

# Meeting Energy Demand with Off-site Modularization

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As the worldwide demand for energy – particularly hydrocarbon-based fuels – continues to grow, energy companies are doing all they can to adequately increase global supply. Not only are they making heavy investments in new exploration and production ventures; they are also upgrading their refineries and gas plants to meet the need for additional capacity.

More greenfield and expansion projects need to be completed faster than ever to keep up with the rising demand. The quicker these oil and gas plants can be commissioned, the greater the benefit for all parties involved. To meet this need, oil and gas projects are being announced in ever-increasing numbers. The challenge for contractors is to optimize their existing resources while continuing to build new oil and gas facilities in a timely and economical manner.

One solution is to use modularization in the place of conventional field construction. By definition, modularization is the process of engineering and fabricating construction projects into shippable packages or segments that can be installed economically and logistically at the permanent site. These tasks are carried out in a shop environment rather than at the project site, so fewer field personnel are required.

Of course, off-site modularization won't replace conventional construction practices. Often conventional, stick-built construction is the optimal solution, especially in remote areas, for large, heavy structures or areas with a skilled resource pool. Also, at least some degree of field construction is needed for every project, regardless of whether a company decides to implement a modular concept. With modularization, on-site crews will still be utilized to carry out civil work, piece together the modules, remove bracing and various other activities.

By that same token, however, some degree of modularization can be used on a majority of projects. The key is for the owner and the contractor to work together to determine the optimal balance. This will require looking at a variety of site-specific issues and determining which conditions favor on-site or off-site fabrication and construction. In addition, either the owner or the contractor must have the necessary experience to carry out modular construction since it requires a different type of planning than that of conventional construction.

## The Advantages and Disadvantages of Modularization

Implementing a modular concept is advantageous because all of the fabrication and assembly activities take place in a controlled environment. As a result, factors such as inclement weather and site labor issues have a smaller impact on the overall project. In addition, companies have a greater degree of control on the quality assurance and quality control (QA/QC) aspects of the project, and civil work can occur simultaneously with shop fabrication



and assembly, reducing the overall project delivery schedule. And of course, off-site fabrication and construction reduces the number of on-site safety risks.

But along with the advantages of utilizing a modular concept, companies must also take into account some of the drawbacks associated with off-site construction. It is important to remember that because modularization takes place within a shop environment, the size of the module is restricted by the size of the contractor's shop capacity, and so is the ability to galvanize, paint and assemble the modules. Module size will likewise be limited by a contractor's shipping and lifting capabilities, especially if roadways are the only means by which a module can be transported from the shop to a port or project site. Contractors that have deepwater access for their fabrication facilities have little restrictions other than the capacity of the barge or unloading area.

In addition, the on-site fit-up of these modules may likewise become an issue, particularly if two different contractors are handling the fabrication and construction responsibilities and these activities aren't coordinated. To avoid such issues, it is generally best to use the same contractor for the engineering, fabrication and construction phases.

As one can see, there are several potential advantages and drawbacks to modularization, which again reinforces the notion that companies will benefit by working with a contractor that can assess all possible project scenarios and then propose the best solution for their particular needs. Whether the best solution involves modularization, stick-built construction or (most likely) a combination thereof, the important thing to remember is that companies have choices when it comes to building their plants. And if all of the relevant factors are taken into consideration, companies will be able to identify the fabrication/construction solution that provides the greatest benefit at the lowest cost.

### Creating a Selection Criteria

So how much modular construction should be used? To answer this question, several important issues must be examined by the owner and contractor prior to executing the project.

When it comes to the module itself, owners and contractors will need to consider such factors as:

- equipment size, because certain components may be too large to modularize;
- maintenance access, particularly if the equipment will need to be frequently removed and replaced by a maintenance worker; and
- the ability to incorporate piping, instrumentation

and electrical systems in the module, since they are part of a highly integrated system.

