Consider Integration Synergies when Selecting an Industrial Gas Supplier

Engineering teams at operating companies can help maximize the value of industrial gas supplies by optimizing the requirements of the gas supplier with the chemical producer

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The industrial gas (IG) industry has been around for decades, with some IG suppliers tracing their histories back for well over a century. And although the industry continually evaluates and implements new technologies, most IG production processes are quite mature. For example, cryogenic distillation, a process that traces its origins back to the late 1800s, is typically still the preferred technology to produce large volumes of gases like oxygen and nitrogen (Figure 1).

For the grassroots chemical process industries (CPI) manufacturer needing world-scale volumes of industrial gas, the IG suppliers will typically propose a production facility to be built on or adjacent to the consumer's plant (generally referred to as an "on-site" plant). In some areas, such as the U.S. Gulf Coast, existing IG pipeline enclaves may be available for tie-in, which gives the IG producer flexibility in determining the most cost-effective size and location for the addition of IG capacity along the pipeline.

Since the number of IG suppliers offering on-site solutions is relatively limited (the industry is frequently referred to as an oligopoly) and given the maturity of IG production technology, one would expect a relatively straightforward procurement process for the selection of an industrial gas supplier. Many CPI operating companies use a traditional RFP (request for proposal) for industrial gas supplies, which need only define their gas demands in terms of the technical requirements (such as quantity required, flow profiles, purities, and pressures) and commercial terms (such as contract duration contingency protocols and pricing specification).

MATHESON

FIGURE 1. Cryogenic distillation in air-separation units, like the one shown here, is a widely used technology to generate large volumes of oxygen and nitrogen

It is not uncommon for such RFP procedures to generate bid results that are extremely close. This is not surprising, since the IG suppliers offering on-site solutions tend to use many of the same major equipment suppliers and tend to require similar returns on their capital investments. Bid differentials of 1–2% are not unusual between the top two IG bidders for an on-site opportunity.

In the experience of the author,

the RFP process, however, does not typically capture integration synergies that generate significant operational expenses (OpEx) savings (primarily power) and capital expenses (CapEx) optimization between the requirements of the consumer and the IG supplier. Such synergies can generate savings far more significant than those evident from the bid results of the RFP. On the OpEx side alone, for example, cost savings of greater than fifteen percent (15%) are possible and should be reflected directly in the consumer's price for the industrial gas or gases needed.

The purpose of this article is to suggest a somewhat expanded IG supplier selection approach to capture such savings. The process requires both the IG users' commercial and technical teams (composed primarily of process engineering and project management personnel). Such teams at chemical production facilities work with the IG suppliers to maximize their value proposition from the IG bidders (in terms of optimizing the trade-offs between OpEx, CapEx, flexibility and gas availability). This selection approach supplements the initial RFP, and is similar in many ways to negotiated procurement. It requires significant dialogue between the IG supplier and IG consumer facility, and is generally more successful if the personnel at the consumer facility has a general understanding of the business drivers influencing the IG bidders, including their market position, their contracting preferences, and areas of potential integration between the consumer's and the IG supplier's production processes. These topics will be highlighted herein.

Optimization considerations

It is recognized that commercial and technical resource constraints and project scheduling pressures prevent the typical operating company from following a negotiated procurement approach with many IG suppliers. For this reason, it is the suggestion of the author to use the RFP process to short-list potential IG suppliers, then work with two suppliers to evaluate the synergies discussed here before selecting the successful bidder.

One word of caution here — admittedly, this suggested approach does not work unless the finalist IG suppliers feel they can share their ideas confidentially. The operating company must reinforce this requirement with his commercial and technical teams to avoid even the perception that good ideas are being "shopped."

For purposes of illustration, the author assumes the CPI consumer needs large volumes of gaseous oxygen. This would be typical for products such as ethylene oxide (EO), which routinely consume over 1,500 STPD (short tons per day) of oxygen as feedstock. As such, it represents an oxygen load that is attractive to most IG suppliers. This quantity of oxygen would justify the process and commercial integration techniques set forth in this article. To a lesser extent, the same optimization considerations apply for the procurement of other on-site gases, such as hydrogen and carbon monoxide, but because of byproduct considerations and cryogenic liquid backup capabilities associated with a cryogenic distillation air separation unit (ASU), the integration opportunities are easier to illustrate using oxygen as an example.

