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Carrying out Engineering Design Work and Mechanical (Piping and Stationary Equipment) in Gas Train Technology

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Abstract: Main object of this project is to assess the impact of disturbance in a natural gas processing train in the upstream oil & gas fields and to validate a representative model which can be used for developing a swift and anticipatory control system. The impact of two different causes of process disturbance on a gas phase train comprising three main process connected processes. The paper provides answers about how feed disturbances, and process unit malfunctions affect series connected processes dew-pointing units. The strategic project on the regional level, is part of industry strategy in expanding capacity in the production and processing of gas to fulfill the local needs. After completion, the plant total gas processing will be approximately 3.2 billion SCFPD

I. PURPOSE

The purpose of this section of the document is to lay down a procedure for mechanical engineering and design work (piping and stationary equipment) to ensure the following:-

- A. Providing standard working guidelines for “in-house” engineering design work by projects department (PD) for major projects.
- B. Uniformity and consistency in design philosophy, detailed engineering and documentation.
- C. To have uniform understanding of work factions, roles and responsibilities.
- D. To shorten the time duration for the learning curve for new recruits regarding familiarization with design work procedure. specifically stated in this section of the document, the words “Engineering”, “design”& “documentation” imply “mechanical engineering (piping and stationary equipment)”, “mechanical design (piping and stationary equipment)” and “mechanical documentation “respectively”.

II. PROJECT MANAGEMENT PROCESS GROUPS & KNOWLEDGE AREAS CONCERNED:

- A. This procedure is concerned with project management executive process group.
- B. This is concerned with project integration management knowledge area (Direct and Manage project execution) and project quality management knowlw=edge area (perform quality assurance).

III. RESPONSIBILITIES OF THE DESIGN ENGINEER (PIPING & STATIONARY EQUIPMENT)

Responsibilities of the design engineer can be classified as follows:-

The above mentioned general responsibilities/major function / activities of the design engineer are described below:-

A. General responsibilities

General responsibilities for design of piping and equipments are to ensure the following as a minimum:-

Design is in accordance with the project criteria / requirements.

Engg. Standards, SHELL DERs and the relevant international codes are followed.

To be in line with internationally accepted sound engg. Practices.

Design are workable, maintainable, safe (i.e. design shall assume the safety of personnel and equipment during operation & maintenance, in particular, safe starting, safe operation and safe shutdown of plat shall be ensured) and environmental friendly,

Design must ensure the most economic usage of utilities, fuel and energy.

Equipments and materials shall be designed in such a manner (i.e. standardization of equipment) that capital investment for stock of spare parts is minimized.

Equipment selected must meet the requirement of the project specifications.

Equipment must meet the requirements of local law and statutory authorities for inspection, safety and environment. To ensure that all engg., procurement and other documentation for engg. Record produced by contractor is consistent in content approach and numbering systems across the project.

To ensure smooth, efficient and un-interrupted execution of the project (i.e. engg., procurement, construction and commissioning) with minimum cost and schedule and without compromising on quality, safety and environmental requirements.

B. Major function / activities

Major function / activities are as follows:-

- 1) Preliminary / basic design are as follows:-
- 2) Detailed design & engineering
- 3) Documentation
- 4) Interaction with other disciplines

The activities listed above are detailed in the following section.

IV. PRELIMINARY / BASIS DESIGN AND ENGINEERING

Activities pertaining to preliminary / basic design and engineering for the projects are listed below:

A. Piping

- 1) Review of the basic engineering documentation including process schemes, data sheets, PFDs, P&IDs, feasibility report, scope of supply/work, plant layout, safety and maintenance requirements, etc.
- 2) Site visit and discussions with the concerned sections of the refineries / LM / Projects Department.
- 3) Collection of data / documents from central archives of refinery / LM.
- 4) Finalizing the execution philosophy i.e. in-house design and construction by contractor or execution through EPC contractor for projects coordinated.
- 5) Furnishing comments on process schemes.
- 6) Review of line classes.
- 7) Preparation of preliminary equipment/piping layouts after checking the existing underground facilities etc.
- 8) Identification of requirements like shutdowns for tie-ins, hot tapping, road/dyke crossings, underground piping etc.
- 9) Preparation of preliminary "material take-off".
- 10) Preparation material specifications and releasing material requisition requests (MRRS) for piping material based on preliminary "material take-off".
- 11) Furnishing information / data to other disciplines.

