

Panel discussion: Vendor-led turnkey projects— pros and cons

In the United States there is a stronger trend toward more vendor-led turnkey projects than ever before. Some owners perceive a cost advantage and a more valid performance warranty as benefits resulting from this approach. This is causing dramatic changes to the manner in which owners implement projects and to the traditional roles of owners, engineers, constructors, and equipment vendors. This approach has been spearheaded by equipment vendors from Scandinavia and the rest of Europe where vendors have led projects for several years.

Moderator W.J. Tomalonis, vice president, Pulp & Paper Engineering, Brown & Root USA, Inc., set the stage for the presentations with a definition of the term "turnkey project" in the session title, "Vendor-led turnkey projects—pros and cons." "Under a single contract, the turnkey vendor will provide overall project management; design engineering; procurement of equipment and materials; construction; operations and maintenance manuals; operator training; flushout, testing, and check-out services; startup assistance and supervision. The turnkey vendor will remain on the site during operations to conduct quality and operational performance tests, mutually with the owner, in accordance with the turnkey vendor's warranties and guarantees. In summary, the turnkey vendor will do everything just short of actually operating the facility.

"Financing for a project is normally a separate agreement with the owner, and is not included in our turnkey definition."

The panelists explored the pros and cons of this approach from the perspective of owners, engineers, constructors, and equipment vendors.

Vendor handling of projects and project experience

R. J. Curry, president, Gotaverken Energy Systems, Inc., Charlotte, N.C.: My company has been building some of the largest and most sophisticated turnkeys mankind has ever built. For example, a 400,000-ton tanker built in our shipyards is an excellent reference of a true turnkey project. Everything required to make a tanker a functional unit must be included. Only after it has passed many demanding sea trials is it turned over and accepted by the owner.

This article is based on a panel discussion presented by the Engineering Management Committee at the 1987 TAPPI Engineering Conference. The transcript was prepared by W.J. Tomalonis, and Ray Vonderau of Beloit Corp. edited the transcript.

Another example of my company's turnkey experience is the large oil-drilling platforms which are towed out to their eventual destination in the North Sea. These maintenance rigs for the offshore industry will accommodate 600 people. They are small floating cities, complete with living accommodations, recreation facilities, dining rooms, etc.

Approximately 25 years ago, the Scandinavian pulp and paper industry began to require that my company supply chemical recovery boilers and wood-fired boilers as a turnkey project. Some of our earlier turnkeys left a lot to be desired, but after about 50 turnkey recovery boilers, wood-fired boilers, continuously fired boilers, utility, industrial and diesel power plants, the modern turnkeys, by contrast, are thoroughly complete.

An invitation to bid on a wood-fired boiler for Stora Forest Industries, Port Hawksbury, Nova Scotia, brought my company to North America in 1980. This project was tendered in the traditional North American custom where the owner purchased all the major components and put the package together with the assistance of a consultant for the engineering and a general contractor for the installation. When the project was shelved because the cost was too high, we submitted a turnkey bid that was accepted.

This project was completed in a shorter time and at millions of dollars less cost when compared to the original bids using the conventional project approach. All performance guarantees were exceeded, and during the past four years of operation, up-time has been 98.7% with low maintenance costs.

Similar stories can be told about the following turnkey projects:

- Champion Paper, Lufkin, Tex. (December 1985)
 - Site development
 - Recovery boiler complex
 - Evaporators
- Federal Paper Board, Augusta, Ga. (March 1988)
 - Recovery boiler complex
 - Evaporation plant
 - Line kiln
 - Causticizing
- Nekoosa Papers, Ashdown, Ark. (April 1989)
 - Recovery boiler plant
 - Evaporation plant
 - New engineering and maintenance office building
 - New store room
 - New machine shop

- Georgia Pacific, Woodland, Me. (April 1989)
- Recovery boiler plant
- Evaporator plant.

