OMAN INDIA FERTILISER COMPANY (OMIFCO)

CONSTRUCTION, COMMISSIONING AND OPERATING EXPERIENCE OF OMIFCO,

C. V. Venugopal, CEO

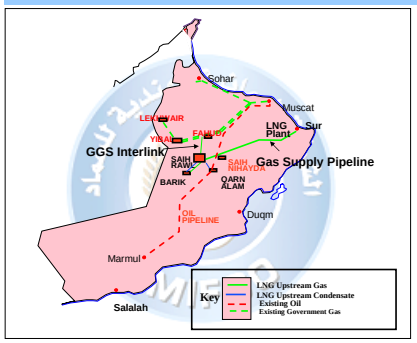
PROJECT OVERVIEW

- A GOO and GOI joint venture fertiliser project in Oman.
- GOO will supply gas under a 20 year GSA at a fixed price for the first 10 years with an escalation formula there after.
- GOI will offtake the Urea production under a 15 year UOTA on a take-or-pay basis at pre-determined prices
- IFFCO will offtake the surplus Ammonia production under a 10 year AOTA on a take-or-pay basis at a fixed price.
- A project with robust economics providing benefits to Oman & India.

PRE PROJECT MILESTONES/APPROVALS

- 2000
  - Site Soil Investigation completed
  - GOI formal approval obtained
  - Amended JVA signed
  - RBI approval obtained
- 2001
  - - Mandated Lead Arrangers re-engaged and due diligence started
  - - ECA promises of guarantee & credit committee approvals obtained
  - - GOI approval of UOTA obtained

PROJECT OVERVIEW/ Location Map



PROJECT OVERVIEW/ Industrial Estate

PROJECT OVERVIEW

- Located at Sur Industrial Estate on coast near Sur.
- 170 hectare seaside plot with space for future expansion.
- Deepwater 1,000M Offshore for dedicated jetty & seawater cooling .
- Temporary jetty used for offloading equipment during construction.
- Level site well suited for construction.
- Gas supply pipeline already in service.
- Development of roads & infrastructure well advanced.

PROJECT OVERVIEW/ Technology

- Proven Technology from Leading Licensors:
  - Ammonia Production : Haldor Topsoe Low Energy Process (including GV CO2 removal).
  - Urea Melt Production: Snamprogetti Total Recycle Ammonia Stripping Technology
  - Urea Granulation : Hydro Agri Fluidised Bed technology presently UHDE
- Licenses provided through Contractor up to final acceptance & thereafter directly to OMIFCO.

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PROJECT OVERVIEW/ Product Export

- Granulated Urea
  - 1,650,000 MT Per Year
  - Guaranteed to meet International Quality Standards
  - Cargoes of 10,000 to 40,000 MT
  - Design loading rate 1,200 MT per hour
- Surplus Ammonia
  - About 250,000 MT Per Year
  - Guaranteed to meet International Quality Standards
  - Cargoes of 8,000 to 35,000 MT
  - Design loading rate 1,200 m^3 per hour

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PROJECT OVERVIEW/ EPC Milestones

	Milestone / Deadline
Effective Date:	Contractor's receipt of down payment.
Target Mechanical Completion:	31 months after Effective Date.
Guaranteed Preliminary Acceptance:	35 months after Effective Date.
Diffect Liability Period:	18 months following Preliminary acceptance.

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TECHNOLOGY FEATURES-AMMONIA

- Plants of Haldor Topsoe design- 2*1750MTPD.
- Primary reformer pressure at inlet 39.2 bar.
- Has only an ID fan with dual drive provision.
- 264 reformer tubes of HP alloy.
- Firing by 720 burners in 6 rows.

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TECHNOLOGY FEATURES-AMMONIA

- Common steam drum for both front end and back end waste heat boilers.
- Steam super heat is done by process gas heat and at the convection section.
- Synthesis converter is S 200 type.
- Common PGR unit for both streams using membranes.

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TECHNOLOGY FEATURES-UREA

- Urea plants design of Snamprogetti for the Melt Section -2*2530 MTPD.
- Ammonia preheat with off gases of process condensate stripper.
- Centrifugal ammonia and carbamate pumps.
- Fluidised bed granulation technology of Hydro Agri (now Uhde).
- Product size achieved is 2 to 4 mm more than 95%. Crushing strength 2.5 kg.

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PROJECT FEATURES- POWER GENERATION

- Two frame 6 Gas turbines (DLN Mode) to provide the total power requirement of the Complex.
- The total requirement of the complex is around 44 MW.
- Load shedding system ensures power for two Ammonia units and one Urea unit along with necessary off site facilities.
- External grid connection is under implementation for import of power up to 30MW.

