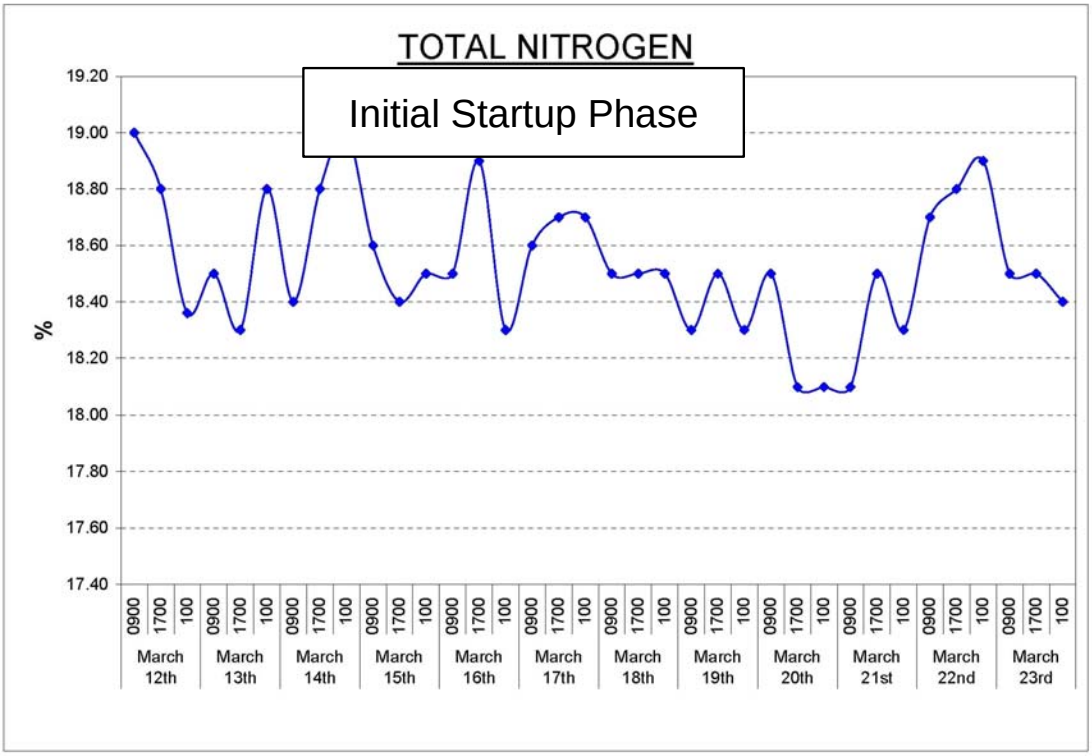
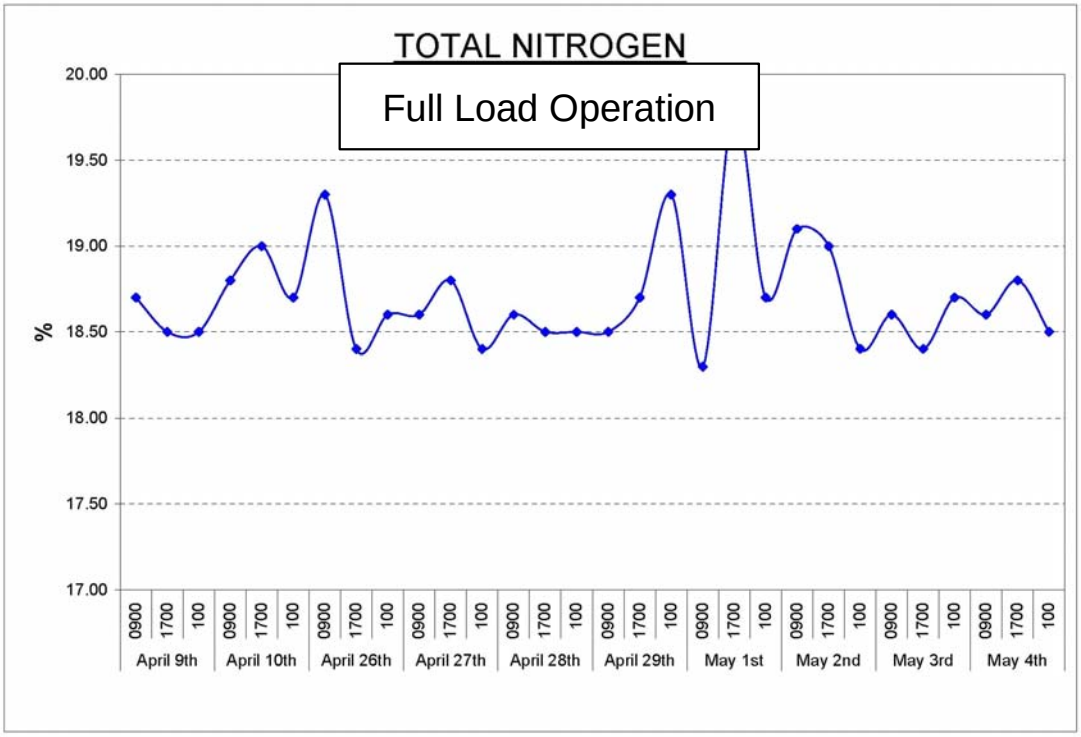
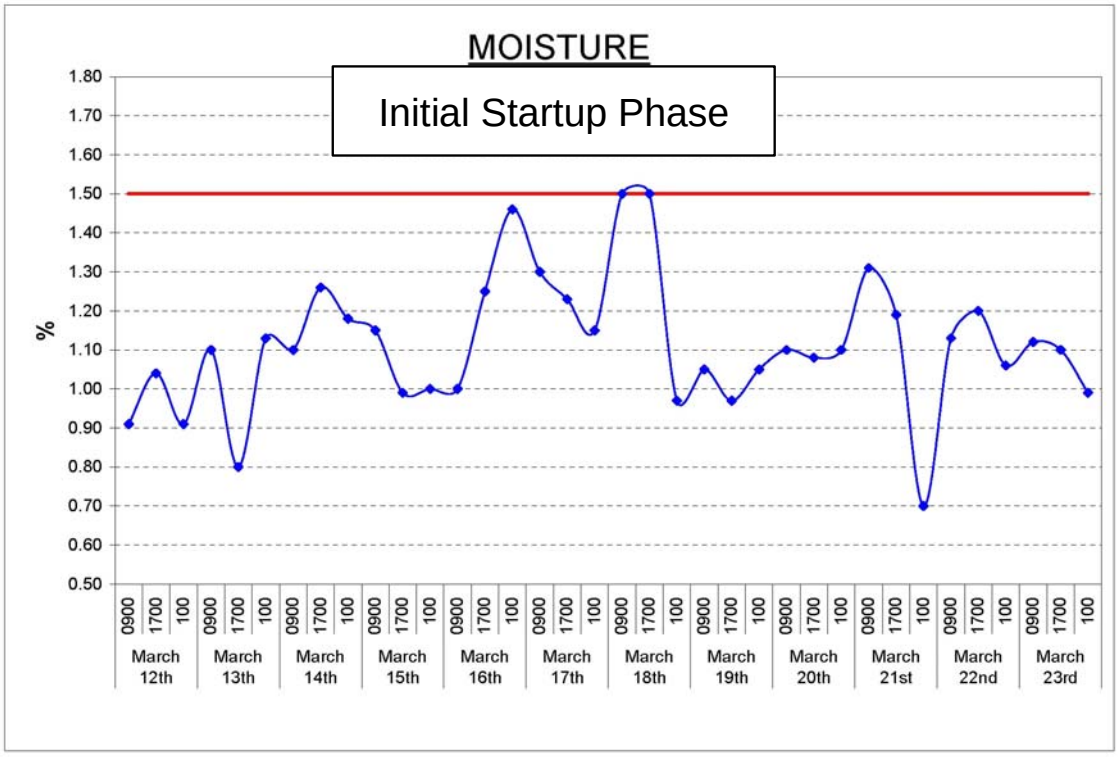
