Project Profile – Ethanol Production Plant

SITUATION

In the fall of 2008, Brillig was contacted to support the commissioning and start-up of an Ethanol production plant. A new company had discovered a new method to produce Ethanol from the material in a recycling plant. During their first years, they proved the functionality of their innovative process in a lab environment and were in the middle of building their first scale facility. Most of the personnel was new to the company and new to the process. Half of the operation personnel were just out of school.

BUDGETING AND SCHEDULING

The principal challenge in this project was to perform accurate budgeting and scheduling with the following constraints:

- a new process
- new operation staff with little or no experience
- new company constructing their first operation facility

COMMISSIONING

Approach

Inspired by the pharmaceutical methodology, (see ISPE Guide, "Commissioning and Qualification Baseline Guide", Vol. 5.), Brillig successfully brought the pharmaceutical technique to the chemical industry and put in place the following:

- Commissioning planning - creation of the commissioning plan
- Systemization and Classification - allowing the project team to differentiate between each system
- Design Verification (DV) - allowing the commissioning team to confirm that the design met user requirements
- Installation Verification (IV) - confirming that all components of the system are installed as outlined in the specifications
- Functional Testing (FT) - verifying that all system functions met the functional requirements and specifications
- Operation Verification (OV) - verifying that the system operated in a way that met the functional requirements

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Commissioning Planning

Management of the commissioning activities started with creation of a plan which included:

- Commissioning overview
- Project overview
- Commissioning strategy
- Roles and responsibilities
- Organization
- Scheduling & budgeting

The creation of the plan provided the opportunity for the commissioning team to meet and talk with the rest of the project team and management. The total exercise took three weeks, resulting in:

- Commissioning plan reviewed and approved by all parties including construction, operations, process engineering, and management
- Commissioning process workflow (see Appendix A)
- First draft of commissioning schedule
- First estimate of commissioning budget

Systemization and Classification

The goal was to focus on the commissioning activities that could have significant impact on the quality of the final product. The classification process began by determining boundaries between each system. The P&I D's were a good place to start as they were already separated by systems. However it rapidly became clear that the systemization from a process perspective would not work from a commissioning perspective. Therefore, we color-coded the P&I D's and the 28 P&I D's became 25 systems. Some systems included a portion of as many as five P&I D's, while others were only half of a P&I D. Once clearly defined, each system could be classified into one of two categories:

- Those required for beginning operation
- Those not required for beginning operation

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Design Review

One of the critical steps in Good Engineering Practices (GEP) is the design review. During design review, the commissioning team met with the design team to ensure the design would match the project requirements. The control system (CS) design was also reviewed. The following documents were used:

- Process description
- Functional specification
- P&I D's
- Instrument and I/O list
- CS code and displays

The design review, led by the Commissioning Manager, was very successful as it highlighted several inconsistencies between the different documents and between the versions of documents used by the construction team. The commissioning team also brought up several points which generated changes in the process (including P&I D's), thereby facilitating start-up and operation.

DOCUMENT PREPARATION

Installation Verification (IV) Documents

The installation verification (IV) documentation allows the Commissioning team to ensure that all components have been installed per specification. This consists of three main areas:

- Process and utilities equipment
- The control system
- Instrumentation

Equipment IV forms were based on typical forms for each type of equipment (e.g. pumps, motor, conveyor). The control system consisted of a review of the system architecture and a set of typical equipment (e.g. panel, network equipment, server). Instrumentation IV documents were standardized by type of device and completed automatically using database integration with the instrument database. Integration with the engineering database is highly recommended to avoid having to maintain a complex database change control system with engineering. Change control was implemented after the system DR was performed.

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Installation System Verification (ISV) Documents

The installation system verification process consisted mostly of a P&I D walk-down to confirm all components had been installed at the appropriate location based on the process flow. Document creation was relatively simple and consisted of a standard form, color coded to match the P&ID identifying the system.

Dry Loop (DL) Documents

Dry Loop forms were standardized by type of device: analog input, analog output, digital input, digital output, and bus devices.

Functional Testing (FT) Packages

The Commissioning team needed to verify all systems through functional testing. All tests needed to be documented appropriately. For this reason an automation system FT package was prepared addressing the following:

- Valve stroking and motor jogging, when not already cover in dry loop
- Interlock and permissive testing
- Instrument testing and loop tuning. This was generally performed with simulated material (water, air, nitrogen) and reviewed with Process Engineering and Operations. The commissioning team was prepared for excursion outside the expected normal operating range.
- Equipment start/stop
- Equipment pre-act adjustment
- In-place calibration (where calibration could not be performed previously e.g. load cell)
- Advance calculation verification
- Sub-system testing

EXECUTION

As cost was the primary driver, execution was performed mainly by the Company staff.

Installation System Verification (ISV)

Upon completion of the construction and construction QA activities for a system, the Commissioning team initiated the installation verification activities to verify all equipment and components had been installed per specification. This activity was conducted by a process engineer and the operators. ISV consisted mostly of a P&I D walk down.

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Installation Verification (IV)

There are 2 types of IV: mechanical and instrumentation. Mechanical IV verified that all process-related equipment had been installed properly. Using a similar process the instrumentation IV was conducted for every element, transmitter, switch, gauge, motor control, valve, cylinder etc. IV was performed by a single technician supported by an operator for each system. Several systems were verified at the same time based on their availability. By working together, the operators became familiar with the location of the devices, saving time during FT verification.

Dry Loop (DL)

Dry loop testing consisted of simulating every I/O in the control system to confirm that they were functional. DL was preceded by verifying that each instrument has been calibrated by verifying it had a valid calibration sticker during the IV activities. Whenever possible, DL activities were integrated with other commissioning activities to minimize the work on a simple device (e.g. testing a valve included testing the limit switches as well). DL testing was performed by two people - one technician in the field at the instrument and one operator at the console. The person at the console was responsible for maintaining the paperwork and signing the forms.

Functional Testing (FT)

At the completion of DL, functional testing began, following a well thought out, detailed and orderly plan. FT was performed by a team of three, consisting of two operators and an automation engineer. The field operator conducted all field manipulations such as opening and closing manual valves and starting field devices (e.g. pneumatic pump, local agitator etc.). A control room operator conducted the tests and start/stops (open/closes) equipment remotely. The automation engineer supervised the results and adjusted the configuration to obtain the desired functionality, including tuning the loops.

CLOSURE

After all testing, completed commissioning packages were transferred to the documentation team for final assembly and approval.

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