PROJECT FEATURES-STEAM GENERATION

- Waste heat from the gas turbines along with auxiliary firing is used for generating steam upto 110 T/hr at 45 bar.
- Two gas fired auxiliary boilers are installed to produce up to 70 T/hr of 45 bar steam.
- External power grid under installation for supply upto 30 MW.

PROJECT FEATURES- SEA WATER SYSTEM

- Sea water intake & outfall system is in place. Two buried RTRP (reinforced thermosetting resin pipe) each of 2.8 meters dia brings sea water from a depth of 10 meters to the plant.
- Four pumps operate to provide Cooling water for surface condensers major Steam turbines, Ammonia condensers and indirect cooling of circulating desalinated cooling water.

PROJECT OVERVIEW- PRODUCT LOADING

- A two berth finger jetty is under operation extending about a kilometer from the shore line with maximum draft of 14 meters.
- Ships with capacity upto 40000 MT (urea) can be loaded.
- Ships with capacity upto 30000 MT (ammonia) can be loaded.

PROJECT OVERVIEW- INSTRUMENTATION

- Common monitoring / Control of all plants : CCR

Major networks

- Integrated Control System (ICS) Network.
- ECS (Electrical Control system)/LSS (Load Shedding system) Configured in DCS.
- Networking of PLCs for Product handling .
- Network of Fire & Gas detection and Monitoring system.
- Environment monitoring System Network.

PROJECT OVERVIEW- INSTRUMENTATION

Other features :

- All major Compressors's control systems and package subsystems are connected to DCS.
- Gas metering station package.
- Vibration monitoring system with network for condition monitoring .
- Mass spectrometers for online analysis in Ammonia Plant.

Project Overview- Instrumentation ICS- Integrated Control System

- Almost 90% of the Process control / Interlock operation and control from CCR (Central control room)
- Integration of DCS with ESD for the ease of operation ,Emergency handling.
- Mulcom (Multiple Protocol Communication Computer) acting as gateway between DCS and ESD system.

Project Overview- Instrumentation ICS- Integrated Control System

- Field signals are connected / processed in Local control rooms called SR's .(Sat. Room)
- The signals from the SRs are exchanged with the CCR through redundant F.O (Fibre optic) network.
- The concept of CCR/SR with F.O reduces the huge cabling, improves system response time and eliminates problems due to grounding .

Project Overview- Instrumentation Dcs - Domains

- The whole ICS network has been divided into 4 domains.
- Domain 1 : All the Utility operation.(Total 4 satellite rooms : SR1 , SR5, SR6 and LCR 4.)
- Domain 2 : Both the Ammonia Streams operations.
- Domain 3 : Both the Urea plant Streams operations.
- Domain 4 : All the shift engineers / Shift manager Monitoring stations.

Project Overview- Instrumentation Load Shedding System

- No dedicated PLC for Load Management system
- Load shedding System is configured in DCS.
- All the Electrical substations are connected to the DCS thru F.O network using Remote I/O feature.
- DCS calculates and decides the loads to be shed
- The remote output from the DCS is sent to respective substations for shedding the electrical loads .

Project overview- instrumentation Product handling networking

- All the parameters related to Urea ship loading, Ammonia loading, Reclaimer, tripper etc are monitored from CCR, LCR4 (load control centre) and Jetty .
- Networking of 10 nos of PLC's installed at various locations ,ie Jetty Urea ship loading, Ammonia loading, Silo, Reclaimer, Tripper & Load Control Centre.
- PLC's are connected thru the fibre optic network .

Project Overview- Instrumentation Fire & Gas Detection System

- OMIFCO has dedicated Fire and Gas Detection system consisting of approx 3000 detectors .
- All the detectors like Flame detectors, Smoke detectors, Gas detectors for CH4, H2, NH3,CO are connected to Local control stations.
- Total 18 nos of Control stations at various locations are connected through Fiber optic network .
- Through Monitoring stations at CCR/ Firestation , healthiness of all the detectors, deluge system, Aragonite system etc can be monitored.

Project overview- Instrumentation Environment Monitoring Stations

- EMS monitoring station/ Server at CCR.
- Networking of 19 nos of local stations installed at various locations.
- 8 nos of Stack stations (NOX, CO,O2,NH3,Urea dust).
- 4 nos of Ambient air stations (NOX, SOX,HC,BM, SM)
- 3 nos of Noise stations (Ambient Noise).
- 1 no of Weather monitoring station
- 3 numbers of Water quality measurement stations (for measuring pH, dissolved O2, Phosphate,NH3,N2 etc.)