We feel there is a growing trend toward the acceptance of the turnkey approach in the North American pulp and paper industry for the following reasons:

1. Cost effective—compared with the conventional approach
2. Fast track schedule—recovery plants are normally completed in 22-24 months
3. Proven approach—an experienced turnkey vendor uses proven repetitive designs, proven equipment suppliers, and developed process knowledge.
4. Lump sum contracts—turnkeys are essentially accomplished about 1-2% above the contract price usually because of extras added by the customer
5. Single-point contract—the owner contacts one company for all phases of the project including training, performance, and warranty.

In the past 2½ years, 60% of all recovery boiler projects in North America were purchased turnkey. In the next 12 months, six recovery boiler projects are expected to be purchased turnkey. We feel the trend to turnkey is well established.

An owner's point of view

J. K. Donald, vice president, printing & writing papers, Champion International, Wilton, Conn.: In the early 1980s when I was with the St. Regis Paper Co., there were two active projects: a recovery boiler project at the Lufkin mill and a coal boiler project at our Bucksport mill. As you remember, our industry was experiencing severe economic conditions at that time, and the extended freeze on capital spending resulted in the Lufkin project being cancelled and the Bucksport project being placed on hold.

At this time, Gotaverken made a proposal for proceeding with the project on a vendor-led turnkey basis and with the possibility of including financing. St. Regis senior management liked the idea of restarting the Lufkin project, and about six months were spent pulling the turnkey specifications together. Corporate Engineering asked for proposals from two groups: (1) Gotaverken and (2) a U.S. group made up of the former purchase order holders. These bids were to include construction financing.

After two to three months the bids were submitted, and after considerable study by St. Regis, the award went to Gotaverken because of their previous experience on this kind of turnkey project. There was extensive work by St. Regis and Gotaverken getting the bid document acceptable to provide for the recovery boiler, evaporators, precipitator, etc. The contract was finalized in March 1984 and called for the boiler to be started up in 24 months. The contract price was for \$70 million and included construction financing, so St. Regis would make no payment until black liquor was successfully burned, only then 95% of the contract price was due.

Gotaverken handled the subcontractors and made equipment purchase decisions with substantial involvement from St. Regis corporate engineering and mill representatives. The boiler was designed to burn 1.9 million pounds of black liquor solids per day which would generate 323,000 pounds of 650-psi steam per hour.



In August 1985, 14 months after construction began, Champion International, which had purchased St. Regis, wanted to accelerate the construction schedule. This resulted in successfully burning black liquor in December 1985—eighteen months after construction began. The total number of changes totaled 1%, which included a \$300,000 bonus for early completion of the boiler in December.

Making such a turnkey project successful requires:

- A well-defined scope which includes all details
- Involvement of all parties before contract signing
- Contract written in precise language.

If done properly, this will provide a known project, at known costs and known quality levels.

Our company may purchase a recovery boiler every four or five years and smaller companies perhaps once in 20 years. It would seem turnkey vendors who do four or five projects a year have familiarities and abilities we in the paper industry may not really have. I also think this approach adds discipline that none of the other approaches seem to have. Some people say a disadvantage is that the

user loses some control over the project once the contract is signed, since every detail is required to be in the specification. This obviously requires a longer, a better, and a more thorough planning period; one could argue if this is really a disadvantage.

Of particular significance in our approach was the economic conditions existing at that time. We were a company in an industry that was in trouble — a company in trouble financially in terms of our capital spending commitments. I believe this approach for our company was the right approach at the right time. Our corporation will consider this approach again in the future. In my opinion, regardless of how a project is done, one cannot make up for poor planning, poor execution, poor decision making, and poor management no matter which approach is used. I submit to you, if all the factions involved in doing a project did a perfect job, then the results from any



particular type project approach could very well be equal.

The vendor-led turnkey approach is certainly an approach whose time has come and will be competing with all other approaches—not only now, but as far as I can see into the future. This approach will not be used only in boilers, but in other areas as well; probably digesters, wood yards and maybe even paper machines.

Owner who prefers the traditional U.S. approach

J. O. Crisp, vice president-engineering, Union Camp, Savannah, Ga.: Traditionally most major projects in the pulp and paper industry have been managed with the assistance of a consulting engineer and a general contractor on a plus-cost basis with a fixed fee. Union Camp has generally followed this principle on their major projects and to a major degree this means we have no idea what our project is going to cost.

