DOCUMENT TITLE

**Cost Estimate Methodology**

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1. INTRODUCTION AND BACKGROUND

ADNOC Gas owns and operates 3 LNG trains in addition to 5 gas dehydration and compression trains at Das Island located approximately 180 kilometres northwest of Abu Dhabi city.

In 2013 Integrated Gas Development (IGD) project, an ADNOC Sole Risk (ASR) project, was deployed by ADNOC Gas (known as ADGAS/ ADNOC LNG at the time). IGD project in Das Island was part of a broader IGD project by ADNOC group that aims to provide Abu Dhabi with its future needs of natural gas. IGD Facilities dehydrates and compresses HP offshore gas in Das Island to export the gas to Habshan Onshore Facilities for further processing to Sales gas quality, thus increasing the supply of gas for domestic and industrial use.

IGD facilities in Das Island are associated with 3 compression and 4 dehydration trains working in parallel with a single inlet separation facility (Plant 4), and associated utilities. Feed to Plant 4 is supplied via different gas sources through incoming Pipelines from ADNOC Offshore.

Currently, outage of Plant 4 results in common outage of IGD trains. Availability of plant-4 is very critical since most of the HP gas is associated gas, unavailability of Plant 4 results in huge economic impacts.

ADNOC Gas (hereafter referred to as COMPANY) has appointed Bilfinger Engineering Middle East (CONSULTANT) to conduct the **"Feasibility to Increase IGD Availability during Plant 4 Outage"**. The aim of this study is to explore all feasible options to increase availability of IGD facilities and avoid all IGD trains shut-down due to unavailability of IGD common facilities, i.e. Plant-4.

1. STUDY OBJECTIVE

The objective of this feasibility study is to increase the availability of IGD facilities during existing Plant 4 shutdown by enhancing the provisions for the inlet separation addressing the current production profiles of IGD facilities. The study will focus on the following specific objectives:

* Assess viable solutions (including minimum cases and additional options) to enhance IGD availability during the Plant 4 outage.
* For each option:
* Perform process simulations considering the gas profile to assess the study options.
* Verify the adequacy of existing facilities, control systems, and space limitations to accommodate additional control systems.
* Identify the plot space/land reclamation requirements.
* Identify the pros, cons, risks & opportunities.
* Develop cost estimates (± 50%) and conduct economic evaluations comparing CAPEX/OPEX against the baseline.
* All recommendations must ensure a) No impact on product specifications b) Reliable, flexible production and safe operation c) Energy efficiency aligned with ADNOC codes and standards d) Full compliance with HSE requirements.
* Recommend the most feasible option and deliver feasibility study report with all technical documents.

1. STUDY SCOPE

The scope of this study is to increase the availability of IGD facilities during existing Plant 4 shutdown. The activities to be conducted as per the SOW include.

