Complete Your Capital Project Efficiently

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Capital projects are complicated and can be fraught with all sorts of issues. Follow these guidelines for safe and efficient work — to avoid problems, maintain relationships, and ensure your success as a construction manager.

Many chemical engineers will find themselves responsible for managing a project and/or the construction of a capital project at some point in their career. Engineers who assume these roles may not have formal training in project management or construction management, and must instead rely on intuition and experience. This article provides guidance that will help you fulfill the role of construction manager for a capital project.

The role

Whether dealing with new construction on barren land (*i.e.*, a greenfield project) or the modification of an existing facility, a construction manager's responsibility is to ensure that the installation corresponds with the design. To accomplish this goal, the construction manager serves as a representative of the project team's intentions when interfacing with contractors, and must be prepared to answer questions that will invariably arise.

The in-house project team typically consists of: a construction manager; project manager; process engineer(s); environmental, health, and safety (EHS) engineer(s); maintenance representative(s); and production representative(s). The type, size, and importance of the project determine the team composition. Where appropriate, representatives from purchasing, research and development (R&D), and other departments, as well as representatives from other plants, may be included in the project team. For smaller projects, the project manager may assume many of these roles — including that of the construction manager.

The in-house project team may be supplemented by a design firm team consisting of a project manager and various design leads from mechanical, electrical, structural, automation and control, and drafting disciplines. The design firm creates the drawings and technical scopes of work that govern the construction project.

With all of these parties involved, it is vital that the construction manager and project manager communicate. Although the construction manager is primarily concerned with the daily activities in the field and the progress of the contractors, it is important for the project manager to inform the construction manager of the overall intent of the project. Agree on a method to obtain and distribute the information necessary for the construction manager to represent the project team in the field. Establish a direct contact for questions and information, and a uniform method of communication (*e.g.*, phone, email, memo, etc.). One efficient communication method is for the construction manager to contact all parties directly via email and copy the project manager on this correspondence to maintain a written record.

Get organized

The project manager should clearly delineate the construction manager's duties. If this is incomplete or not provided, present a written construction management plan that includes duties, responsibilities, reports to be written, and reporting frequency to the project manager and other parties

involved. Request their suggestions and approval to confirm the plan.

The construction manager needs to have a comprehensive understanding of the project to be able to effectively relay information between the project team and the contractors. Collect any project information available, including the scope description, project plan, drawings, schedule, contractor scopes of work (SOWs), contractor quotes, equipment and contactor purchase orders (POs), etc.

To gain an overall understanding of the project, become familiar with these documents. For example, it is important to understand the project drawings, but it is equally important to understand their intent and purpose. A piping and instrumentation diagram (P&ID) depicts the hardware associated with a control scheme, but it does not show the actual control scheme or how the operators will interact with the system. Instead, the control scheme is explained in the automation specification document. Memorizing the information and drawings associated with a project is unrealistic, but knowing where to locate information is essential.

Additionally, familiarity with the project and documentation will help you visualize the practicality of the installation. This includes the purpose and uses of the area and equipment, and how operators will work and move throughout the area. New equipment and structures will need to safely accommodate operators and equipment. The hardware and programming for control equipment will also need to be available and accessible to operators.

To avoid last-minute surprises, become well versed in the schedule and scope details two weeks in advance of deadlines. This expertise can help you anticipate problems in the field. Bring these issues to the attention of the project manager for a discussion, suggestion, or resolution.

Conduct coordination meetings

Hold coordination meetings with contractors and, if the project takes place at an existing facility, plant personnel. The first meeting should be the project kickoff meeting. All of the contractors should be present to discuss their work and how they plan to interact with each other. The primary goal of this meeting is for the contractors to be aware of who else will be working near them, what work will be done, and how that work may affect them. Contractors are typically used to working side-by-side, but will appreciate the opportunity to share information.

After the kickoff meeting, hold regularly scheduled coordination meetings to keep contractors aware of current work plans, as well as to introduce any new contractors. Include pertinent plant personnel as necessary.

The frequency of these meetings is determined by the size and complexity of the project, or by personal preference. A daily coordination meeting with the contractor foremen can be helpful when held at an opportune time, such as after the contractor's regularly scheduled morning break. Request a brief description of the work that is planned for the near future to ensure that the appropriate work permits are obtained. There may be little information to relay, but it is important to provide parties a convenient platform to discuss any issues, no matter how small. On most days, this meeting might last 15 min or less, but it will highlight issues that could cause slowdowns or stoppages.

