SPOTLIGHT
on the commissioning of metallurgical plant*

by P. LLOYD† and K. LEVIN†

During the commissioning phase, which is usually the most exciting part of a project involving the design and construction of metallurgical plant, the commissioning engineers interact between the client and the project management. The client wants to see whether all the equipment that he has bought and that, in his opinion, has taken far too long to erect will actually work. Project management expects the commissioning people to convince the client that this is the best design ever developed and that never before have time and money been spent so well. The commissioning team has to fulfil these expectations.

Commissioning work is a 'shirt sleeve' function, with little of the glamour that is normally associated with fields such as engineering and operations. The team usually works in a partially completed plant with more temporary than permanent services and little (if any) office accommodation, normal working hours do not apply, and the demands made on the team change suddenly and dramatically.

This article outlines the activities of the commissioning group and the systems used to smooth the commissioning path.

Objectives

As a service input to project management, the commissioning department has to meet the following specific objectives:

(1) to bring the plant into operation as quickly as possible within programme and budget,
(2) to demonstrate that the plant falls within the design parameters with respect to capacities and efficiencies,
(3) to ensure that all the emergency and interlock safety devices operate effectively,
(4) to obtain acceptance certificates for the plant, and
(5) where required, to train the client's personnel to operate the plant.

To meet these objectives, the commissioning group has to be involved from the start of the project.

Contractual Phase

The commissioning of new plants proceeds more smoothly if all the requirements can be defined as early as possible.

The client has to indicate the extent of the commissioning services he requires, and the cut-off point between project management and client. Normally, project management supplies a commissioning engineer in a supervisory role, and the client provides operating personnel so that on-the-job training of their personnel starts during the commissioning phase. In addition, the client should indicate the following:

(*a*) the staffing requirements, and basic and other training needs,
(*b*) the responsibilities for the raw and operating materials such as lubricants, for the first loading of process materials and chemicals, and for utilities and services, and
(*c*) the requirements for operating and maintenance manuals.

Engineering Phase

The planning and preparation for commissioning start during the engineering phase, during which the commissioning engineers, as part of the project team, make their contribution to ensure an operable plant. Allowance has to be made for break-out flanges to permit the flushing and cleaning of pipelines, for the installation of temporary spool pieces to bypass equipment for cleaning or 'cold' commissioning operations, and for any requirements dictated by the provisional commissioning and operating procedures.

These procedures are used in the evaluation of the design for operability and safety during commissioning, start-up, and normal and emergency operations. Procedures are also drawn up for performance and acceptance tests on equipment and plant.

Plant layouts are studied to ensure that equipment is accessible for maintenance purposes. Lists of recommended spares are drawn up, and vendor information is obtained for inclusion in the maintenance manuals.

Planning is then started on the supply of commissioning materials such as utilities, flushing and cleaning materials, lubricants, chemicals, and process materials.

Construction Phase

The commissioning engineer pays periodic visits to the site throughout the construction phase to familiarize himself with the plant and the commissioning requirements. The plant is normally divided into various systems or sub-sections, which as far as possible are contained within a given area. The components of the system that require commissioning are identified, and responsibilities and procedures established.

The commissioning engineer liaises with the construction group and client during the very important pre-commissioning stage to ensure that all the activities are correctly carried out and that the agreed documentation is formally handed over to the client.

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Pre-commissioning activities cover the inspection, cleaning, and preparation of the equipment for commissioning. This is usually the phase when everyone despairs and tempers flare. 'Completed' systems are not totally complete, test certificates seem to disappear, cut-off points and responsibilities of various disciplines and contractors become vague, and everyone is disgruntled.

The commissioning engineer now has to beg, borrow, or steal documents, people, sump pumps, air compressors, and other diverse equipment; he has to ensure that all the necessary test documentation is made available, that lines and equipment are flushed and cleaned, that equipment is aligned and lubricated, that rotation tests are carried out on equipment, that motor overloads are set, that cables are voltage-tested, that temporary connections are made for the testing of equipment, and that everything is in working order.

While the plant is being pre-commissioned, operating instructions for 'cold' commissioning, 'dummy run' operations, and start-up and emergency procedures, and all the relevant documentation have to be finalized for submission to the client.

Commissioning

'Cold' commissioning includes the checking of the plant, but not under process conditions. The equipment is operated under no load or on water or a safe medium so that the performance of the equipment can be checked with bearing temperatures, operating parameters, instrumentation, and safety and interlock systems simulating those in the actual process as far as possible. This step provides excellent on-the-job training opportunities, and a check of the operating procedures.

When all problems have been sorted out, 'hot' commissioning, or the operation of the unit under process conditions, can commence.

Process materials are introduced into the plant and load is gradually applied, with close monitoring to ensure safe operations. Once the unit is operating satisfactorily, loads and operating parameters are increased to the required or design conditions.

When the equipment and process operate smoothly, a formal evaluation is made of the performance, and performance tests are carried out.

Take-over and Acceptance

After successful commissioning by the commissioning engineer, the project management issues take-over certificates to the client. After the latter has accepted these, he assumes full responsibility for the care, custody, and control of the operation of the system that has been handed over. If no performance tests are called for, the client issues the project management with an acceptance certificate, which states that testing is not applicable.

The project management and its sub-contractors and suppliers are still responsible for any repairs or defects that manifest themselves during the guarantee period applicable to the equipment in that system, providing that such repairs are not required as the result of poor operating methods. Routine maintenance is the responsibility of the client.

Letter to the Editor

Dravo Corporation is seeking information concerning a special method of transporting explosives to aid in designing a large underground oil shale mine in the mountains of Colorado.

Mr Valencia, president of the Denver-based International Ground Support Systems, Inc., recalls one South African mine which used a vertical drop-pipe in a shaft to transport dry ANFO explosives by allowing the material to free fall from the surface to various mining levels. Mr Valencia said that Mr Peter Lawrence, South African Contractors in Johannesburg, may be a possible source of information on this method; unfortunately we do not have his full address.

We will be grateful for information concerning Mr Lawrence's full address, and other material and sources about transporting explosives in vertical pipes.

Background

Dravo Corporation is a mining and engineering company currently designing an oil shale mine in western Colorado.

Every day, a large amount of explosives must be transported down a shaft to a depth of 1700 feet. Two basic types of explosives will be used in the mine: dry ANFO (Ammonium Nitrate Fuel Oil) in prills and liquid slurry explosives. Both types of explosives could be preferably sent down a utility shaft through slicklines or utility boreholes with lining. To the best of our knowledge, this has not been attempted in the United States.

Some technical problems with free fall of dry ANFO prills through a pipe could be as follows:

- Build up of static electricity in the pipe;
- Crushing of prills through attrition or impact;
- Plugging of the pipe;
- Prills absorbing moisture from the air; and
- Evaporation of fuel oil from the prills.

Some technical problems with the flow of liquid slurry explosives down a vertical pipe are as follows:

- Damaging increase in density of slurry explosives under hydrostatic pressure ("dead press");
- Plugging of the pipe; and
- High dynamic impact on the bottom part of the pipe in some situations.

Again, we would greatly appreciate any information or possible sources of information concerning the transportation of explosives in pipes.

Anyone who can help should write to John Peshel, Senior Mining Engineer, Denver Division, Dravo Engineers and Constructors, 1250 14th Street, Denver, Colorado 80202, U.S.A.

Editor