Since the mid 1970s, we have seen the cost of capital projects skyrocket to the point that a bleachable grade greenfield mill can cost \$700,000 to \$800,000 a daily ton. This was brought about by a number of factors: principally high inflation, high interest rates, technological advances in processing equipment, and an increasingly heavy demand for environmental considerations. A result of this is that we have been forced to look more closely at new and innovative methods for lowering the cost of our projects. One of these methods is the vendor-led turnkey project approach which has been used in Europe for many years with reasonably good success.

A number of key concerns usually surface each time a vendor-led turnkey project approach to managing our projects is considered.

1. Loss of owner input
2. Loss of long-term commitment on part of traditional equipment suppliers
3. Loss of specific standards for design factors such as operator stations, ventilation, operating floors, etc.

From an owner's point of view, these things are important because they impact labor relations on which we place high value. This means we are forced to do considerable work up front, and that can add to the length of the project for the owner. Previous speakers indicated that vendor-led projects are typically shorter than conventional projects; however, this time does not include the six months to a year the owner must spend preparing front-end engineering, turnkey vendor bid packages, soliciting and evaluating bids, and selecting a turnkey vendor.

Final negotiation of the specifications and details of the vendor's package may be difficult, since the needs of the client and the vendor may not coincide.

Basic issues of concern to the user:

1. Equipment performance warranties—can the turnkey vendor effectively act in our interest?
2. Cost and availability of original and future spare parts
3. Coordination and quality of operator manuals
4. Project management—there appears to be a greater burden of project management on the owner since we no longer have the consulting engineer and general

contractor providing a natural balance.

5. Cost—how can we effectively minimize the project cost without the traditional team members?
6. Future—can the vendors afford to be involved long term? If not, we could be effectively weakening our general contractor and consulting engineer base in the United States for years to come.

Union Camp has been involved in two fairly significant projects on a vendor-led turnkey basis; a complete set of evaporators at our Franklin mill and a woodyard at our Montgomery mill that we are currently installing. The Franklin project was very successful, with minimum changes and minimal additional costs at the project conclusion. We are confident these were good decisions and we will realize significant savings on each project.

However, we feel that, not all projects are suitable for the vendor-led turnkey approach. Paper machine rebuilds would be difficult to handle, since machine rebuilds are seldom duplicated. Any project that affects equipment within an operating mill where upsets in the operation will occur would certainly be a problem. I feel this type of project will still best be handled by general contractors and consulting engineers. Vendor-led turnkey projects seem to provide opportunities principally on single-area items such as a new paper machine or boiler where a vendor can function almost as if it were a greenfield project.

Viewpoint of the consulting engineering company

C.D. Bassett, president, CRS Serrine, Greenville, S.C.: Over the last few years, interest in vendor turnkey projects has undergone dramatic change in the engineering business. Is this a trend with long-term significance, or is it just another short-term phenomenon that our pulp and paper industry has historically experienced?

Design/construct firms, providing single-source responsibility, developed rapidly in the early '70s with owners providing liaison between the design/construct firms and their own plant operations. In the early '80s, a business slump shocked our industry and owners began reducing their overheads. During this period, financial managers evaluated exchange rates in offshore financing, and purchasing departments began to exert greater influence on the selection of services. Major equipment purchasing decisions were determined, to a greater degree, on a fixed-price basis, with less emphasis on technical scope and contents of a proposal. As a result, the vendor concept was considered more often by our industry. Turnkey vendors offered a high degree of knowledge concerning the design and operation of their equipment, along with a guaranteed price for equipment, installation, and performance.

Have you ever listed all the companies that are able and willing to offer the turnkey approach? We find at least 20 equipment vendors and 15 service companies now offer this approach. From within their own organizations, how many of these firms provide total engineering, procurement, project management, fabrication and construction services required to execute the project? None do. There-

fore, you, as owners, must recognize that you are dealing with companies that must subcontract some portion of services outside their organization. The turnkey vendor must provide project implementation skills, such as overall management of project activities, planning and scheduling of the work packages, procurement and expediting of equipment, and construction materials, inspection, and quality control during manufacturing and installation.