Maintain a request-for-information log

Coordination meetings present an opportunity for questions. Some of the questions will be technical and will require consultation with an expert, such as an engineer, designer, production manager, or maintenance personnel.

Create a request-for-information (RFI) log by organizing the questions in a spreadsheet (Table 1). Include the date of the query and who asked the question, as well as the name of the individual queried and the date of the inquiry. Distribute this list to the project team and any other responsible parties each week. This weekly reminder is a powerful organizational tool that ensures questions are answered and not forgotten. When a question is answered, record the date and move this entry to a separate page documenting closed items.

Many questions can be answered by examining the job materials, SOWs, and drawings. Inspect the appropriate document with the contractor to ensure there is no miscommunication of the question or answer. If the answer cannot be found in these materials, then there is a shortcoming in the documentation that needs to be addressed. This should be recorded in the RFI log.

Table 1. Maintain a request-for-information (RFI) log to document questions that arise and their answers.

Questioner, Affiliation	Submission Date	Question	Responder, Affiliation	Response Date	Response
John Doe, BTS	4/14/2014	What piping spec should be used for potable water?	Glen Rosentrater, BSI	4/15/2014	Spec 120
Jane Doe, FBC	4/16/2014	Does pump P-2064 get a concrete pad?	Glen Rosentrater, BSI	4/16/2014	Yes. Use the details of pump P-2065's pad
Jordan Doe, IEC	4/17/2014	Who will supply the pump starters?	Glen Rosentrater, BSI	4/18/2014	IEC

Inform facility personnel

If the project is at an existing plant, production and maintenance representatives should be kept informed of contractor plans. Some work permits will require special procedures that could impact them. Any potentially affected parties should be notified in advance to allow them to adjust their work plans.

Although most permits will not affect operating procedures, it is still prudent to inform plant personnel of the work by attending production meetings and by sending out a daily email that details the work to be done the following day. The emails should include the location of the work, number of contractors, equipment to be used, permits required, permit issuer, and any other pertinent information.

Use these emails as a detailed construction log. Annotate these in the field as work progresses, and log them as a daily record of the work performed.

Understand work permits

Most plants have six types of permitting: safe work, hot work, line break, confined space, lockout/tagout, and elevated work. Some plants may combine two or more of these into a single permit, while others issue them separately.

The construction manager is usually not responsible for issuing or signing work permits. However, it is important to become an expert in the company's permitting procedures. Consult the EHS department for information and guidance.

Production and maintenance foremen are generally responsible for issuing permits, but may not be knowledgeable about the trade receiving the permit or the details of the work to be performed. This discontinuity can result in an accident if it is not properly managed. The construction manager should serve as an expert, and provide the foreman with any necessary information about the work or the contractors to ensure that the permit is correctly and appropriately issued.

Enforce site safety

The construction manager is expected to enforce site safety. Contractors who are not familiar with site-specific safety requirements look to the construction manager to set the tone, and generally work to the level of safety expected by the construction manager.

Become an expert in the site's safety policy and make

Types of Work Permits

Safe work involves mechanically coupling or bolting equipment, as well as moving equipment at grade, either manually or with the aid of equipment. For example, a contractor installing threaded pipe or running conduit requires a safe work permit.

Hot work is defined differently by different facilities. Most plants consider any process that can create a spark or heat to be hot work, including welding, torching, cutting metal, grinding, drilling, or live electrical work. An area where hot work is to be performed needs to be checked with a gas detector to ensure that no explosive vapors are present and that flammable and combustible materials are stored sufficiently far away. Plan this type of work well in advance, and, when necessary, present the plan to production and maintenance personnel for verification.

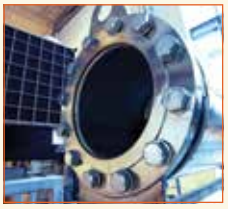
Line break involves breaking a line by unbolting, unscrewing, or cutting. The most important factor is the contents, or previous contents (if the line is thought to be empty), of the line. Was the material hazardous? Is the line empty? If so, how has this been verified? These questions need to be answered in a meeting with production, maintenance, and EHS personnel. These groups should help in formulating a work plan and recommending the proper personal protective equipment (PPE) for the scenario.