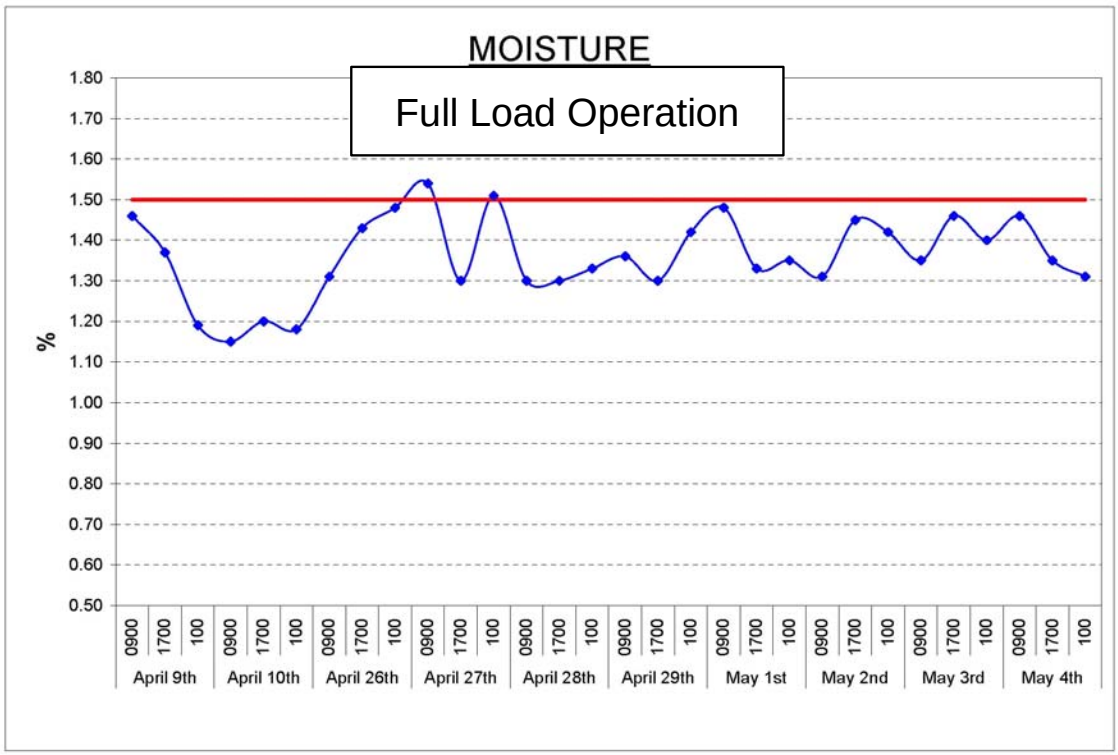
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th