Before proceeding, it is important for the CPI operating company to understand that the value of the business may be viewed quite differently by the potential bidders. And, to a certain extent, the IG user can impact this value. The goal is to maximize the attractiveness of the user's "baseload" oxygen demand in the context of the IG supplier's strategic objectives in the geography. If the IG supplier spends incremental CapEx for its needs in the market, the potential exists for the gas consumer's "baseload" pricing to benefit based upon how the capital Is allocated. This typically involves the IG supplier adding merchant liquid addition for sale to third parties, and is discussed further in the next section below.

It is also relevant to discuss the commercial structure in which IG suppliers sell their products. This primarily falls into one of two categories: SOE (sale of equipment) or SOG (sale of gas). In the SOE case, the consumer essentially purchases the IG production equipment or the turn-key IG facility. The consumer facility may operate and maintain the IG facility itself or subcontract to a third party for such services. The SOG case involves buying the oxygen and related gases "over the fence". Here, the IG supplier and consumer enter into a long-term product-supply agreement (typically 15 to 20 years in duration) with agreed-upon pricing, price escalation and minimum gas purchase obligations. The IG supplier's intent is to capture the plant investment over the agreement term at an acceptable rate of return. Those in the industry sometimes refer to sale of equipment as "buying the cow" versus sale of gas as "buying the milk".

Traditionally, the IG industry strongly prefers SOG over SOE and for the purposes of this article, a SOG model is the assumed contract structure.

Areas of potential integration

Given the preceding background, the evaluation of three areas of potential process and commercial integration is suggested. Much of this falls within the IG supplier's analysis, but it is important for the consumer to understand what the supplier is contemplating as it impacts the integration opportunities the parties should explore.

Merchant liquid synergies. If an IG supplier is considering the construction of an on-site ASU for a major oxygen requirement, it is almost a certainty that the addition of merchant products will be considered ("merchant" refers to liquified products trucked and sold by the IG supplier to third parties). The incremental addition of liquid nitrogen (LIN), liquid oxygen (LOX) and liquid argon (LAR) to an on-site facility is almost always more cost effective than the IG supplier's alternative of a stand-alone merchant plant, even if significant trucking of the merchant products is required from the new on-site facility (Figure 2). Depending upon the merchant pricing in the geography under consideration, merchant credits for sales to third parties can approach or exceed the margin of the consumer's underlying baseload requirement. In short, adding merchant capabilities can support a significant amount of incremental CapEx and allow the IG supplier to subsidize the pricing of the consumer's baseload. Essentially, it gives the IG supplier another lever to improve their bid

FIGURE 2. **Merchant products are liquefied gases that are trucked and sold by industrial gas suppliers to third parties**

to the consumer while maintaining their required return criteria for the ASU investment.

Given the economic benefits of adding LOX, LIN and LAR capabilities to an on-site plant, it is helpful for the consumer to have a general knowledge of each IG bidder's merchant position within the geography. If Supplier A has a dominant merchant position, while Supplier B is attempting to establish merchant capabilities, a dynamic may be established in which the bidders are looking at defensive drivers, as well as growth drivers, in terms of their aggressiveness in pursuing the consumer's baseload.

Since the IG industry uses a product line (or standardized plant) approach for most ASU plant sizes to minimize upfront engineering and execution costs (including the design of large ASU plants in this size range), the addition of merchant products can also lead to the selection of a more cost-effective plant in the product line, or better utilization of the facility appropriate for the consumer's baseload. Additionally, synergies are likely with respect to the ASU's liquid backup system if the IG supplier elects to supply merchant customers from the on-site plant. This synergy is discussed further below.

Electricity cost transparency and synergies. In addition to being CapEx-intensive, the IG production process requires significant quantities of energy. Electricity is typically the key operating cost in the case of atmospheric gases, and natural gas is typically the key operating cost with respect to process gases, such as hydrogen. Typically, the most important lever in reducing the ASU's OpEx is directly related to the power procurement strategy, so the author will focus on this topic. But again, to understand the opportunities here, it is beneficial to understand some of the behaviors and standard practices of the IG industry.

