AMMONIA PLANT REVAMP

SPIC, Tuticorin, Tamilnadu

BASIC ENGINEERING DESIGN PACKAGE

KBR Project No : G740
Document : INTRODUCTION & EXECUTIVE SUMMARY
Document No. : G740-PM-GEN-REP-0001

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1.1 Executive Summary

Project was executed in multiples centers and was monitored from Gurgaon Office.
KBR having its different offices at different locations worked as an as an entity in pursuit of "One KBR". This Revamp has prime objective of energy reduction in the ammonia plant with incidental augmentation of the plant capacity (if any) arising from energy saving schemes from existing 1260 MTPD (with naphtha) with natural gas feedstock.

The agreement came into effect with the signing of the Engineering services Agreement & License Agreement Dated 28th Oct-2016. BED work was completed as per client confirmation on the Revamp Options proposed by KBR as per agreed scope.

1.2 SPIC Objectives for the energy revamp of the plant:

a) Revamp plant with both options of NG and Naphtha as feed stock. Also continue to use furnace oil where it is currently being used in plant
b) Reduce energy consumption from 6.9 Gcal/MT of urea to 6.0 Gcal/MT of urea at least

c) If it is necessary to increase capacity to achieve energy as in b) above, the same is acceptable.

Above objectives were successfully met by KBR team along with many suggestions by SPIC studied and implemented in this Project.

1.3 Project Success Criteria and Drivers

Following were the drivers for the project's successful execution:

- Adherence to critical milestones identified in schedule.
- An open, honest, direct relationship within the global project execution team as well as with the Client.

The project team endeavored to follow the following practices to ensure successful completion of project:

- "One team" execution approach with common project objectives.
- Proactive and responsive actions to Client's requests.
- Use of KBR standard tools and engineering design procedures / specifications across various execution centers.
- Timely decisions and approvals of project documents by Client.
- Effective communications between Client and KBR team members.

1.4 Salient Features of the Project Schedule were as follows:

- During the BED Phase, the detailed project schedule was the primary control tool for managing the project's lifecycle. A dedicated scheduler and a Project Control Manager were engaged full time to support all schedule & Project Controls related functions for SPIC Revamp FEED Project.

- The schedule was prepared on Primavera P6 v 8.3.9. The Schedule was being supervised, updated and reported regularly as per project team requirements.

- Progress measurement tracking and reporting was performed for engineering disciplines and Project Management deliverables as necessary to monitor the status of the Project. This was an internal exercise to measure the progress of various disciplines.

1.5 Scheduled Completion Date

SL. No.	Milestones	Submission Date
1	Kick Off Meeting	18th Nov-16
2	Issue of Base Case by KBR	18th Dec-16
3	Revamp Case submitted by KBR	14th Feb-17
4	Revamp Option Finalization by SPIC	24th Feb-17
5	Issue of revamp PFD & HMB	3rd March-17
6	Rated case in the process datasheet representing the 1500 MTPD capacity	15th May-17
7	ISBL Plot Plan(Preliminary)	17th May-17
8	P&ID Review by client thru mail & Video Conference	16th June-17
9	Submission of Draft BED	29th June-17
10	Client comments on BED closed on	14th July-17
11	BED Review Meeting at KBR office	17th July-17 to 19th July-17
12	Submission of Final BED	15th Sept-17

1.6 Project Execution and Engineering Management Overview

Project execution was done for SPIC project as per the agreed scope of work, depicted in snapshot below:

- Contract Signed
- Completed study for the Base Case by KBR.
- Completed Study for the Revamp Case by KBR.
- Revamp Option Finalization meeting with SPIC done.
- BED completed as per the finalized option & Process Design Basis.

Engineering was performed using the “KBR way” standard work process, deliverables, tools and procedures.

It has been envisaged that complete BED work will be involving different KBR offices, namely, Houston Technology Center (HTC), India Technology Center (ITCg) and Chennai Operating Center (COC), other centers as required. The KBR team led by the Project Manager located in ITCg. ITCg Project Manager was responsible for overseeing the execution between different offices (HTC, ITCg and COC), reporting and communication with Client / Corporate Management etc.

KBR offices (HTC, ITCg and COC) provided a seamless operation for the BED engineering work. This is accomplished by:-

- Use of common Web and communication tools, methods and standards
- Clear division of the scope along the lines of disciplines between HTC, ITCg and COC to ensure consistency in the documents generated

Various work group leads (WGL) of these office locations were reporting to the KBR Project Manager directing and supporting major areas of activity.

