



A smooth start-up

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discusses the role of
pre-commissioning in
the successful
start up of pipelines*

Any energy project, together with its distribution network infrastructure, will involve basic engineering, planning, procurement, construction, fabrication, erection, pre-commissioning, commissioning and start-up. Each of these activities has its own importance. However, the post construction pre-commissioning and commissioning phases are the most critical to ensure a smooth start-up.

Commissioning of plant equipment, sub-systems, systems and pipelines can be identified as those activities post mechanical completion up to the certification and performance, which guarantee acceptances between the EPC (engineering procurement construction) contractor and the owner. The cost of commissioning can be considerable and is widely underestimated in the conceptual engineering/design phases of many projects. As a general guide, commissioning costs can be broken into percentages for the purpose of the general Scope Vs cost analysis to estimate quite accurately the budget that should be allocated for commissioning and start-up activities, in order to avoid delays and additional costs during final commissioning of the project:

- 5 - 10 % for established processes.
- 10 - 15 % for relatively new processes.
- 15 - 20 % for new processes.

In order to ensure that any new build undergoes a smooth transition from construction and fabrication assembly, to the commissioning interfaces, and through to the final stages of start-up, it is essential that the controls and processes during the mechanical completion and preparatory activities for commissioning are thoroughly performed.

This normally includes undertaking extensive pre-commissioning activities, or 'cold tests', such as internal cleaning, hydrostatic testing and leak testing of pipelines and vessels, loading of lubricants, chemicals, installing mechanical seals, aligning rotating equipment, loop testing instrumentation/calibration of instrumentation and pressure testing of electrical systems. Once these tests have been completed, the plant will be ready for commissioning/start-up.

Planning and controls

Commissioning Managers should be present at the beginning of any project, as part of the project team, playing an important role during early engineering clarification, design challenges, procurement of major packages and vendor selection. The Commissioning Manager should be responsible for the selection of the key commissioning team and personnel required to generate the project specific procedures and operations, and maintenance manuals required for the commissioning and start-up activities. The commissioning team should be considered as the final client of the construction team. Commissioning and operations personnel from both the client and EPC contractor should be in touch with the construction staff at an early stage of piping erection, in order to establish priorities for mechanical completion in line with the priorities for commissioning and start up. Ideally, when construction activities have reached 60 - 70% completion, the construction team should start to focus on the priorities of the commissioning team, and those priority systems and sub-systems that will be required by the commissioning group for early start-up.

During the early fabrication and detailed engineering phase, the Commissioning Manager should co-ordinate the construction and engineering groups to work in a methodical manner, so that the project is divided into various manageable systems and/or subsystems (known as 'work packs') in the order and priority mechanical completion as is desired by the commissioning group. Many of these interfaces will be predetermined or constrained by the design build and/or modular units determined by engineering. It is essential that commissioning input is adhered to during these early stages, as plant and equipment such as gas



Figure 1. Commissioning of process units, Gulf of Mexico.



Figure 2. Installation of PBKUM topside, Gulf of Mexico.



Figure 3. MC process flow diagram.

turbines, generators or pumps may have to be test run at the early stages of commissioning. This is to ensure that they meet performance requirements prior to the final start-up to undertake troubleshooting. It is essential to be well prepared before the commencement of start-up activities. Schedules should take into account those activities that fall into the critical path of the project start-up sequence.

The critical path of any project should be looked upon as the ultimate master schedule and used as a guide to measure any delay and/or respective recovery required during the project. Identifying the critical path at the earliest opportunity, following the finalisation of confirmed engineering cut off dates (engineering freeze) and procurement delivery (lead items/key vendor packages), is essential to avoid delays at the later stages of fabrication. Loss of control of the critical path will have a serious effect on the final commissioning schedules if left to slip without a strategic recovery plan implemented at the earliest stage possible.

Mechanical completion

Using an electronic mechanical completion and handover tracking system will increase the accountability during the fabrication and installation phases of the project. This will ensure that critical documentation is signed off in a phased manner, as required by the commissioning team to ensure a smooth handover process.

Having the right personnel is essential in the commissioning and

start-up of any project. The team should be headed by an experienced Commissioning Manager, supported by Senior Process Engineers and Discipline Engineers for mechanical, electrical instrumentation and piping (Telecoms) if required. The number of engineers required from each discipline will be dependant on the size and complexity of the project. Senior construction personnel and key vendors (such as compressor manufacturers) should also form part of the commissioning team or what is known as a Project Completion Group (PCG). They should be called on at an appropriate time during the running and testing of the equipment packages.

Process Inspection

Before any commissioning can begin, it is essential that all equipment and piping are thoroughly checked to ensure that they conform to the detailed P&ID (Piping and Instrumentation Drawing's) and the project specifications.

This is the final post construction check to ensure that the construction build is as per the design and any errors can be rectified prior to the handover to the commissioning group. Inspection of the plant and equipment can be divided into the following groups: personnel and safety; vessels and heat exchangers; machinery; piping; electrical and instrumentation (E&I).

Commissioning of essential equipment and utilities

Critical system for an early start-up should include utilities such as instrument air, diesel, emergency generation, cooling water, and critical safety systems such as fire and gas alarms. Deluge and telecoms should be put into service prior to the introduction of hydrocarbons. It is essential for a smooth start-up that pre-commissioning of all utility systems has been completed to the highest standard. This will ensure that the start of plant and equipment goes to plan and that any teething problems and or trouble shooting have been resolved prior to these systems being energised.

Technical audit, plant handover

The concept of a technical audit has become increasingly



Figure 4. Statoil's Snorvit LNG process barge. Petrotec undertaken mechanical completion of 36 000 t topside.

popular, especially when large projects are handled on the basis of lump-sum turnkey contracts. Before handing over the plant to the owner, the contractor is required to offer various sections of the plant (normally in order of their agreed completion) to the owner for an audit. During the course of this audit, the owner's inspectors and/or third party certification bodies (such as DNV, BBV or Lloyds) would carry out a thorough check to ensure that the design build and mechanical completion is as per the P&ID and design specifications. This

information is collected during the fabrication assembly and incorporated into the system's mechanical completion manuals in a series of check sheets by discipline, system and subsystem.

Following the final audit, the owner generates a list of defects or non-compliances, known as a 'punch list'. At this stage, these punch list items would normally be minor. For example, wrong size or missing bolt's in the pipe supports or unfinished/damaged painting. The contractor should rectify any errors, after which the owner performs the final check on the owners acceptance for start-up. Once the owner has noted any pending defects as acceptable, the audit is considered to be complete and the plant is ready for start up. ●●●