As noted above, the sale-of-gas model is by far the IG industries' preferred method of supply. When promoting SOG, IG suppliers will frequently (and appropriately) claim that the consumer essentially has a power performance guarantee over the entire life of the contract, as opposed to an initial (or limited) performance test guarantees associated with the sale-of-equipment model.

In the SOG model, each product's price typically has a coverage factor to pass through the IG supplier's energy cost. Depending upon the geographic region, well over 50% of the IG producer's product price (in this case, oxygen) is electricity pass through (Cvg1 in the example formula below). Assuming the coverage factor does not change over the life of the contract, the IG supplier is guaranteeing an energy efficiency via the escalation formula agreed to contractually.

The following simplified escalation formula (Equation (1)) only escalates the base oxygen price (the price set at the beginning of the oxygen supply agreement) as a function of electricity at the time of escalation. In actual practice, numerous other terms may be included in the formula to pass through the IG supplier's cost changes in such areas as labor, taxes and maintenance and repair (M&R) costs.

$$O_2Price_{new} = O_2Price_{base} \times [Cvg_1 \ (PWR_N \ / \ PWR_B) + (1 - Cvg_1)] \qquad \textbf{(1)}$$

Where:

- O_2Price_{new} is the new oxygen price resulting from the pricing escalation, administered at a frequency as defined in the agreement (for example, once per month)
- O_2Price_{base} is the base oxygen price as set forth in the supply agreement
- Cvg_1 is the coverage factor (or multiplier) associated with electricity passthrough
- PWR_N is the electricity price at the time of each escalation
- PWR_B is the electricity price assumed at the time $Price_{base}$ was established

To account for changes in the cost of electricity during the term of the agreement, the IG supplier and consumer usually agree on a published index or schedule from the appropriate utility to represent the IG supplier's power cost (PWR_B above) associated with the base oxygen price (O_2Price_{base}). At a frequency set forth in the agreement, the then-current index (PWR_N) is used to determine the new oxygen price at the time of each escalation. Although this method is common, it can become problematic over a long-term agreement, because the index may not accurately reflect the actual cost of electricity being purchased by the IG supplier.

However, the key issue with the above escalation approach is that it does not capture a core competency of the industrial gas industry — that is, the ability to obtain low-cost power. While utility rate structures and power procurement strategies are beyond the scope of this article, it is fair to say that the IG industry is exceedingly knowledgeable in power procurement and where appropriate, negotiating with the utility for specialized rate schedules and other incentives. Historically, utilities value the ASU's power load because of its size (routinely over 50 megawatts) and its high load factor. Going forward, however, the ASU's ability to quickly shed load by utilizing its liquid backup system(s) brings even more value to the utility (as more intermittent generation sources such as wind and solar are added to the grid). This ability to quickly interrupt allows the IG supplier to look at numerous rate schedules from the utility (such as time of day or interruptible rates) as well as provide flexibility to act as reserve load which the utility may shed when the grid becomes stressed. Depending upon the geography and specific utility, it is not unreasonable to expect power savings of well over 30% by employing such opportunities. And as noted above, such power cost improvement translates to a savings potential of well over 15% in the consumer's oxygen price.

If the consumer and IG supplier have entered into an arrangement where both parties are incentivized to aggressively pursue low-cost electricity (and incentives from the power-providing utility), it probably makes more sense to escalate the oxygen price based upon the IG supplier's actual cost of electricity, rather than utilizing an index or utility rate schedule for PWR_N and PWR_B. This WACOE (weighted average cost of electricity) approach assures the pricing escalation is accurate and allows the IG supplier to aggressively pursue utility incentives which are ultimately reflected in the consumer's cost of oxygen. If the gas user has a concern regarding the validity of such WACOE data, they can always include audit rights in the product supply agreement as recourse.

Note that if the IG supplier includes merchant liquid in his scope, it is a good indication that the consumer's and IG supplier's power procurement interests are aligned. The IG supplier desires low-cost power to improve business margins when selling LOX, LIN and LAR to third parties. The CPI operating facility benefits from a lower oxygen price on the baseload demand of the facility through lower power passthrough costs.

Although understanding the various energy rate schedules and incentives is typically a commercial conversation between the IG supplier and the utility, the operating company's technical team is essential here to assure the size of the backup system results in an acceptable risk profile for the power procurement strategy implemented. This is discussed in further detail in the following section.