TOTAL NITROGEN
Initial Startup Phase
%
19.20
19.00
18.80
18.60
18.40
18.20
18.00
17.80
17.60
17.40
0900 1700 100
March 12th
March 13th
March 14th
March 15th
March 16th
March 17th
March 18th
March 19th
March 20th
March 21st
March 22nd
March 23rd


TOTAL NITROGEN
Full Load Operation
%
20.00
19.50
19.00
18.50
18.00
17.50
17.00
0900 1700 100
April 9th
April 10th
April 26th
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th

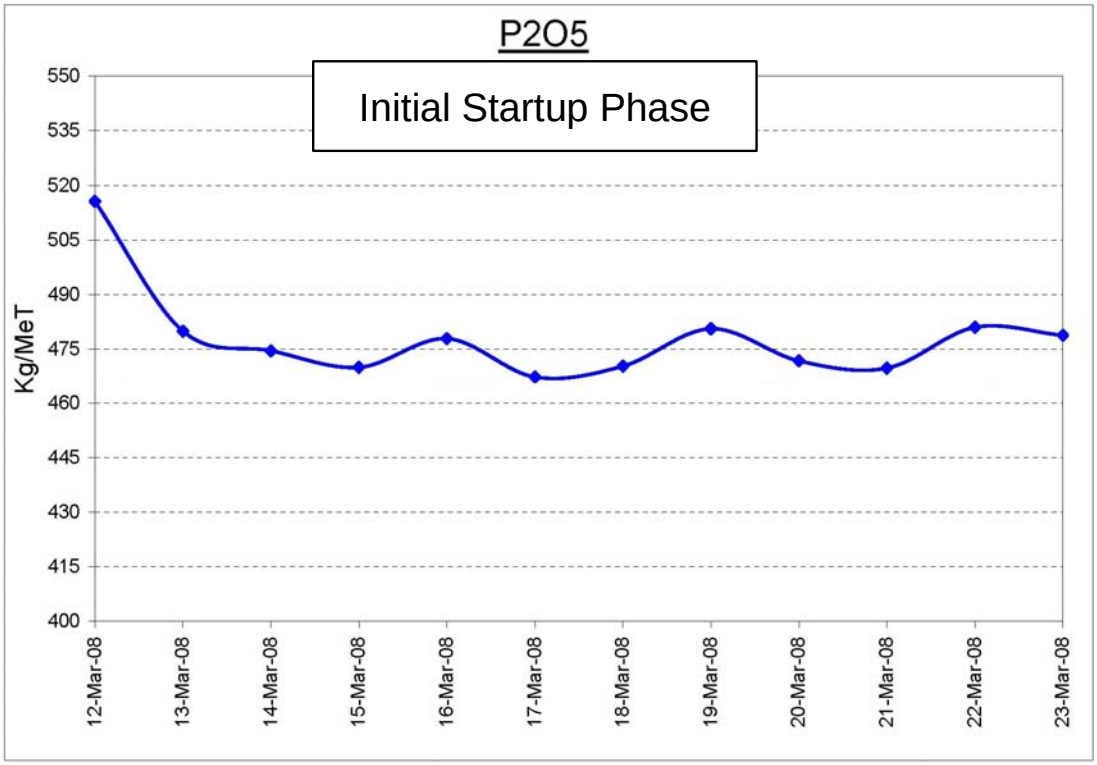

MOISTURE
Initial Startup Phase
%
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0900
1700
100
March 12th
March 13th
March 14th
March 15th
March 16th
March 17th
March 18th
March 19th
March 20th
March 21st
March 22nd
March 23rd

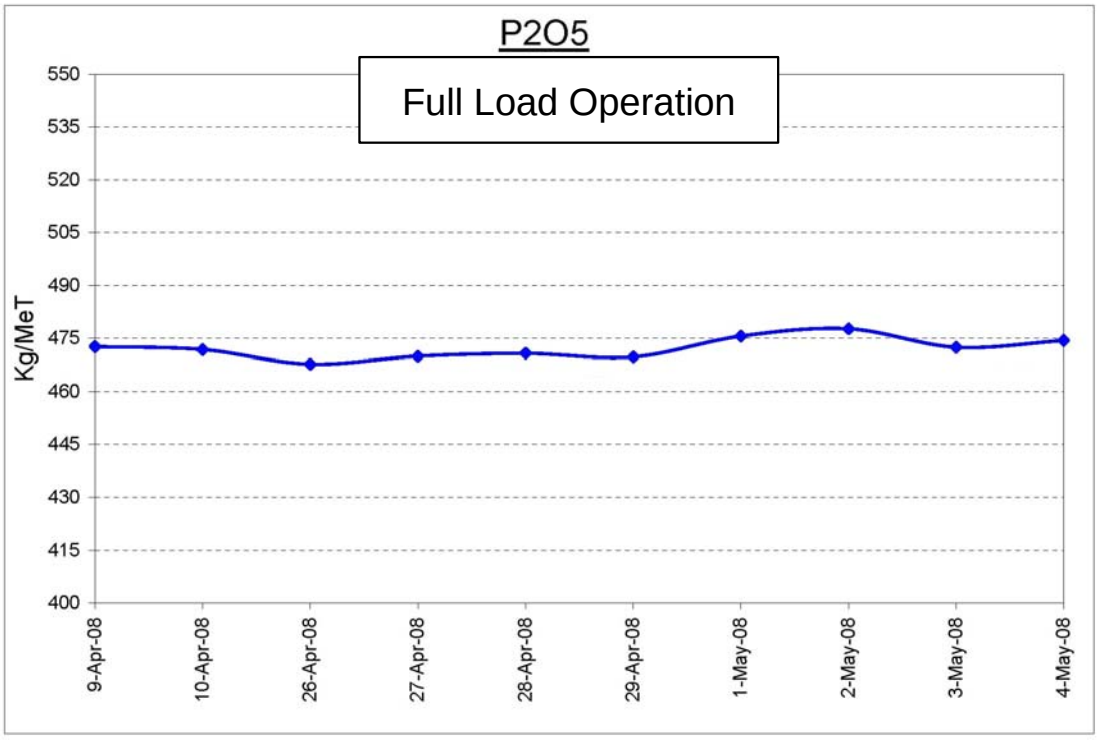

MOISTURE
Full Load Operation
%
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0900
1700
100
April 9th
April 10th
April 26th
April 27th
April 28th
April 29th
May 1st
May 2nd
May 3rd
May 4th