1.7 Project Monitoring, Meetings and Reports

1. Weekly Engineering Status Review meetings were held every Wednesday with the work group lead of every discipline. In this meeting the pending deliverables and concerns for completing the target was discussed

In preparation for this meeting, each Work Group Lead prepared a weekly status brief as per the look ahead given to the team from Project Controls team. Items to discuss are issues/concerns, schedule progress and potential changes.

2. Review meeting with client was held on an agreed date with SPIC during course of Project execution. In this meeting the project progress, mitigation plans and any other technical issues and concerns was discussed with SPIC. This covers the KOM, PID & other review meetings.

2.1 Introduction

Southern Petrochemical Industries Corporation Limited (SPIC) operates a single stream of 1260 MTPD Ammonia Plant in a diverse fertilizer complex. The facility is located in Tuticorin, Tamilnadu. The ammonia plant was designed using ICI, UK Technology utilizing steam naphtha reforming process. The plant was commissioned in the Year 1975.

The plant is currently operating at capacities close to 1200 MTPD with an energy performance around 9.76 Gcal/MT of NH3 utilizing Naphtha as feed stock and fuel. Furnace oil is also used for generation of high pressure steam.

SPIC has carried out various changes in plant such as feedstock conversion, Ammonia convertor revamp, reformer tubes material change, additional air compressor etc. over the years for plant performance improvement.

As stated above, present energy consumption level in SPIC plant is 9.76 GCal / MT of Ammonia with the Naphtha as feed / fuel.

SPIC is planning to change the feed and fuel stock from Naphtha to Natural gas as per Government of India policy directive and to reduce the operating cost.

The plant is being revamped for energy saving cum feedstock changeover with incidental capacity increase. The revamp ammonia plant will be able to operate with Naphtha or Natural Gas feed stocks. All the revamped sections of the ammonia plant are based on well-proven technology features. All process equipment is based on single train production of ammonia. All major compressors are centrifugal compressors driven by steam turbine.

Under this revamp scheme, the plant is designed to operate with 100% Naphtha, Mixed-Feed (Naphtha+NG) and 100% NG feed scenarios. At present Primary Reformer is loaded with Naphtha based catalyst. When NG is available, the plant operates in a mixed mode based on availability of feedstock. The Primary reformer catalyst is not changed in this scenario. Once the client is sure of 100% availability of NG, the primary reformer catalyst will be changed. Once the catalyst is changed to better suite natural gas feed, the operation is irreversible. The control system has been updated for operating the plant in any mode of operation (Naphtha only, mixed feed and Natural Gas only).

The revamp scheme presented in the Basic Engineering Design Package (BEDP) has the following features:

1. Primary reformer efficiency improvement for energy saving.
    a) New Mixed feed preheat coil 1537A in-place of flue gas boiler coil.
    b) Replace existing hot steam superheat coil 1536A for better heat recovery

c) Replace existing process steam preheat coil with new mixed feed preheat coil 1537B
d) Replacing the Air Preheater (APH) for better heat recovery and efficicncy improvement.

2. The NG Heater 1435 (already constructed) shall be used for NG Feed preheating
3. New air compressor 3120 driven by gas turbine 3620 replaces existing air compressor. Suction chilling of Gas turbine air is implemented for increasing gas turbine capacity.
4. HRSG is provided for heat recovery of gas turbine exhaust gases. The following coils are included in heat recovery –
    a) Steam Superheat Coil - Superheating HP Steam from Synloop Boiler and HRSG Boiler
    b) Process Air preheat Coil
    c) High Pressure Steam Generation
    d) BFW preheat for HRSG and ASGU
    e) NG Fuel (GT and P.Ref) preheating

5. HTS effluent heat recovery – new BFW preheater 1570 is added to recover heat from HTS effluent.
6. **CO_2 removal section** is revamped with GV's low-energy process for energy saving with following changes -
    a) CO2 Absorber – Bottom packed beds merged
    b) New LP Stripper Reboiler (1572)
    c) Replace LP BFW Preheater-2 (1513)
    d) Replace DMW Preheater (1551)
    e) New CO2 Booster Compressor (3121)
    f) New CO2 Product Cooler (1571)
    g) New Condensate pump 3231A/B
    h) New Absorber inlet KOD 1165

7. **Synloop** capacity is enhanced and energy consumption is improved by
    a) The ammonia converter 1121 basket is replaced with new design of 3-bed with 2 interchangers.
    b) New converter effluent steam generator 1175 added to generate SEH Steam in synthesis loop.
    c) Replace loop boiler BFW heater 1523 for better heat recovery
    d) New feed/effluent exchanger 1574 for optimizing the synloop heat recovery.