* Data collection, review and validation.
* Conduct site visits, familiarize with existing facilities, utility requirements and space constraints, and submit site survey reports.
* Prepare and submit study execution plan and planning package.
* Development of Study Design Basis:
* Establish the design basis by outlining assumptions, interface projects, process simulation cases, and design considerations.
* Prepare high-level methodology for assessing the adequacy of existing utilities and associated systems.
* Establish a methodology for estimating the capital expenditure (CAPEX), operating expenditure (OPEX), and evaluating the economic feasibility of all study options.
* Perform adequacy assessments of existing utilities and evaluate constraints and potential bottlenecks in the current systems to ensure smooth operation during outages.
* Account for all relevant interface projects impacting the feasibility study.
* Conduct a brainstorming session to discuss initial findings and explore all potential options.
* Propose multiple options for enhancing availability, with a focus on operational reliability, cost-effectiveness, and HSE compliance.
* Maximize the utilization of existing facilities while ensuring minimal HSE risks and maintaining product quality.
* Develop and run HYSYS process simulation models considering latest production profiles to evaluate feasibility of each proposed option.
* Carry out space and layout studies:
* Analyze plot space requirements and propose layouts for new equipment, including potential land reclamation.
* Study the feasibility of routing and connecting new facilities to existing systems.
* Carry out Electrical and Instrumentation assessments:
* Study the electrical network adequacy, including load lists and power supply arrangements for new facilities.
* Analyze DCS/ESD system configurations, tie-ins, and compatibility with existing systems.
* Evaluate required changes to the control system, including integration with existing infrastructure and alignment with ADNOC’s cybersecurity requirements.
* Prepare adequacy reports for existing instrumentation and control systems, ensuring seamless integration with new facilities.
* Perform a +/- 50% cost estimation for all options, considering CAPEX, OPEX, and overall economic viability.
* Prepare Options Catalogue:
* Develop a detailed options catalogue, including technical descriptions, CAPEX/OPEX estimates, block flow diagrams, and risk assessments for each proposed solution.
* Identify pros, cons, and opportunities associated with each option.
* Carry out Project Economics. Compare economic indicators (NPV, IRR, payback period) across all options to identify the most favorable scenario.
* Preparation of Feasibility Study Report:
* Compile all findings, simulations, and assessments into a Feasibility Study Report including process descriptions, tie-in diagrams, utility assessments, and a recommended path forward.
* Present the study results and recommendations in both technical and management presentations and deliver the final Feasibility Study Report, incorporating all stakeholder feedback, with a clear implementation strategy.
* Prepare and submit Scope of Work and Statement of Requirements for SELECT Stage.

1. SCOPE BOUNDARIES

The scope of the Feasibility study includes the following as minimum; but not limited to the following:

* NMGL, and IGL pipelines
* Inlet gas facilities (NMGL and IGL) in Das Island
* IGD Trains, utilities, flare & off site
* Green Field Development for new inlet separation facilities.

1. PURPOSE OF THIS DOCUMENT

The purpose of this document is to describe the approach and define the work involved for Cost Estimation activities to fulfil the requirements for preparation of Cost Estimate. The cost estimate accuracy is of +/-50%.

1. DEFINITIONS AND ABBREVIATIONS
   1. Definitions

For this document, the following definitions are listed:

|  |  |
| --- | --- |
| COMPANY | ADNOC Gas |
| PROJECT | Feasibility to Increase IGD Availability during Plant 4 Outage |
| CONSULTANT | Bilfinger – Tebodin Middle East Ltd |
| SHALL | The Use of The Word “Shall” Indicates A Mandatory Requirement |
| SHOULD | The Use of the Word “Should” Indicates a Strong Recommendation to Comply with the Requirements of this Document |

* 1. Abbreviations

| Abbreviation | Description |
| --- | --- |
| ADGAS/ ADNOC | Abu Dhabi National Oil Company |
| ALARP | As Low As Reasonably Practicable |
| CAPEX | Capital expenditure |
| CBS | Cost Breakdown Structure |
| EPC | Engineering Procurement Construction |
| FAT | Factory Acceptance Test |
| FEED | Front End Engineering Design |
| HSE | Health, Safety and Environment |
| LDE | Lead Discipline Engineer |
| PM | Project Manager |
| PPE | Personal Protection Equipment |
| QA/QC | Quality assurance / quality control |
| SOW | Scope of Work |
| VAP (GVAP) | Group Value Assurance Process |

1. REGULATION AND REFERENCE DOCUMENTS
   1. Order of Precedence

In the event of a conflict between this document and the referenced codes and standards, the following hierarchy of adherence shall be followed:

1. UAE Statutory requirements
2. COMPANY HSE Standards
3. Equipment datasheets and drawings
4. Project Specifications and Standard Drawings
5. COMPANY/AGES Specifications
6. National / International Standards

In case of conflict between this specification and other specifications, codes or standards referred in this document, the most stringent requirement as interpreted by COMPANY shall be entertained and written COMPANY confirmation on the same shall be obtained before proceeding. COMPANY decision shall be binding in this regard.