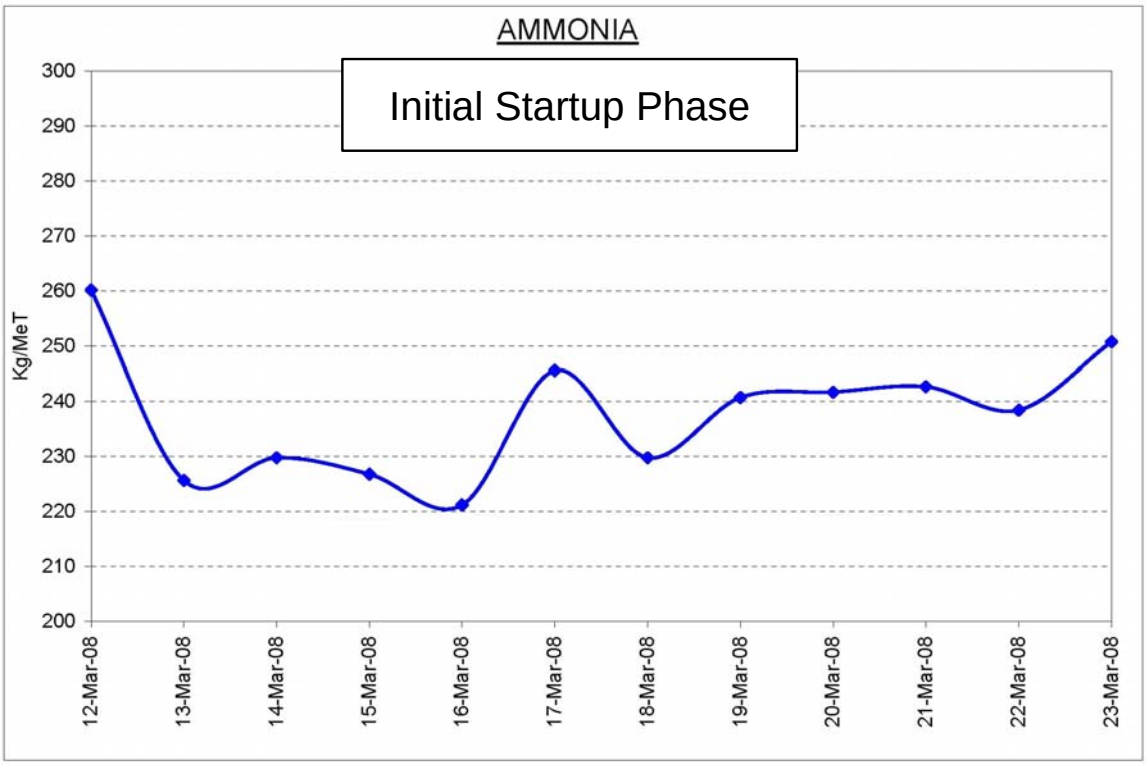
C. RAW MATERIALS SPECIFIC CONSUMPTIONS

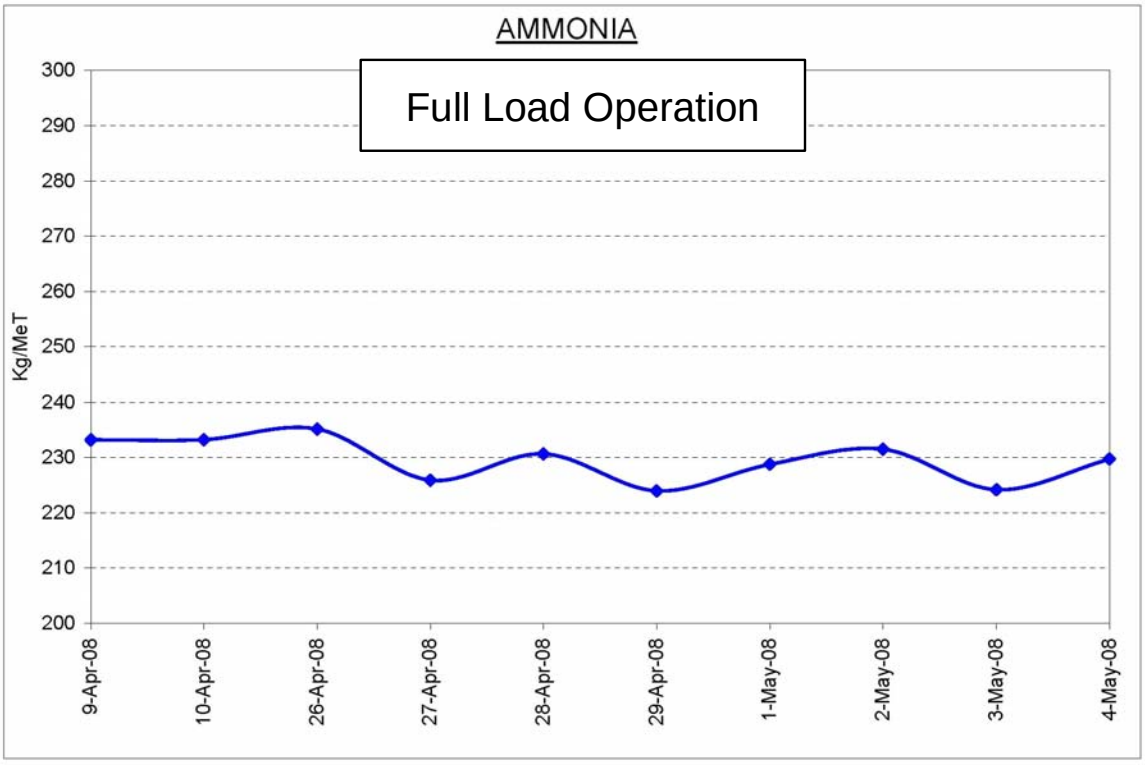
RAW MATERIAL SPECIFIC CONSUMPTION DURING INITIAL START-UP PHASE								
DATE	Production (MeT)	P_2O5 Conc.	H_3PO_4	P_2O_5	NH_3	H_2SO_4	Filler	Coating Oil
			Kg / MeT					
13-Mar-08	1,254	51.65	929.03	479.84	225.678	39.87	39.87	6.14
14-Mar-08	1,014	51.9	914.20	474.47	229.783	43.39	20.71	6.94
15-Mar-08	1,120	51.8	907.14	469.90	226.786	17.86	29.46	6.70
16-Mar-08	868	52.3	913.59	477.81	221.198	23.04	29.95	6.91
17-Mar-08	969	52.1	896.80	467.23	245.614	27.42	27.86	6.50
18-Mar-08	705	51.8	907.80	470.24	229.787	22.70	34.04	5.53
19-Mar-08	702	50.65	948.72	480.53	240.741	42.74	84.05	4.16
20-Mar-08	1,510	51.65	913.25	471.69	241.722	52.32	58.45	4.64
21-Mar-08	1,504	52.75	890.39	469.68	242.686	49.87	45.88	3.48
22-Mar-08	1,451	53.15	904.89	480.95	238.456	35.84	43.42	4.42
23-Mar-08	1,571	53.3	898.15	478.72	250.796	33.10	52.83	3.50