During the introduction of the turnkey concept in the United States, one could perceive there may have been a technological advantage in using turnkey equipment vendors' engineering skills from Scandinavian or other European countries. In several cases, the technology of engineered equipment was a step ahead of that offered by domestic suppliers, but the ability to provide state-of-the-art design engineering services and project implementation procedures was weak. Many U.S. equipment suppliers were losing significant business opportunities, which motivated and stimulated their interest. Now they have become aggressive and pro-active and are offering equivalent equipment on an equal technical basis.

If the owner is willing to accept the scope and design criteria offered on a previously installed system, vendors should be able to provide repeat design packages from one project to another, except for the site-specific areas. Most vendor turnkey projects are for islands, for which they have developed specific technical packages suitable for a variety of projects. If a project contains work in several process areas of a mill and several island packages are being considered, consistent design criteria, process control philosophy, standard materials of construction, check-out procedures, and startup criteria may not be achieved if dealing with more than one vendor.

Many vendors do not have internal process design engineering capabilities and require engineering consultants to provide this service for them. In many cases, these services become commodity items, often awarded to the low bidder. Some vendors are not licensed professional engineers in the state where the mill is located and must retain a licensed engineer to review their design and stamp the drawings.

Here are some ideas to improve projects:

1. Develop the front-end design and overall program definition with a consulting engineer.
2. Allow an engineering firm to establish detailed design criteria and to prepare bid specifications.
3. Do not purchase a system with only a performance specification.
4. Foreign specifications are different, and money can be saved if they will Americanize their designs.
5. Computer-aided design facilities should be used to lower engineering costs.
6. Remember that vendor turnkey packages will not include any excess operating capacity.

The successful engineering companies are those that possess process expertise. As this knowledge begins to reside in the vendor's house, the opportunity for using a consulting engineering firm diminishes. If the trend

continues toward more vendor-led turnkey projects, the result will be less plant-wide process expertise available to pulp and paper companies from outside sources, other than equipment vendors. Is this in the best interest of the pulp and paper industry? Will the equipment vendors openly and fairly evaluate their competitor's technology and offer improvements to their systems?

Most large engineering companies serve a variety of diversified industries. Only we have the ability to interchange the latest process technology from one industry to another. We need to continuously challenge ourselves to give the owner superior methods and techniques of implementing capital programs, regardless of our personal bias. If owners will allow proven design philosophies to become standard and will discipline themselves to control scope and minimize changes, and a vendor does not desire to buy into the market, then a vendor turnkey concept is not the only economical approach. If we all tighten up our management skills, there will be an economical alternative to the vendor turnkey approach. I believe that the engineering consultant can deliver a superior product for lowest cost, all conditions being equal.

A view of changes to the construction business

T. M. Buck, vice president, Pulp and Paper Group, Daniel Construction Co., Greenville, S.C.: The U.S. paper industry is still a world leader in papermaking, which is a vivid contrast to most of the smokestack industries in our country today. The owners and managers of paper companies need to be commended for that and, obviously, all of us who serve this industry desire for you to maintain that leadership. The question in my mind is, do vendor-led turnkey packages help the owner be more competitive in the world marketplace?

The moderator's definition of a vendor-led turnkey project will cause two basic changes in the way we do business:

1. The contractor signs a contract with a vendor, not an owner
2. Normally, the contracts are executed under a lump sum agreement as opposed to a cost-reimbursable agreement.

The contractors have no difficulty signing a contract and working with turnkey vendors because they are reputable firms with a long history of success. One negative point may be that we do not know the management in the vendor's companies as well as we know the management in the paper companies.

Table I shows a comparison of the features of each contract style from a contractor's point of view. The decision as to which type of contract and approach an owner takes determines who is going to bear the risk and what the potential liability of the risk will be. The vendor-led turnkey approach has some advantages; although, in my opinion, it is not the best approach for all of your projects. Each project needs to be evaluated on its own merits to see which contract style best meets the project requirements.