Project Overview- Instrumentation Gas Metering Station

- Gas metering station has a local Network of 2 Supervisory computers ,5 flow computers , 2 Gas chromatographs.
- This local network also communicates with DCS.
- All the important parameters like flow,pressure,
- NG analysis are sent /received form PDO located at approx 300 miles away from OMIFCO site.

Project Overview- Instrumentation Sub System Communication

- Approx. 35 nos of remote subsystems are connected to DCS system for indications of various parameters.
- Some of the important subsystems connected are:
  - i) Gas Turbines
  - ii) Gas metering station
  - iii) Bently Neveda systems,
  - iv) Micronet Compressor control system
  - v) Turbolog Air compressor control system
  - vi) Electronic governors of Compressors/ Pumps.

Project Overview- Instrumentation

The Concept of Networking has helped in bringing all the plant information at single location ie. at CCR . (right from Ammonia to jetty).

This centralized information concept of CCR helps in better coordination between various plants like Urea, Ammonia and Utilities.

The closer proximity amongst the operating personnel has resulted into better emergency situations handling.

PROJECT IMPLEMENTATION

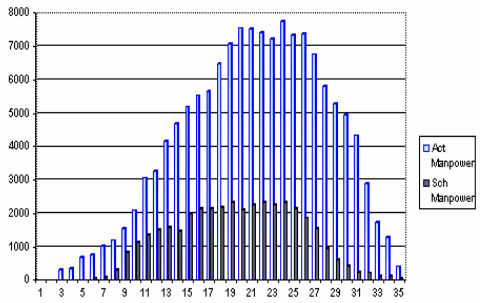
PROJECT IMPLEMENTATION

During the implementation of the project, Contractor faced a number of challenges as below:

- Delay in delivery of equipments as compared to his time schedule.
- Exceptional weather conditions preventing marine works as against planned.
- Shortage of material, like gravel, steel and fresh water for hydro testing.

Delay in delivery of some equipment forced the Contractor to increase manpower resources far more than planned at the final stages.

MANPOWER RESOURCES - PROJECT



MAJOR PROBLEMS FACED

PRE COMMISSIONING EXPERIENCE

PRE COMMISSIONING EXPERIENCE

HIGH VIBRATION IN KP BFW PUMPS

- KP BFW pumps (4 Nos) supplied by Flow Serve, France.
- These pumps initially experienced high shaft and bearing housing vibrations during commissioning.
- Detailed investigation revealed that vibrations were flow induced.

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PRE COMMISSIONING EXPERIENCE

HIGH VIBRATION IN KP BFW PUMPS

- Inter stage labyrinths clearances were increased.
- One of the impeller's diameter was reduced by 5mm which resulted in reduction of discharge pressure by about 5 bar.
- Vibrations were reduced to acceptable limits and reduction of 5 bar discharge pressure did not adversely affect the process requirements.

PRE COMMISSIONING EXPERIENCE

HIGH VIBRATIONS OF ID FAN TURBINE

- ID fan turbine in both Ammonia plants had the problem of tripping before reaching the operating speed.
- Trip valve was getting de-latched and closed due to excessive vibration of the turbine.
- Plant was started with motor while vendor investigated and found that it was a wrong coupling that caused the high vibration.
- Correct heavier coupling was installed and problem was resolved.

PRE COMMISSIONING EXPERIENCE

REFRACTORY LINER FAILURE

- Just few days after commissioning Ammonia-1 unit, internal refractory liner of the cold collector transfer line from primary reformer to secondary reformer suddenly failed at the bottom L portion of the vertical and horizontal joint.
- Thermo sensitive paint turned to white and metal temperature measured was well above the design temperature of 450 C.

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PRE COMMISSIONING EXPERIENCE

REFRACTORY LINER FAILURE

- Plant was immediately shutdown and the refractory lining at the damaged portion and other part of the complete cold collector / transfer lines were inspected by the CIRIA, refractory supervisor.
- Refractory expert from India was also called to site to inspect and assist in the repair of the lining within shortest possible time.
- Failure was due to bad workmanship during casting of the liner like improper shuttering and compaction etc.

Contd.

PRE COMMISSIONING EXPERIENCE

REFRACTORY LINER FAILURE

- One complete segment of the refractory at horizontal and vertical lengths was removed and recasting was done under the supervision of CIRIA supervisor and the refractory expert from India.
- Rest of the cold collector refractory was in good condition. The plants were restarted after proper curing and dry out of the repaired lining.