RAW MATERIAL SPECIFIC CONSUMPTION DURING DESIGN LOAD PHASE								
DATE	Production (MeT)	P_2O5 Conc.	H_3PO_4	P_2O_5	NH_3	H_2SO_4	Filler	Coating Oil
			Kg / MeT					
9-Apr-08	2,264	52.15	906.36	472.67	233.22	28.27	39.31	4.42
10-Apr-08	2,281	52.35	901.36	471.86	233.23	28.50	43.40	4.71
26-Apr-08	2,309	52.61	889.13	467.73	235.17	31.62	14.29	3.70
27-Apr-08	2,302	52.70	891.83	470.00	225.89	31.71	20.85	4.11
28-Apr-08	2,276	52.55	895.87	470.78	230.67	32.51	19.68	3.03
29-Apr-08	2,277	51.95	904.26	469.76	223.98	32.06	13.61	2.42
1-May-08	2,308	52.08	913.38	475.64	228.77	30.33	15.16	3.30
2-May-08	2,285	52.15	915.97	477.68	231.51	24.51	14.44	3.57
3-May-08	2,266	52.10	906.88	472.49	224.18	25.15	22.07	3.00
4-May-08	2,281	52.20	908.81	474.40	229.72	24.11	21.04	3.56


P2O5
Initial Startup Phase
Kg/MeT
550
535
520
505
490
475
460
445
430
415
400
12-Mar-08
13-Mar-08
14-Mar-08
15-Mar-08
16-Mar-08
17-Mar-08
18-Mar-08
19-Mar-08
20-Mar-08
21-Mar-08
22-Mar-08
23-Mar-08

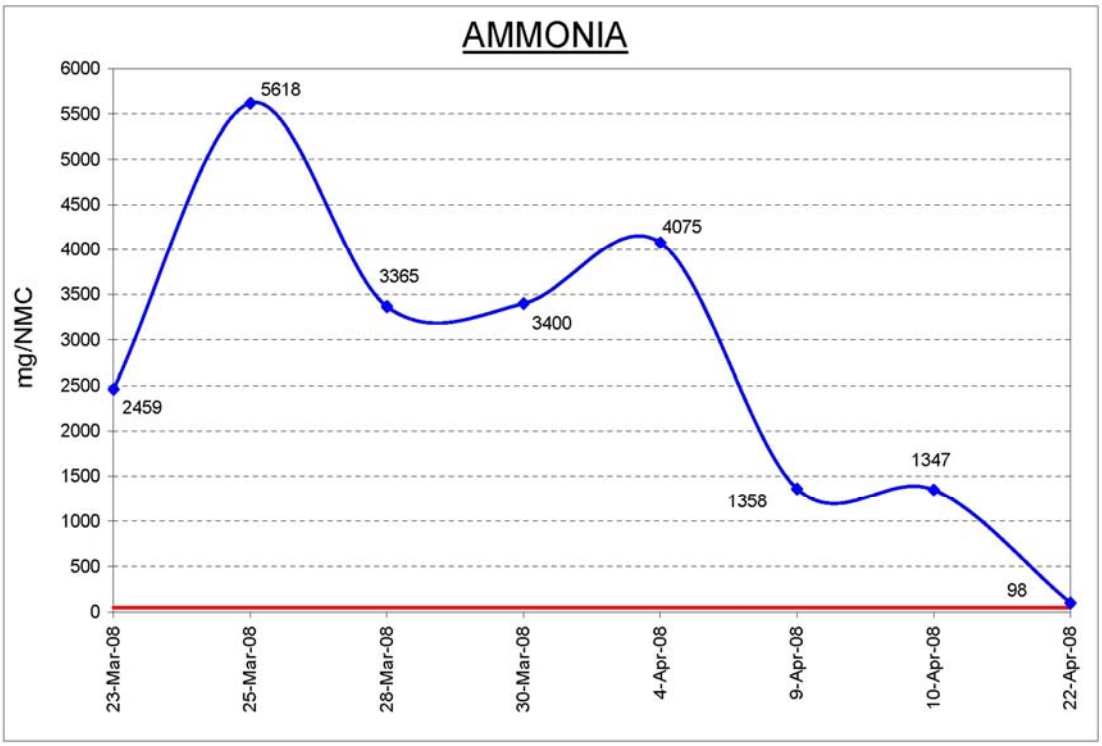

P2O5
Full Load Operation
Kg/MeT
550
535
520
505
490
475
460
445
430
415
400
9-Apr-08
10-Apr-08
26-Apr-08
27-Apr-08
28-Apr-08
29-Apr-08
1-May-08
2-May-08
3-May-08
4-May-08

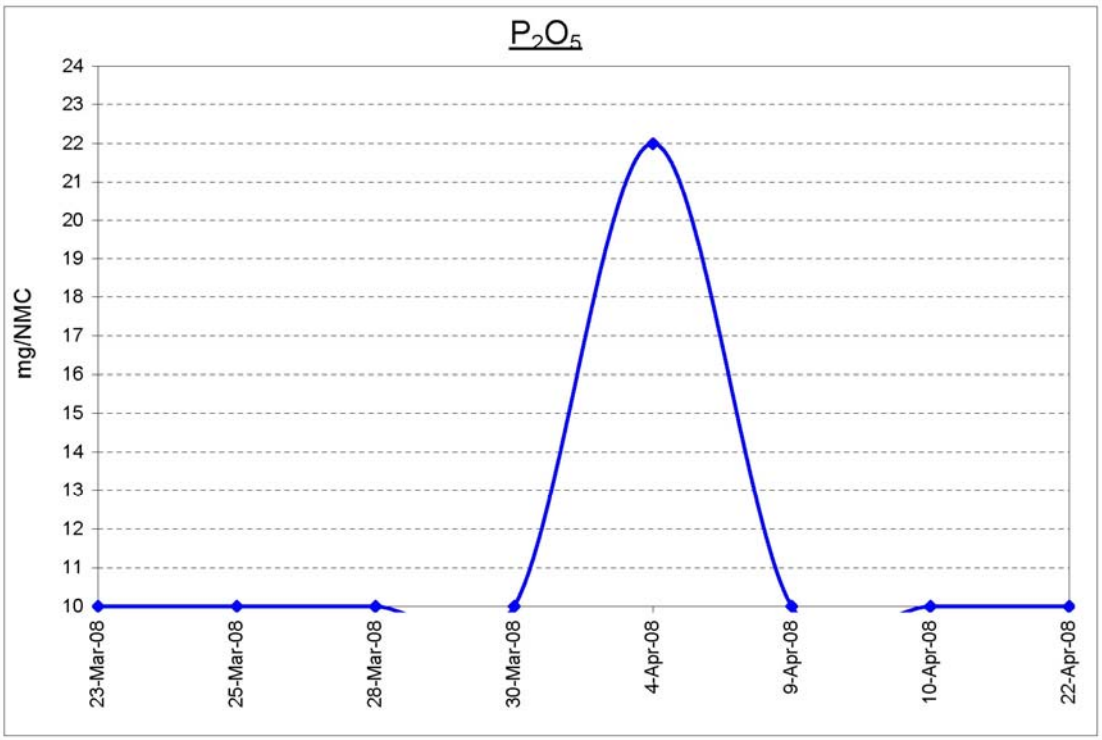

AMMONIA
Initial Startup Phase
Kg/MeT
300
290
280
270
260
250
240
230
220
210
200
12-Mar-08
13-Mar-08
14-Mar-08
15-Mar-08
16-Mar-08
17-Mar-08
18-Mar-08
19-Mar-08
20-Mar-08
21-Mar-08
22-Mar-08
23-Mar-08