I. Contract features

<i>Lump sum</i>	<i>Cost reimbursable</i>
<ul style="list-style-type: none"> • Fixed overall project costs • Any cost overruns, labor problems, and material delays are at contractor's expense. • Any savings will be realized by the contractor and not the owner. • Longer overall project schedule because engineering must be more complete and scope well defined in order to solicit bids. • This contract form usually establishes a situation where the owner's and contractor's interests are in opposition to each other • Scope changes normally costs the owner a premium over any other contract form. • Any delays caused by the owner will more often than not result in a price increase request by the contractor. • The highest fees are paid by the owner, since the contractor will have to include all contingencies in his contract price. • Contractor will bid the project using the lowest criteria available to meet specifications. 	<ul style="list-style-type: none"> • Owner pays actual cost and consequently can determine costs without contingency or other contractor markups. • Contingency budgeted but not utilized reduces owner's cost. • All savings accrue to owner. • Project completion time is shorter than other contracts because the contractor can begin construction with only a partial issue of engineering drawings. • Owner and contractor work toward common goal. Team members rather than adversaries. • Changes are easily incorporated. • Owner can control schedule. • Lowest fee • Quality considerations can be maximized. No shortcutting or compromise of quality.

Comments

The following comments were made in response to questions from the audience after the formal presentations by each speaker. They provide additional insight and clarification of the speakers' experience and thoughts on this timely topic.

Curry:

- A turnkey vendor's competitiveness results from doing the same thing over and over again using high-quality equipment and vendors. There has been little pressure for us to upgrade quality, particularly after the clients see an existing plant and talk to the operators. It is very important we do not "reinvent the wheel" on each project because that does add a lot of cost.
- A decision for the construction contractor is not required before bids are requested, since we solicit construction bids only after receiving a contract. We know how many manhours it takes to put a job together, and we know the productivity and labor rates for the mill location, so we can calculate construction costs for our bid. For equipment, we use what we call "golden suppliers" to minimize cost and we try to convince our clients to continue to use these suppliers.
- The owner can have as much involvement in the approval process for equipment layouts, equipment selection, and sub-contractor selection as he wants. Some projects have maximum involvement by the owner and some have minimal involvement—both systems work.
- It is important that both owner and turnkey vendor have an excellent understanding of what equipment is being supplied and what performance is expected. This is accomplished through the preparation of a very detailed specification before the contract is signed. If the owner does not have a detailed specification, the specification we prepare then becomes the governing document, and many clients feel comfortable with that.
- There is no foreign government subsidy provided to my company to assist us to be competitive.
- Since our North American operations are relatively small, all of our projects are backed financially by our parent in Sweden to protect against problems or catastrophic results on our projects. This is an extremely strong guarantee, because our parent is the Swedish government.
- Our turnkey contract does not normally include an analysis of the overall mill process and energy impact of a project, but we sometimes get involved in helping a client justify the project.
- Our North American operations have grown to the 75-80 people required to manage our projects. We get tremendous support from our parent in Sweden, of course; however, we are projecting our fast growth rate to continue at a controlled rate so we can manage it properly.
- The turnkey concept will not work if the vendor supplies second-rate materials and equipment. The turnkey vendor must have a very strong philosophy to supply only first-class materials and equipment to assure the owner of long-term satisfactory operation to enable the turnkey concept to survive.
- The turnkey vendor would not come back to the client for extra money if he were hurt by a period of inflation. That is part of the risk for which the owner is paying.
- The biggest problem for a foreign turnkey vendor in North America is the electric code and the supply of electrical equipment, since it is very difficult to get foreign electric equipment certified and accepted. So, the way to do it is to buy North American electrical equipment and, in some cases, subcontract the electrical portion of the project to North American com-

panies.