On-site facility backup considerations and shared CapEx opportunities. The benefits discussed in the previous two sections above cannot occur without a detailed analysis and appropriate sizing of the IG on-site liquid backup system. The backup system is also critical in assuring the IG plant can meet the oxygen availability requirement for supply to the consumer's facility in the event of planned or unplanned ASU downtime.

Most air separation units utilize large LIN and LOX storage tanks with natural gas vaporizers for immediate backup supply. The liquid backup system assures continuous gas supply to the consumer in the event of a power interruption or ASU planned or unplanned outage. Typically, the backup tank is an LR (liquid reservoir) designation, which is a stick-built tank designed to hold large quantities of LOX or LIN at low pressure. An LR-100 for example is sized to hold a quantity of LOX that, when vaporized, is 100 million standard cubic feet of gas.

It is important to understand that LR tanks scale very efficiently (in the experience of the author, at less than a 0.6 scaling factor). Like the ASU product line, they tend to follow standard design sizes and need relatively minor customization from location to location (apart from wind and geotechnical considerations, which influence the foundation and vessel shell details).

There are at least two considerations which influence backup system sizing:

Consumer availability requirements: It is important to understand from the IG supplier the reliability expectations and guarantees of the ASU (greater than 98% is typical). Assuming the consumer needs availability approaching 100% (excluding planned, joint outages), one aspect of the LR design must include such storage to meet this differential between the ASU's anticipated reliability and the consumer's required availability.

Capturing power incentives: In addition to time-of-day rates and load shedding incentives from the utility supplying the on-site plant, additional savings may be available on the demand side by shedding load during peak electricity usage periods. And while each cost savings opportunity has a quantifiable benefit, each also has an associated risk profile. The consumer's technical team needs to work with the IG supplier (and utility) to understand the risk-reward profile for each power savings opportunity and agree on the appropriate increases in LOX and LIN storage to support.

One final consideration in backup system sizing is the time needed to initially fill and to refill the selected LR tank following an ASU outage or power reduction. Desired fill time may also impact the ASU's liquifier design and even impact the ASU size itself to assure adequate peaking volumes are available. Keep in mind that while third-party merchant liquid may be present in the area for purchase, its availability may be significantly limited if stress on the grid is widespread. Clearly, there are many considerations when sizing the LR system, and it is the opinion of the author that design tradeoffs and optimizations can only occur here if joint discussions occur between the consumer's and IG supplier's engineering and commercial teams.

Finally, besides CapEx benefits that may exist from sizing the LR tank(s), keep in mind that joint infrastructure savings are likely if the CPI facility and ASU construction periods overlap. Since the ASU will probably share utilities with the consumer, the project teams should evaluate CapEx sharing opportunities in areas such as electrical substation facilities, high voltage transformers, and coordination and sharing of utilities such as potable water, cooling water, and storm and sanitary sewer. The CapEx savings may be significant if bundling opportunities exist rather than if executing the ASU as a stand-alone project.

Questions for discussion

Overall, selecting an industrial gas supplier for an on-site facility should consider technical and commercial integration opportunities between the consumer and IG facility. Such potentials are not readily defined through the RFP process but through an optimization procedure occurring downstream of the initial RFP. The technical/commercial optimization discussions should result in an understanding between the parties in the following areas:

- Will the IG supplier expend CapEx to meet the consumer's baseload requirement and allow the IG supplier to provide merchant products (and potentially, gas products) to third parties in the area?
- Is the power purchase strategy understood and agreed to by the parties? Are the parties aligned on expected electricity cost savings, associated risk and the manner in which the power pass through is administered for oxygen pricing escalation
- And finally, are the parties aligned on the design of the liquid backup systems (and ASU peaking capabilities) and the way in which they will be used to pursue OpEx savings with respect to power? Have the parties evaluated other CapEx savings opportunities which may occur due to joint project execution of the ASU and consumer facility?

When each IG bidder's scope and optimization approach are understood, the consumer should then be in position to select the IG supplier that brings the best value proposition to the consumer, while understanding and accepting the associated risk profiles for those savings opportunities captured. ■

Edited by Scott Jenkins

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