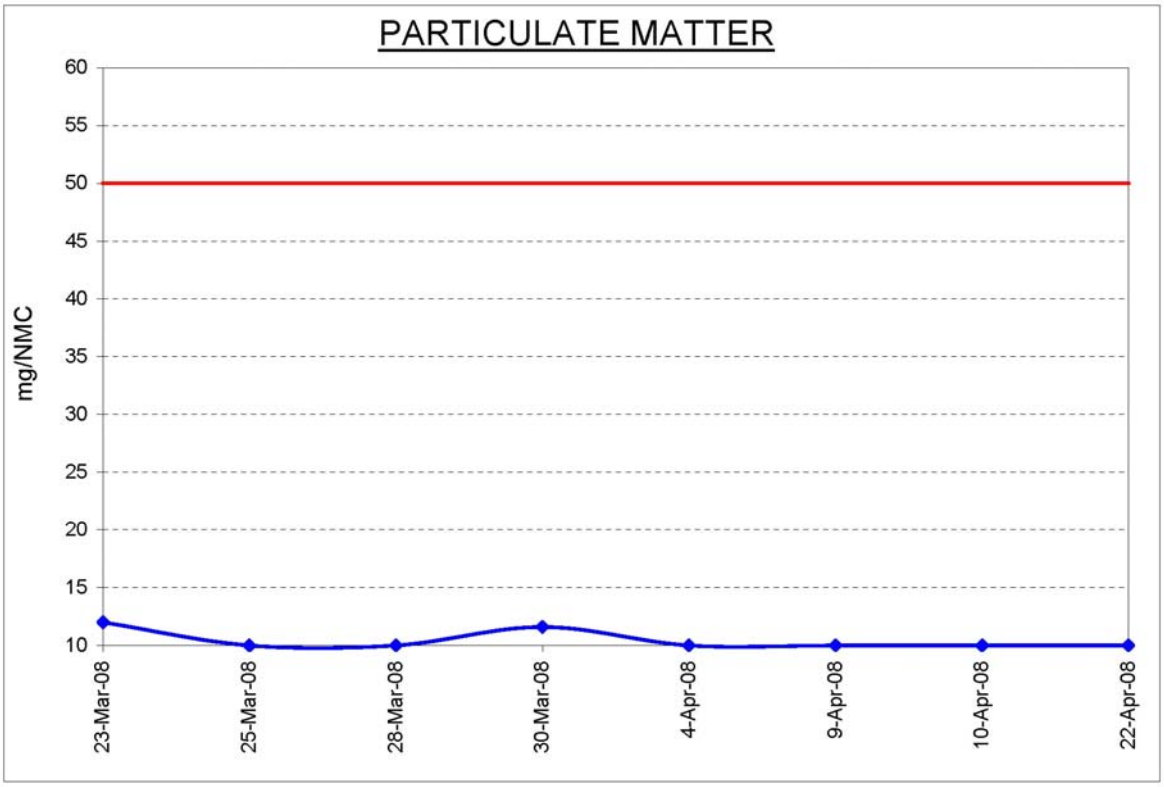

AMMONIA
Full Load Operation
Kg/MeT
300
290
280
270
260
250
240
230
220
210
200
9-Apr-08
10-Apr-08
26-Apr-08
27-Apr-08
28-Apr-08
29-Apr-08
1-May-08
2-May-08
3-May-08
4-May-08