Donald:

- If all factions involved in managing a project did their very perfect best, the results could basically be the same, regardless of whether the approach is conventional or turnkey. However, the signing of a turnkey contract brings with it a set of disciplines that are forced on the owner. The owner becomes reluctant to make changes or to allow project growth, and operating management must decide what they want to buy before they buy it. This is a plus you just don't get the other way.
- The front-end costs to establish project scope and specifications for our Lufkin recovery boiler project were part of our corporate budget and were not included in the \$70 million contract with Gotaverken.
- A substantially smaller group of owner personnel is required to look after a vendor-led turnkey project as compared to a conventional one because the controlling instruments are the contract and the bid document. These instruments are developed as a result of a comprehensive planning and detailed work effort during which you decide what you want to do. It needs to be done one time, done correctly, have input from all interested parties, and be completed prior to signing a contract. Once you reach that point, it is a lot easier to let someone else manage it than to do it yourself.
- Seven people were permanently assigned to the Lufkin project. In addition, five or six people from the Corporate Engineering Group made input, and owner representatives from the mill participated in equipment decisions and approval of drawings and specifications.
- The opportunity for operator input into equipment selection and project design is about equal for a turnkey or a conventional project. Again, this must be accomplished in the planning stage before the contract is signed with the vendor.
- A vendor-led turnkey project for a greenfield mill would be a very big job to tackle; however, it should not be impossible to do. My suggestion would be to establish well-defined packages for the wood yard, pulp mill, paper mill, etc. and then put them together in that form, as opposed to one big package.
- The vendor-provided financing aspect was one of the driving forces that caused St. Regis to get seriously interested in the Lufkin project being done the way it was done. The adverse economic conditions that existed at that time really drove us in that direction. All major capital spending by paper companies was basically stopped. Now, during more normal times, corporate financial people of paper companies believe they can borrow money more cost-effectively than vendors. In the long term, it is my opinion that you will see our company financing its own projects, primarily those in the United States, anyway.
- When purchasing multiple turnkey packages on one project, obtaining consistent project documentation for future maintenance and mill engineering work is part of the increased responsibility of the corporate engi-

neering group. They must achieve these objectives with an established plan before the contract is signed.

- Under the vendor turnkey approach, owners are delegating key responsibility, mainly contingency, to vendors for taking risks. Obviously, the vendor is paid to bear the cost of these risks; how much this is, of course, is unknown. But it gets back again to how well the job is planned ahead of time, which certainly reduces the risks and contingency costs required.
- It is my feeling that some projects have gone to turnkey vendors because of financial advantages, and those decisions are made by the owners, up front. It is not because the owners do not have the ability to manage and control projects. In addition, the vendor turnkey approach is not necessarily the only answer, but is just one approach that has been used successfully and certainly offers merit. The conditions that exist at the time the project is considered weigh heavily on which approach is followed.

Crisp:

- It seems to me a turnkey-led approach is more suitable for projects like recovery boilers, caustic room rebuilds, etc. because they are definable separate entities. To use this approach for a paper machine would require the vendor to assume a lot of risk in areas where he does not have existing standards and consequently would not be competitive. It would be extremely difficult, maybe impossible, to adequately define such a project up-front because so many things will turn up after the project is started.
- If the owner's indirect costs on a traditional project runs 30-35% of total project cost, I feel, on a vendor-led turnkey project, the owner's indirect costs would be equal to or greater than 30-35%.
- If we don't have the necessary discipline for project cost control on a traditional project, there is no question the vendor-led approach will be a better way to do it. The up-front effort and discipline must exist in either case: If it exists, I don't think either approach would have an advantage, but the risk is equally great if the job is not done right.
- I see no reason why an engineer-led turnkey project would not work in the paper industry. This has been done for some time in the steel, chemical, and power industries. I think it could work equally well with a [engineering] contractor, maybe even better than with a vendor-led turnkey project.
- A pulp mill, a bleach plant, an evaporator, a recovery boiler, and a digester all lend themselves reasonably well to a turnkey approach. When considering the paper mill, someone (owner or vendor) is going to have to have a lot of courage and expertise, because there are so many interrelated options with every decision that will make the results different. I personally do not see a vendor-led turnkey project for a paper mill occurring in North America anytime soon.
- The turnkey approach is not used by owners to cover up lack of project management skills and the inability to maintain internal discipline for change; this is not the driving force on a turnkey project, but rather that

certain projects lend themselves well to this approach. I might add it is not necessarily bad management to change your mind during a project, but sometimes it is just too easy to do if you don't have the discipline up-front.