8. Steam System

a) Replace Syngas compressor turbine 3701-001/002 for better efficiency. The new turbine will be foot-print replacement over existing turbine frame.

b) Replace existing BFW turbine by condensing type turbine for better efficiency and steam header balancing.

KBR has developed Basic Engineering Package based on information available from SPIC, Vendor or sub-licensors. The project shall move to detailed engineering design and detailed engineering contractor shall further develop and update this information. Following points should be noted specifically for smooth implementation-

1. **Adequacy checks** for existing affected plant equipment were performed by KBR as a part of this revamp project. The report (G740-PM-GEN-DEC-0001) provides a summary of these adequacy checks. In addition to this, further specific Notes to DEC/ Detailed Engineering Scope are included for smooth transition from BED to DED.
2. The Basic Engineering Package is designed based on implementing all the revamp features at the same time. However, if SPIC decides to implement the project in phased manner, SPIC to consult KBR.
3. The BED is based on operating the plant with Natural Gas feedstock. The Naphtha feedstock is a check case. Operating the plant for mixed feed (combining Natural Gas and Naphtha) shall be considered after due diligence of system and alarm and trip set points.
4. A suggestive field package for furnace changes is provided mentioning the changes/procedures to be taken care, for the modification work. This shall be reviewed during DED with KBR and contractor for clear understanding.
5. Steam and Cooling Water Balances shall be updated based on purchased vendor information
6. SPIC to inform KBR of any deviations from KBR equipment specifications.
7. Gas Turbine driven Air compressor along with HRSG is one of critical equipment's of this revamp. SPIC to have single point responsibility of supply of this package. KBR shall be consulted at different stages of implementation of this package. KBR intensive involvement is required for seamless implementation. The P&IDs shall be updated according to vendor information. The control scheme should be thoroughly reviewed with KBR and included in P&ID.
8. The Converter basket is supplied by KBR under separate PEQ contract. The revamp project is based on the converter basket design of KBR. The P&IDs and other documents to be updated based on final design of converter basket. Successful performance of add-on converter requires transportation, handling, preserved storage, inspection, installation, hook-up, pre-commissioning, commissioning and start-up per KBR's requirements to be defined inside the PEQ package provided

under separate contract. KBR shall review of detailed engineering of piping, instrumentation, installation, catalyst loading, reduction and start-up.

9. KBR has submitted a preliminary design of Converter Effluent Steam Generator (1575) along with Steam Drum (1163). This will be package equipment supplied by vendor. There will be single point responsibility for design of exchanger and steam drum. The thermal and mechanical guarantees shall be by vendor. SPIC can also evaluate the option of vertical design of boiler.
10. SPIC should have a formal procedure to incorporate changes which will be communicated to SPIC by KBR during post BED.
11. KBR shall be involved in key activities of project not limited to below activities –
    a) KBR mechanical specialists for vessels, heat exchangers along with construction advisor should witnessed, confirmed and advised corrective actions for all the key site construction activities pertaining to KBR PEQ, critical equipment.
    b) Involve KBR machinery as pertinent per scope, e.g. shop performance test, field witness
    c) KBR piping mechanical should witness, confirm and advise corrective actions for all the key site construction activities pertaining to KBR PEQ, critical piping.
    d) KBR CSE & CSS (or process) should witness, confirm and advised corrective actions for FAT, SAT for trip logic and complex loops
    e) KBR furnace is involved and should witness, confirm and advise corrective actions for all the furnace related site activities
    f) Ensure plan of cleaning, line blowing etc is in place, KBR should witness and verify
    g) Ensure testing of critical loops and trip system is made, witnessed and agreed by KBR before start-up
12. KBR has submitted the Final BED package with the above considerations. The next expected steps are:
    - SPIC has selected Detailed Engineering Contractor. SPIC should invite KBR for a discussion with the Detail Engineering Consultant at the earliest.
    - KBR will provide all mandatory services as part of the existing Engineering Agreement Contract Exhibit A , Attachment 4 (Post BED scope)
    - KBR and SPIC shall discuss and agree upon following at the earliest–
        - Recommended reviews and approvals of KBR during DED (Detailed Engineering Design) as defined in the contract.
        - Recommended visits until acceptance, i.e., during installation / construction / pre-commissioning / commissioning / acceptance.
        - Pre-shutdown audit, 6 months before taking shutdown for revamp implementation.
    - Scope of work for Pre-commissioning, Commissioning and PGTR specialists as defined in recommended services.