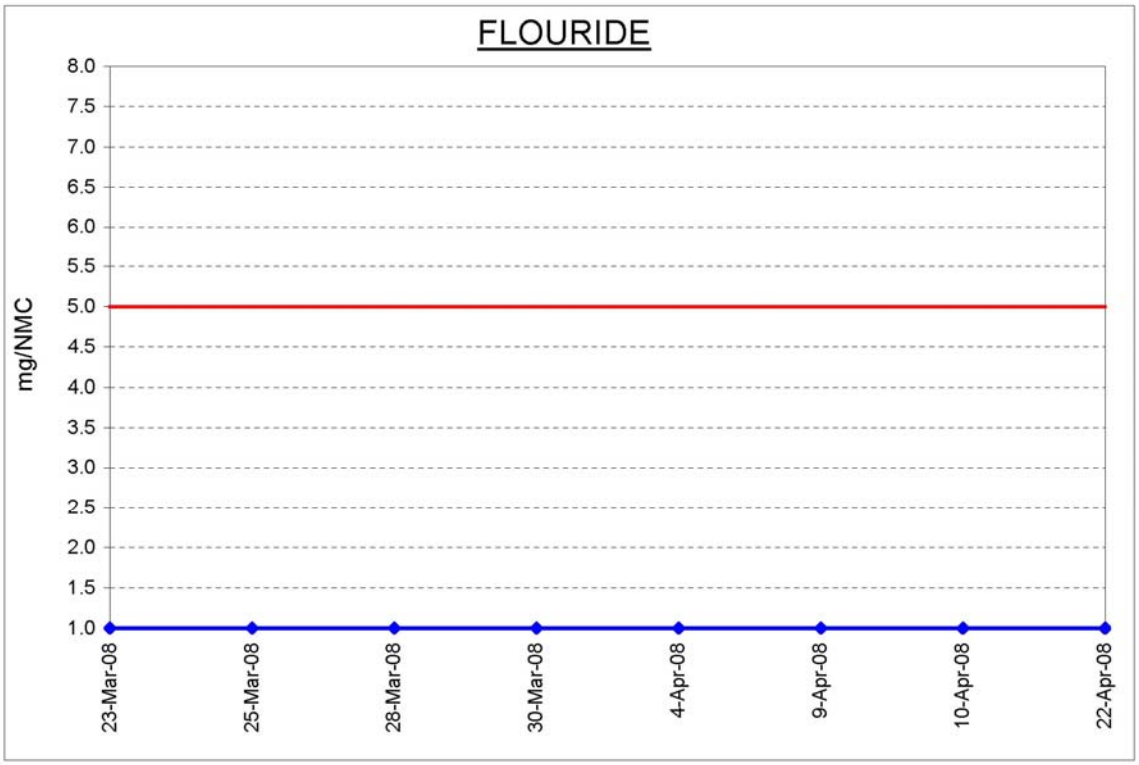
D. STACK ANALYSIS

STACK ANALYSIS										
TEST	**UNIT**	**23-Mar-08**	**25-Mar-08**	**28-Mar-08**	**30-Mar-08**	**4-Apr-08**	**9-Apr-08**	**10-Apr-08**	**22-Apr-08**	**2-May-08**
Time	Hrs.	1700 ~ 1800	1830 ~ 1930	1630 ~ 1730	1700 ~ 1800	1945 ~ 2045	1500 ~ 1600	1600 ~ 1700	1900 ~ 2000	1430 ~ 1645
Moisture	%	9.4	13.1	14.3	13.0	17.6	17.1	18.3	18.0	19.4
Velocity of Stack	m/sec	16.4	15.6	14.8	14.5	15.8	16.49	16.06	15.73	15.52
Actual Flow @ Plant Conditions	m^3/Hr	505673.0	479623.0	454166.0	445274.0	485643.0	507832.0	494451.0	484012.0	477772.0
Dry Flow @ Standard. Conditions	Nm^3/Hr	370923.0	337919.0	315410.0	314044.0	324028.0	337763.0	325444.0	318499.0	305966.0
Ammonia	mg/Nm_3	2459.0	5618.0	3365.0	3400.0	4075.0	1358.0	1347.0	98.0	113.0
Particulate Matter	mg/Nm^3	12.0	<10	<10	11.6	110.0	<10	<10	<10	<10
P_2O_5	mg/Nm^3	<10	<10	<10	<10	22.0	<10	<10	<10	<10
Flouride	mg/Nm^3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

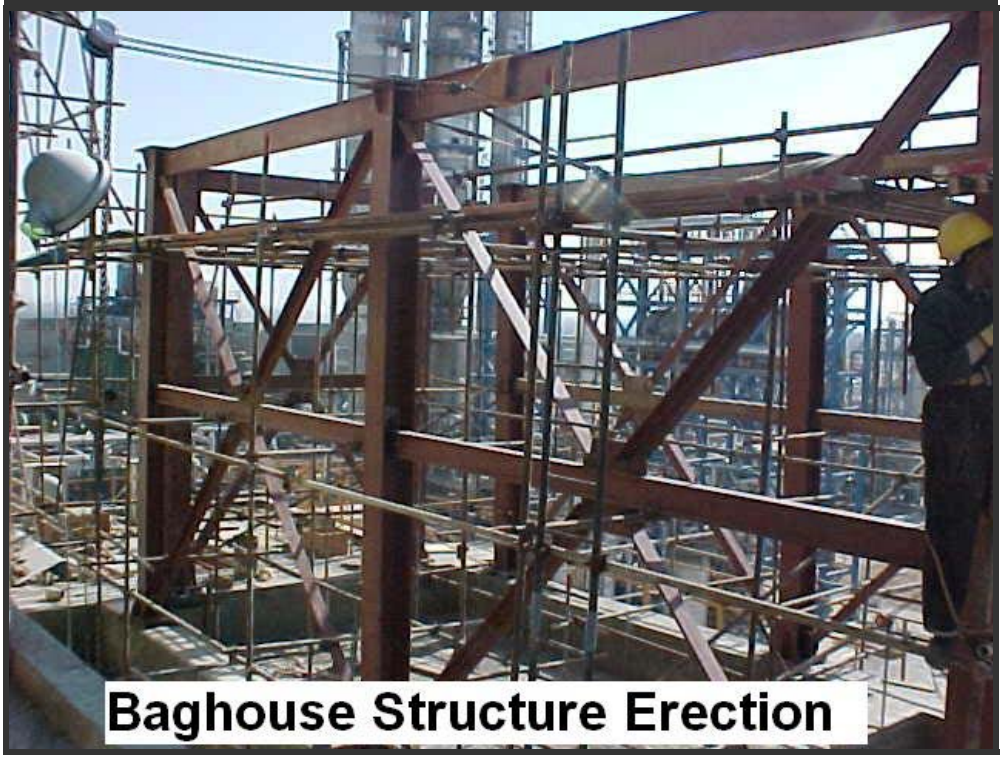

AMMONIA
mg/NMC
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5618
4075
3365
3400
2459
1347
1358
98
23-Mar-08
25-Mar-08
28-Mar-08
30-Mar-08
4-Apr-08
9-Apr-08
10-Apr-08
22-Apr-08


P_2O_5
mg/NMC
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
23-Mar-08
25-Mar-08
28-Mar-08
30-Mar-08
4-Apr-08
9-Apr-08
10-Apr-08
22-Apr-08


PARTICULATE MATTER
mg/NMC
60
55
50
45
40
35
30
25
20
15
10
23-Mar-08
25-Mar-08
28-Mar-08
30-Mar-08
4-Apr-08
9-Apr-08
10-Apr-08
22-Apr-08


FLOURIDE
mg/NMC
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
23-Mar-08
25-Mar-08
28-Mar-08
30-Mar-08
4-Apr-08
9-Apr-08
10-Apr-08
22-Apr-08