Bassett:

- The consulting engineer has the ability to have good communications with several vendors to remain aware of their latest technology or emerging technologies. The incentive for us to investigate and push the latest state-of-the-art technology is that we want to remain leaders in the industry, which requires that we point out to the owners the latest technology available to them.
- On a few projects where equipment manufacturers supplied engineering, it was very clear to me certain vendors do not have the CAD capabilities that the consulting engineering house has. For instance, we have 46 CAD workstations today with which we are doing 2D and 3D. We are able to execute our work with less man-hours than for earlier projects without those facilities.
- To qualify a vendor to do a turnkey project requires careful consideration in several areas. Certainly you would look at their accomplishments to-date on previous projects with regard to their performance on costs and schedule objectives. You would be sure they have been previously involved in similar projects such as a recovery boiler, a bleach plant, or similar projects and were capable to expand their scope as required to other areas for utility tie-ins, etc. Project management capabilities are essential to assure you are not buying a system on cost only, but rather you are buying a reputation.
- I think it is entirely possible an engineering consultant will take the lead in turnkey projects in the future; however, a lot depends on the project size. If the project scope is \$500 million or \$700 million, an engineering company may get a little skittish on assuming liability for that magnitude of a project. As jobs become more than identifiable islands for a plant rehabilitation or modernization program, the consulting engineer's process knowledge of various mill areas is going to be the key for owner selection as to who should lead such a project.
- As owners get into more vendor-led projects, they are going to want a consultant they can work with who is knowledgeable of many process areas of the mill to get involved with front-end evaluations and to help scope out the job and develop cost parameters. We will soon determine if we need to change our own organization and resources to strengthen our process engineering or staff engineering capabilities to provide the required support if the vendor turnkey concept continues.
- Specific goals needed to tighten the management skills by consulting engineers and owners include the following:
 1. Avoid cost and schedule surprises
 2. Minimize and control project scope changes.

- I believe it is possible for a consultant to work successfully as a subcontractor to a turnkey vendor but we, at this point, are not providing such engineering services on a turnkey project; however, arrangements could be made where we could supply detail engineering for a vendor.

Buck:

- From my observation, turnkey vendors are breaking down construction work into several small packages and work with multiple contractors as opposed to one general contractor. We are going to have to wait until this issue shakes out to see which is the most effective way to go.
- Under a cost-reimbursable contract, the contractor may make the most money by increasing costs; however, all lump-sum contracts do not necessarily result in adversarial relationships. I am saying the potential is there by the way the contract is written, where everyone is trying to protect their liabilities and profits as opposed to being committed to the goals of the project. The solution to this is a team approach where the owner, engineer, and contractor know the project goals and objectives.
- A project with vendor supply and engineering lump-sum, and contractor cost-plus, as was done for Mead's Chillicothe bleach plant, is a viable approach. A number of variations to the vendor-led turnkey project will be developed as we gain experience. The key in deciding how to go about a project is to decide who is best prepared to take the risk and how much is that risk worth to each one of the participants.
- My company is currently making an effort to get to know the management of vendors' organizations better to see what abilities they have and how they may mesh with ours for a vendor-led project. We have not as yet been involved in a turnkey vendor-led project using the definition supplied for this panel discussion.
- Based on our experience, I would agree the code that gives the offshore vendor-led engineering work the biggest problem is the electrical code.

There have been some paper machine projects done with vendor-led engineering in the U.S. but not a vendor-led turnkey project to date. When we talk about a vendor-led turnkey project as defined for the panel discussion, it seems that the projects that fit this approach best meet these three requirements:

1. The project needs to be construction cost driven, not product driven, and by that I mean the success of the project is not going to be determined by whether or not a product gets to the market a month ahead of schedule or six months late
2. The chemical or manufacturing process needs to be somewhat standard to reduce process and scope changes
3. The project scope needs to be well defined so that decisions made up front in the project are the best decisions in the long term of the project.