If the equipment being designed and built for the project is capable of being modularized, other site-specific issues should be considered. A primary consideration when evaluating modular construction is labor productivity. Because modularization takes place in a controlled environment, shop productivity is generally higher than field productivity. Also, the use of "spot" overtime is significantly reduced in a shop environment.

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Other issues to consider include:

- weather, particularly in areas where inclement conditions are likely to occur during the construction phase;
- local labor regulations, since many countries include specific quotas for the amount of local labor required on projects; and
- the space available to install equipment, which is especially important if the dimensions of the existing plant are not accessible to cranes or larger modules.

All these factors can potentially restrict a company's modular construction options.

Owners and contractors need to check on the shipping limits imposed by each country in which they operate and know whether those limits allow for the transportation of large modules. Also on the to-do list: examining the costs associated with the transportation of these modules, as well as the cost of the additional steel needed for the modules, and whether these extra expenses will exceed the benefits of modularization.

Site accessibility is likewise an important consideration, particularly if the project is located in a remote region where there are few roadways. In addition, site permits may be needed before commencing work on a project. If these permits are not readily available and if the schedule is critical, then off-site construction might be the best solution since shop work can begin while permits are being obtained. Once these factors are evaluated, the owner and contractor can then work together to determine the degree of modularization that should be implemented.

### Prequalifications Needed by a Contractor

While off-site construction has its advantages, it also comes with certain disadvantages. These negatives can be overcome if the contracting company has the required expertise not only in the fabrication of modules, but also in their engineering and design. Knowing what to place on modules, ensuring adequate spacing, and meeting constructability requirements in the shop and field are just a few of the engineering aspects that must be considered.

In addition to experience, however, there are particular capabilities a contracting company must possess to ensure that the benefits of modularization can indeed be delivered. One such prerequisite is having the necessary fabrication shop capabilities. Like the project sites to which the modules are being transported, the fabrication facilities owned by the contractor must have easy access to roads and railroad systems that can connect to major thoroughfares. It is especially beneficial if these facilities have deepwater shipping access that will allow for the transportation of larger modules to destinations around the globe.

These facilities must also have the necessary capacity to build and assemble modules. Modules are usually fabricated horizontally rather than vertically in order to reduce risks associated with elevated construction. And because these modules often need to be turned over, a contractor will need to have an adequate amount of covered shop space and sizeable laydown areas to execute these activities.

Another prerequisite is access to transportation, which can become very complicated when it involves the shipment of very large modules. Because the timing of such moves is critical to ensure the delivery of equipment at a project site, it is important that contractors not only have ready access to trucks and ships, but also extensive experience with planning and coordinating these transports.

Also, the construction contractor must have experience in handling and connecting modules. Modules must be lifted with the correct rigging to prevent improper strain. As any good pipe fitter knows, the order and methods by which equipment is placed and connected to pipe is important for fit-up and future stress considerations when the plant is started up and operated.

Finally, a carefully planned execution strategy is perhaps the most important prerequisite to ensure the success of modular construction. The owner and the contractor need to define a clear scope of modularization for each project and how any site-specific issues, such as equipment spacing requirements and confined areas, will be handled. Careful planning will ensure that the



ultimate benefits of modularization are achieved, and energy companies will be able to successfully bring their new facilities online with fewer on-site personnel.

### Supporting Industry Trends

For many years, energy companies have realized the benefits of off-site construction. With project schedules becoming increasingly aggressive, one should expect to see a greater degree of energy projects being executed with a modular concept. In addition, the scope of modularization has grown significantly. Modular units are becoming larger and larger. Today, modularization is used for anything from process plant projects to offshore structures to liquefied natural gas facilities.

With the industry leaning heavily toward modularization, owners will need to find contractors that have the resources necessary to accommodate their needs, from the fabrication capacity to build larger units to an execution strategy for determining the appropriate amount of modularization for each project. Having the skills and the experience to do both off-site modularization and on-site stick-built construction, and the insight to know when to use either, is an advantage for any contractor or owner. With these capabilities in place, energy companies and contractors alike will be able to bring many new facilities online. ■

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