7. PLANT PICTURES




Duct & Chutes Pre-Fabrication

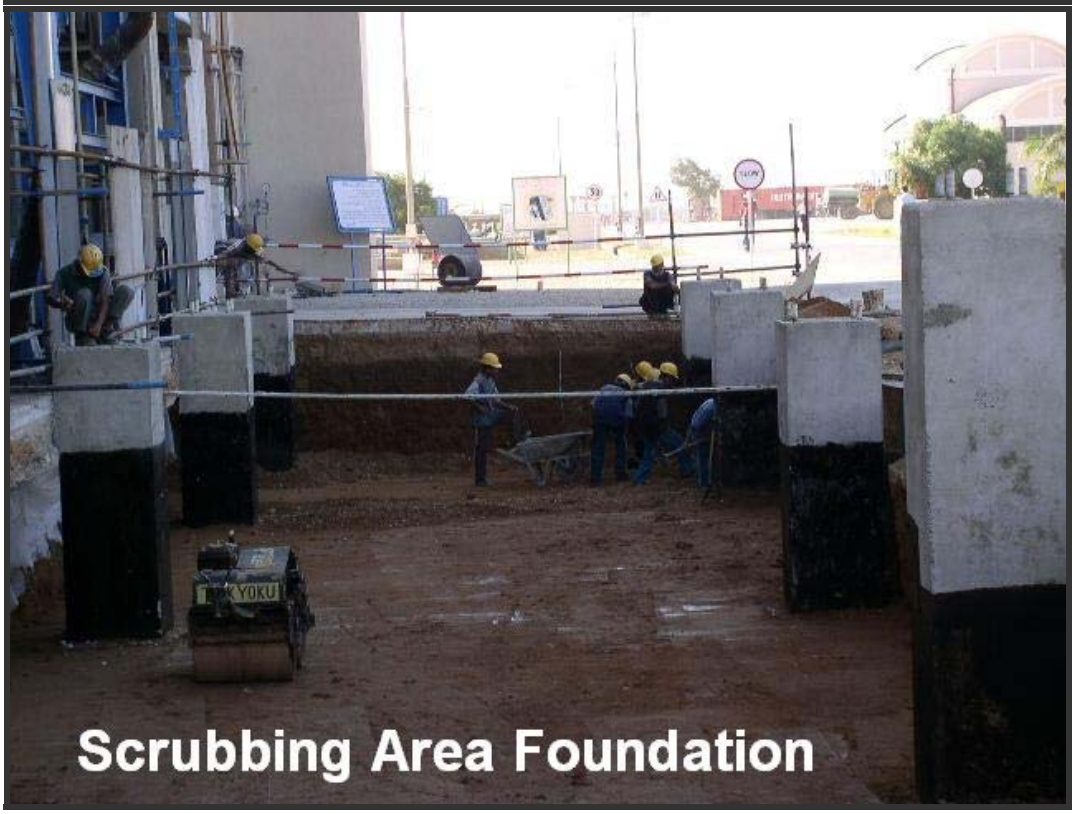

Duct Work Erection


New Ammonia Air Chiller


ERECTION OF NEW HOT GAS GENERATOR


Baghouse Erection Looking East

Steel Structure Pre-Fabrication



Scrubbing Area Foundation

Baghouse Civil Foundation Works

New Baghouse Fan


Preneutralizer


Anti Acid Tiling at Scrubbing Area


Removal of Old Hot Gas Generator


Piping Pre-Fabrication


Granulator Rigging Arrangement


Steel Strcuture Erection

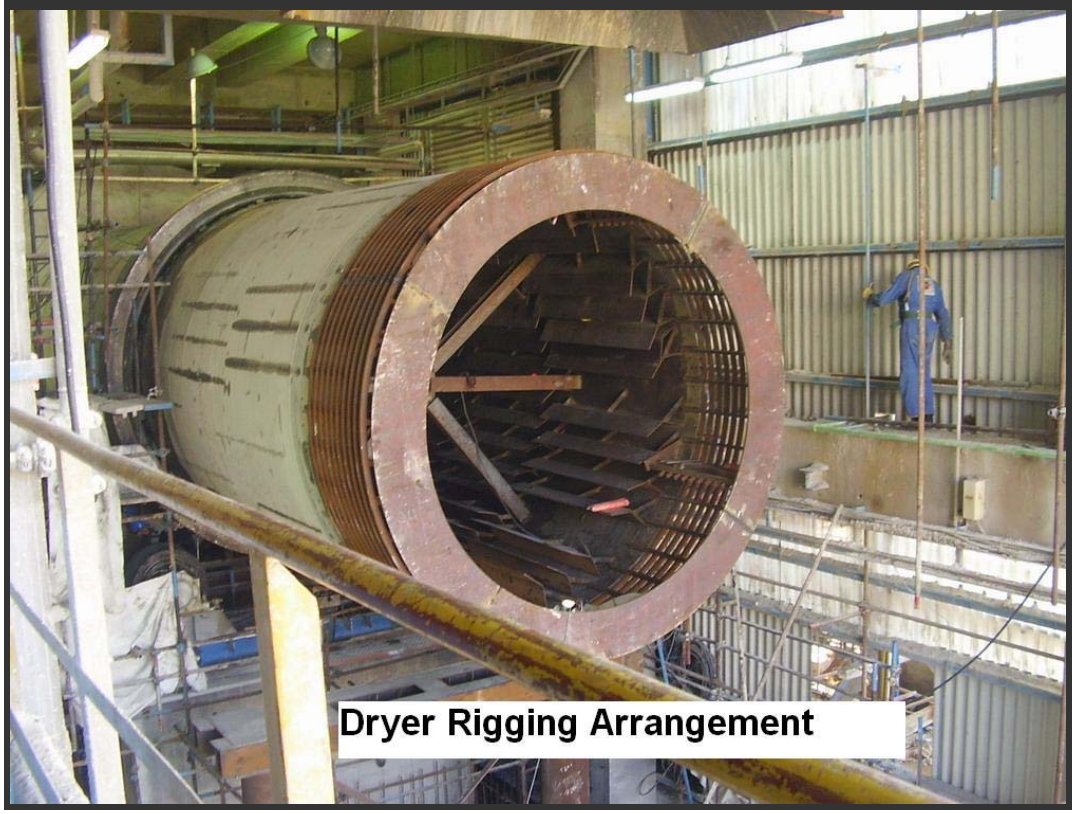

New Polishing Screen


NEW RG SCRUBBER


Rigginig Arrangement for HGG


Old Cyclone Relocation

Bucket Elevator Tail Shaft Allignment



Dryer Rigging Arrangement

ERECTION WORK AT DAP PLANT