B. Stationary Equipment

- 1) Review of the basic engineering documents including process schemes, equipment data sheets, PFDs, P&IDs, layouts etc.
- 2) Site visit and discussions with the concerned sections of the refineries / projects department.
- 3) Checking of crane approach for erection and verifying constructability.
- 4) Furnishing comments on process schemes.
- 5) Identification of requirement like shutdowns for tie-ins etc.
- 6) Preparation of preliminary equipment specifications.
- 7) Furnishing information / data on the equipment to other disciplines.

C. General

- 1) Preparation of execution methodology of the project for projects coordinated.
- 2) Participation in / assistance in preparation of project cost estimate and its review. Also, obtaining budgetary quotations as and when required.
- 3) Preparation / review of engineering schedule / bar chart for projects coordinated.
- 4) Preparation / review of engineering Man-hour requirements.
- 5) Review of planned unit shutdown schedule of the refinery for accommodating the shutdown requirements for the specific projects and assist in preparing revised shutdown schedule with a view to minimize operational shutdown.

- 6) Identification of critical issues including safety, maintenance and environmental requirements, specific operational / control requirements which call for concurrence / comments from the refineries for completion of basis design engineering.

V. DETAILED DESIGN AND ENGINEERING

Activities pertaining to detailed design and engineering are listed below

A. Piping

- 1) Preparation / receipt of final P&IDs.
- 2) Participate / coordinate HAZOP studies.
- 3) Preparing final plot plans, equipment / piping layouts including isometric and sending the same for comments to the concerned division / sections of the refineries / projects dept.
- 4) Carrying out design calculations and stress analysis, where-ever required.
- 5) Incorporating the comments received and finalizing the layout drawings.
- 6) Preparation of material specifications and releasing material requisition requests (MRRPS) for procurement / reservation in stores.
- 7) Preparation of scope of third party inspection, if required.
- 8) Technical evaluation of the bids received against the MRRS for package items, which are not similar to stock items in nature and recommending placements of purchase orders.
- 9) Review and approval of vendor drawings/documents.
- 10) Finalizing support details and furnishing input in piping supports, platforms, ladders etc. to other disciplines.
- 11) Preparation of tender documents (construction package or PC or EPC contract) in co-ordination with other engineering disciplines.
- 12) Technical evaluation of tenders and recommending for awarding of contracts.
- 13) Review of EPC contractor's documents and drawings and participation in HAZOP studies conducted by EPC contractor.
- 14) Finalizing "as-built" drawings.

B. Stationary Equipment

- 1) Preparation of final data sheets.
- 2) Preparation detailed equipment specifications
- 3) Preparation nozzle orientation sketches for all equipments.
- 4) Forwarding the nozzle orientation sketches and equipment specifications for comments to the concerned divisions / sections of the refineries / projects department.
- 5) Obtaining comments and finalizing the above.
- 6) Releasing the material requisition requests (MRRS) for procurement.
- 7) Preparation of scope of third party inspection, if required.
- 8) Technical evaluation of bids received and recommending for placement of purchase orders.
- 9) Review and approval of vendors 'drawings/ calculation / test procedure and certificates / operation and maintenance manual.
- 10) Providing final equipment data to the other disciplines.
- 11) Preparation/providing input on tender document for installation / PC / EPC works in co-ordination with other engineering disciplines.

C. General

- 1) Preparation of inspection and testing requirements.
- 2) Establish applicable VEC list for the equipments / obtain approvals for single source equipment / items.
- 3) Establish applicable CEC list for floating tenders / prepare PQ document and participate in PQ process.
- 4) Preparation of scope of "third party inspection", if required.
- 5) Attend/witness factory acceptance inspection / tests of equipments at vendor's shop and at site as required and as approved by management.
- 6) Technical evaluation of construction tender.
- 7) Forwarding basis inputs to the civil group for construction of foundations for equipments.

- 8) Co-ordination with other discipline for site activities like tie-in with existing process and utilities system, installation, testing, pre-commissioning checks and commissioning of the equipments/packages to ensure that contractual obligation are met.
- 9) Identification of special equipment and organizing “preparation” and vendor literature for the same.
- 10) Assistance in development & modification of company engineering. Standards / guidelines.
- 11) Review of VEC / CEC files and giving recommendation.
- 12) Review of SPIR forms by submitted by vendors, finalization of required operational spare with user, item number creation and subsequent procurement.