Confined space is any work that removes the worker from the ambient environment — for example, work inside a vessel or in a trench that is more than 4 ft deep. This type of work requires extensive planning to minimize risk, and should be identified well in advance of the scheduled date. A temporary ventilation system may have to be designed and installed to ensure a breathable or nonexplosive atmosphere. Special cleaning procedures may need to be carried out prior to entry. A rescue team must be assembled or identified, and incorporated in any planning meetings.

Lockout/tagout requires isolating hazardous energy sources and disabling equipment to prevent unintentional startup or a release of energy that could result in injury. This permit is typically required as part of line break or confined space permitting.

Elevated work is work above grade or work that uses a crane. Jobs that are performed from a scaffold, erecting a scaffold, and working from a lift are examples of elevated work. Any mobile equipment, such as cranes and lifts, must be operated by certified personnel. Some plants require a lift analysis prior to crane use.





sure it is completely clear to all contractors. Require each contractor to have a short safety meeting at the beginning of each day. Attend at least one (preferably more) of these meetings daily, and each week try to be involved in at least one meeting of each of the contractors that will perform work that week.

Visit the construction site at least four times a day, and vary the times of your visits. Inspect for adherence to the safety policy. Also use this time to check on construction progress and adherence to the design. Call attention to even minor infractions, because these small issues can grow into larger problems.

Monitor the schedule

The schedule should be accepted by the project manager and the contractors. Weekly schedules that have clearly defined tasks and goals are useful for tracking and monitoring progress.

A detailed schedule for each contractor should include project line items each week. The contractors should provide these schedules. If they do not provide a schedule, work with the contractor and project manager to create one. It is easiest to obtain these schedules before the PO is issued.

Work with any contractor that is not progressing in accordance with the weekly schedule to determine why there is a discrepancy. Determine the cause and devise a solution to get the work back on track to meet milestones.

Help contractors work efficiently

By reviewing drawings and plans two weeks ahead of construction and by communicating with contractors regularly, potential problems should surface well in advance. Problems can be resolved easily on drawings and in plans, but are difficult to remedy after construction has begun and will undoubtedly lead to slowdowns or stoppages. Thorough planning ensures that work is conducted as efficiently as possible, without frequent stops and starts.

To help contractors work more efficiently, check on equipment deliveries and compare them to the bid. If they differ, make sure an expediting program is established — negotiate for better delivery, or, if necessary, pay an expedition premium. Once deliveries are confirmed, notify the contractor.

When the equipment arrives, compare the equipment manuals with the installation design to ensure that they correspond. If they do not, notify the parties responsible to remediate any discrepancies as soon as possible.

Identify tie-in points and other issues that will require shutdowns or coordination with production and maintenance. Electrical and mechanical tie-ins require that the appropriate facility personnel and sometimes the utilities be notified of the work two weeks or more in advance. It is judicious to schedule all tie-ins at the beginning of the project.

It is also the responsibility of the construction manager to discuss and receive approval for the placement of heavy equipment, scaffolding, laydown areas, fabrication areas, trailers, and the use of company restrooms and lunchrooms by the contractor(s). This should be done during the job bidding process, but, if it was not, resolve this as soon as possible.

Coordinate with the project manager

Notify the project manager of progress during a daily phone call or meeting. Discuss any additional work or materials that are required, and present a time-and-materials-not-to-exceed (T&MNTE) price, which is an agreed-upon maximum time and price that should not be surpassed during the project.

Do not personally authorize any work without the project manager's approval. Even if the construction manager is cleared to authorize work for a certain dollar amount, check all additional costs and work with the project manager to gain approval. Daily contact with the project manager should present a suitable opportunity to receive authorization, and will not slow down work.

Keep a record of changes and share this record with the project manager. Create a numbered list in a spreadsheet of each change order, submission date, description, cost, status, and approval date. When the scope of the contract is changed (*e.g.,* a concrete pump pad is widened by 1 ft to accommodate a larger-than-expected pump) and additional funds are requested, record this in the change-order log.

To formally record and communicate progress, write a monthly status report. Include a description of the work to be performed in the following month. Issue this report to the project manager and other key stakeholders.

Foster morale and a professional attitude

All projects are processes that are being done for the first time, which means problems will arise and mistakes will be made. Focus on solutions rather than problems. This will help to foster morale and a professional attitude among the project team members and the contractors. It will also help complete the capital project efficiently and maintain colleague relationships. CEP

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