* 1. Reference Documents

|  |  |
| --- | --- |
| Document No. | Description |
| AGPM-STD-501\_Rev 1 | ADNOC Group Capital Projects Estimating Standard |

1. COST ESTIMATE BASIS & METHODOLOGY
   1. Company Project Stage Classification

|  |
| --- |
|  |

COMPANY follows a ‘stage gate’ Value Assurance Process (VAP) for the projects. The VAP stages are as follows:

ASSESS Stage - Determine Project feasibility and alignment with business strategy

SELECT Stage - Select preferred project option(s) incorporating pre-DEFINE engineering

DEFINE Stage - Finalize project scope, cost and schedule and get project funding.

EXECUTE Stage - Produce an operating asset consistent with scope, cost and schedule incorporating EPC and commissioning.

OPERATE Stage - Evaluate asset to ensure performance to specification and maximum return to shareholders

* 1. General

Cost estimation, as part of this study will be performed to support the following:

The Cost Estimate with +/-50% accuracy levels at this stage will be prepared based on the equipment list, high level MTOs generated, Constructability report and execution schedule prepared.

Budgetary vendor offers will be requested for long lead items, inline with COMPANY guidelines. Basis of cost for each item will be clearly stated in the cost estimation sheet for that item as a part of the cost estimation report.

* 1. CAPEX Estimation Methodology

The CAPEX estimates will be developed by breaking down the project into key components. Costs will be categorized into direct costs, contractor indirect costs, and client indirect costs. A contingency will be added to account for uncertainties and risks inherent to project.

Estimation will be performed using in-house spreadsheets and cost database e.g. per ton material cost, installation vessel day rates, ton/ton bulk factors, man-hour/ton factors, rate/man-hour, vendor quotations etc. Cost indexation will be done to take care of the year of database.

Budgetary vendor offers will be requested and verified with cost estimation from ASPEN Capital Cost Estimator. All the items required for the cost estimate have sufficient cost references in the in-house database in Middle East or ASPEN Capital Cost Estimator and will be used in the estimation. Basis of cost for each item will be clearly stated in the cost estimation sheet for that item as a part of the cost estimation report. Other input to cost estimation will include, as applicable:

1. Equipment size, weights, plot area etc.
2. High level discipline inputs for bulks (e.g. piping, instrumentation, electrical, structural) outside the package or skid.
3. Brownfield modifications on existing facilities such as process equipment, piping & pipelines, electrical and instrument systems, structural supports etc.
   1. Cost Breakdown Structure

Cost break down structure will include the following elements:

* SELECT Stage
* Conceptual Select & Design Engineering
* Studies & Surveys
* DEFINE Stage
* FEED Engineering
* Studies & Surveys
* EXECUTE Stage
* Home Office Services (Detailed Engineering, Project and Procurement Management, HSE Studies)
* Equipment Material and Bulk Material Cost
* Freight Cost
* Construction, Pre- Commissioning, Commissioning
* Field Supervision
* Vendor Assistance
* EPC Contractor’s Margin
* Contingency
* COMPANY Indirects
* COMPANY Project Management
* Insurances
  1. Basis for Cost Elements

Detailed basis for each cost element associated is as per below:

| **Cost Elements** | **Particulars** | **+/-50% Approach (Selected Project Scheme)** |
| --- | --- | --- |
| **SELECT Stage** | Conceptual Select & Design | Based on manhours estimated on number of deliverables and manhour cost applied |
| **DEFINE Stage** | FEED Engineering | FEED – 2.5% of EPC cost |
|  | Studies & Surveys | Based on In House Database |
| **EXECUTE Stage** | Home Office Services |  |
|  | Detailed Engineering | 5% of Material and Construction cost |
|  | Project & Procurement Management | 7% of Material and Construction cost |
|  | Studies & Surveys | Based on In House Database |
| **Procurement Costs** | Equipment & Package Cost | Vendor offers, In-house capacity vs cost database from previous ADNOC projects |
|  | Bulk Material Costs (Pipes, flanges, fittings, electrical and instrumentation cabling, structural steel etc) | Bulk weight % of equipment weight, Preliminary MTO (where equipment not envisaged), Bulk weight (ton) x per ton cost |
| **Commissioning & Start-up Spares** |  | 1% of Material Cost |
| **Freight Cost** |  | 7% of Equipment and Bulk materials Cost |
| **Construction & Commissioning** | Fabrication and Assembly Costs (Separator modules, welding and construction labour, load out, offloading and handling at site etc) | % of equipment & bulk material costs based on previous project experience and in-house cost database |
|  | Electrical, Civil and Structural Works Costs | Man-hour/ton (based on brownfield project data for Abu Dhabi offshore)  Rate/man-hour |
|  | Demolition and Modifications Costs | Man-hour/ton (based on brownfield project data for Abu Dhabi offshore)  Rate/man-hour |
|  | Pre-Commissioning, Commissioning & Startup Assistance | 2% of Construction Cost |
| **Field Supervision & Others** | Field Supervision | 15% of Construction Cost |
|  | Vendor Assistance & Third Party Inspection | 2% of Construction Cost |
|  | Temporary Site Facility | 7% of Construction Cost |
| **2 year Operational Spares** |  | 1% of Material Cost |
| **Contractor Mark Up & Other Overheads** |  | 7% of Total EPC Cost |
| **Contingency** |  | 20% of the EPC cost |
| **Client Indirects** | Company Project Management |  |
|  | Client PMC & PMT, Studies + FEED, Project Insurance & Other Overheads | % of EPC Costs as agreed with COMPANY |

* 1. OPEX Estimation Methodology

The section provides a basis and methodology used to estimate operating expenditure (OPEX) referred to as operating and maintenance (O&M) cost.

The methodology explained in this document corresponds to the feasibility study of project and does not cover detailed OPEX estimation that is typically performed at the FEED or detailed design stage of a project. In the absence of specific information a high-level approach is used i.e., factored based OPEX.

Tariffs or use of asset charges related to processing and transportation, taxes and royalties are excluded. In addition, the costs associated with unplanned maintenance viz., major breakdown are also excluded.

OPEX for the various options consist of the fixed and variable cost. Below, it is explained how these cost components are estimated.

OPEX / O&M costs are classified as

1. Fixed OPEX (manpower cost, maintenance cost (planned / unplanned), General / admissions costs & overheads etc)

Variable OPEX (utility costs, maintenance and repair costs, inspection and compliance costs, consumables etc)

1. COST ESTIMATE EXCLUSIONS

The following exclusions will be included in the cost estimate:

* Allowance towards cost increase due to following is not included in the estimate:
* Delays in project
* Cost estimate does not include any factor or contingency towards currency hedging.
* Cost estimate excludes costs incurred to-date.
* Factor or contingency towards currency trends, price escalation and/or inflation are not considered in the cost estimate.
* COMPANY In-directs costs such PMC, PMT, Insurance, TPA, Travel, etc.and taxes have been excluded from the estimate.
* Provisional sums
* Reimbursable sums
* 2 years operational spares
* Chemicals & Catalysts

Storing of fabricated materials at contractor’s yard due to any delays during execution

1. Cost Estimate Report

Project Cost Estimates shall be presented as per COMPANY provided templates. Any alteration to the template shall be made only after consulting the Company’s Cost Estimation Engineer.

Electronic native files (Editable) with relevant formulae & links in ‘Excel’ shall be submitted along with pdf and / or hard copies of the cost estimates

Cost estimate report shall comprise of the following sections:

1. Project Objective

2. Executive Summary

3. Reference document list

4. Brief project scope of work

6. CBS

7. Summarized discipline wise quantity

8. Tabulation of budgetary quotes received and quote considered for estimate

9. Detailed estimate basis for each cost element

10. Assumptions and basis

11. Exclusions

12. Currency exchange rates

13. Estimate validity

14. Cost estimate attachments including the cost estimate breakdown and vendor offers

Cost estimate report attachments will be listed. It will have MTOs, equipment list, budgetary quotes, constructability study report, EPC /FEED SOW, schedule, cost estimate excel linked, etc.

1. ATTACHMENTS

Attachment 1 – Cost Estimate Template

Attachment 1 – Cost Estimate Template