VI. DOCUMENTATION

The documents to be prepared by design engineer are listed below

A. Piping

- 1) PFDS, UFDS and P&IDS, piping material specifications if non-standard piping line classes are Used, as applicable.
- 2) Plot plans, equipment / piping layouts including isometrics, piping plans, support details.
- 3) Tie-in list / schedule
- 4) Stress analysis report.
- 5) Design calculation.
- 6) Preparation of clip details for vessels/columns / exchange etc. for pipe support.
- 7) Material requisition request (MRRS /ISRS /SRRS).
- 8) Line index / schedule.
- 9) Tender documents containing standard as well as projects specifications covering handling, Erection, welding, stress relieving, painting, installation of piping.

B. Standard Equipment

- 1) Nozzle orientation sketches.
- 2) Design calculations
- 3) Data sheets and specification.
- 4) Scope drawing for vessel mounted platforms and ladders.

VII. INTERACTION OF PIPING / STATIONARY ENGINEER WITH OTHER DISCIPLINES

The design engineer shall interact with various groups within as well as outside the refineries / projects department as detailed below to freeze various engineering aspects pertaining to the projects being handled, the following paragraph outline, in brief, the jobs for which interaction / discussions are required to be held by the design engineer with various groups through his engineering coordinator.

A. Process

Discuss about process schemes, PFDS, UFDS, P&IDS, process / equipment data sheets, nozzle orientation etc.

B. Instrumentation

- 1) Discuss on P&IDS.
- 2) Discuss and finalize location of in-line instrument and instrument mounted on equipment.
- 3) Discuss and finalize requirement of instrument cable routing on pipe racks / sleepers etc.
- 4) Discuss and finalize requirement of instruction air supply, tie-in etc.

C. Electrical

- 1) Discuss about underground power cable routing etc. while finalizing equipment / piping layouts.
- 2) Discuss and finalize requirement of above ground power cable routing on pipe racks / sleepers etc.

D. Civil

- 1) Discuss and finalize equipment foundation sizes, locations, underground facilities etc. and finalize equipment / piping layouts / supports
- 2) Discuss and finalize size, location of elevated platforms and associated stairs / ladders etc.

E. QA/QC

- 1) Discuss and finalize equipment / piping layouts, piping material specifications, piping fabrication specifications, tie-in details and its methodology, etc
- 2) Review, discussion and finalize vendor's / contractor's inspection plans for equipment / material
- 3) Discuss and obtain clarification on issues related to metallurgical aspects and welding.

F. Projects Control

- 1) Review of NPP / CPP.
- 2) Issues MRRs / ISRs.
- 3) Reserve free issues materials.
- 4) Evaluate bidder's offers for classifications and forward technical recommendations for order placement for projects coordinator.
- 5) Issues tender documents / drawings for projects coordinator.
- 6) Participate in pre-tender meetings and provide minutes of meeting (MOM) for technical scope.
- 7) Provide assistance for finalizing costing and project schedules.
- 8) Budgetary requirements as and when required.
- 9) Project schedule / Bar chart for projects coordinator.
- 10) Preparation of addendum to tenders for projects coordinator.
- 11) Evaluate VEC / CEC applications and forward technical recommendation
- 12) Request for copies of drawings.

G. Commercial Section

- 1) Obtain clarification on all issues pertaining to commercial of the projects.
- 2) Communicate with vendors through faxes and letters to commercial.

VIII. CONSTRUCTION

A. Supplied Materials And Drawings

- 1) Sort out queries on drawings
- 2) Issues stores issues requests (SIV's) for materials.
- 3) Clarify issues pertaining to SIRs/
- 4) Issues stores return vouchers (SRRs) for materials.

B. Contractor Supplied Materials Design And Drawings

- 1) Review / approval design and drawings.
- 2) Review / approval bill of materials, materials requisitions etc.
- 3) Assist in vendor selection by the contractor.
- 4) Inspection of materials/ equipment at vendor's shops.
- 5) Review test reports.

C. Drafting

- 1) Inspect materials received.
- 2) Expedite delivery of materials.
- 3) Clarification of issues pertaining to local purchases.
- 4) Review of MR.



IX. CONCLUSION

The project charter authorizes the project manager to carry out the project within the approved boundaries, scope, budget and timelines. Preliminary scope document (statement of work) is a key input for development project charter. Based on the project charter and baseline from various other project management process a project management plan is developed. The work defined in the project management plan is performed as per direct and manage project execution sub-process which is tracked for progress under monitor and control project work based on the execution of project. Finally close project or phase sub-process finalizes all the activities to formally complete the project or phase.

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