PRE COMMISSIONING EXPERIENCE

STEAM LET-DOWN SYSTEM FAILURE

- Stand alone and dedicated KS (110 bar steam) to HS (45 bar steam) letdown pressure control station is installed to achieve quick opening on total tripping of synthesis gas compressor drive turbine in order to control the crucial 45 bar steam header pressure so that reforming is not affected.
- Unfortunately control station did not work due to wrong EPROM's and the valves could not be operated at all and pressure control station became ineffective.

Contd.

PRE COMMISSIONING EXPERIENCE

STEAM LET-DOWN SYSTEM FAILURE

- An in-house control scheme was developed in within a day and scheme was implemented to achieve the required opening time of the PRDS valves.
- This change saved more than a week in starting up of the Ammonia -1 unit.
- This proved very effective and worked well in controlling the 45 bar header pressure during few occasions when synthesis gas compressor drive turbine tripped.

PRE COMMISSIONING EXPERIENCE

FAILURE OF THE FRESH COOLING WATER (FCW) HEADER

- Just after successful completion of the performance test run of the complex, the underground fresh cooling water discharge RTRP (Reinforced thermosetting resin pipe) header close to FCW pumps failed abruptly and water started leaking profusely forcing shutdown of all the plants.

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PRE COMMISSIONING EXPERIENCE

FAILURE OF THE FRESH COOLING WATER (FCW) HEADER

- After excavating the area around the horizontal portion of the header, an irregular hole of 4 inch dia. was noticed and the exact reason for this could not be established.
- After repairing this hole by laminating and adequate curing, FCW pumps were restarted & production resumed.

Contd.

PRE COMMISSIONING EXPERIENCE

FAILURE OF THE FRESH COOLING WATER (FCW) HEADER

- As FCW supply is essential and critical for the reliable operation of the Plants, it was decided to install above ground carbon steel pipe parallel to the existing RTRP damaged header up to the plate heat exchangers.
- The implementation of this has already been completed and hook up operations are on. The rest of the original RTRP lines continue to be in service.

Table No. 2 Project milestones – planned vs actual

Milestone	scheduled	Actual
Charging electrical substation with temporary power	20	24
Commissioning of sea water intake facilities	19	26
Start of first gas turbine	19	24
commissioning of auxiliary boiler	20	26
Start up of desalination unit	21	27
Start up of fresh cooling water system	21	29
Commissioning of first ammonia unit	30	32
Commissioning of first urea unit	30	32
Commissioning of second ammonia unit	31	34
Commissioning of second urea unit	31	34
Completion of individual performance tests	34	34/35
Completion of overall performance test	35	35
Provisional acceptance	35	35
Final acceptance	53	53

Table No. 3 Performance in the last 27 months - Production data:

Period	Plant	Production (MT)	Capacity utilisation (%)	On-stream days
14 July '05 to 13 July '06	Ammonia-12	622568.8	104.6	329.7
	Ammonia-22	611561.4	102.8	326.6
	Urea-11	863215.4	104.5	318.6
	Urea-21	855586.2	103.6	316.7
14 July '06 to 13 July '07	Ammonia-12	663741.9	111.6	353.1
	Ammonia-22	532187.9	89.4	284.8
	Urea-11	880447.9	106.6	328.4
	Urea-21	897133.0	108.6	325.6
14 July '07 to 20 Oct '07	Ammonia-12	167141.2	102.3	80.6
	Ammonia-22	173603.9	106.6	82.0
	Urea-11	236976.5	103.8	76.8
	Urea-21	275158.8	122.6	86.9

Table No. 4 Performance in the last 27 months – Energy data

Period	Description	Guaranteed energy consumption (Gcal/MT)	Actual energy consumption (Gcal/MT)
Year 2005	Ammonia (BL-Design)	7.225	7.636
	Urea (Overall - Guaranteed)	5.425	5.781
Year 2006	Ammonia (BL-Design)	7.225	7.421
	Urea (Overall - Guaranteed)	5.425	6.072
Year 2007	Ammonia (BL-Design)	7.225	7.501
	Urea (Overall - Guaranteed)	5.425	5.888

CONCLUSION

CONCLUSION

Following are the factors for successful completion of mega size fertiliser project in Oman :

- **Owner's active involvement right from the beginning, in the engineering phase, vendor selection, inspection at vendor works.**
- **Active and regular owner participation and intervention in construction phase.**
- **Delay in mechanical completion of various units made up by thorough and efficient pre commissioning and commissioning.**

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CONCLUSION

Following are the factors for successful completion of mega size fertiliser project in Oman :

- Smooth startup facilitated by knowledgeable and experienced owners' personnel.
- Excellent coordination, cooperation between Contractor and Owner's project teams.
- Active and positive intervention by OMIFCO Board.

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Thank you

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