Justifying Process Automation Upgrades for Older Facilities

Kevin A. Lawlor
Oneok Field Services
Tulsa, Oklahoma, U.S.A.

Mark E. Roop
eSimulation, Inc.
Houston, Texas, U.S.A.

MARKET DYNAMICS

The gas processing industry has been active in Oklahoma since the early 1930's. The majority of gas processing plants currently in operation were installed in the late 1970's and early 1980's to take advantage of advances in turboexpander technology. Many of these plants have not been upgraded since their installation with regards to process technology or their plant control systems. Thus these plants are still operating at the same level of efficiency as they were 25 to 30 years ago. However, the market has evolved to the point where many of these plants do not yield the rates of return on their operating expenses that their companies and investors demand. Therefore, gas processors in Oklahoma are faced with the option of finding new ways to increase their profitability or ceasing operations.

Oneok Field Services was formed in 1999 and is the result of midstream facility acquisitions from Koch, Kinder Morgan and Dynegy. All of Oneok's gas processing facilities lie in the TX, KS and OK areas and the majority of these facilities are of late 70's and early 80's vintage design. Furthermore, the contracts for the gas supply to these plants are primarily Keep Whole in structure wherein the processor is taking the full risk of the commodity pricing of natural gas and natural gas liquids. In the past several years this commodity risk has been extreme and the profitability of the midstream segment has suffered.Figure 1 illustrates this fact by showing how the price differential between the equivalent price of ethane compared with natural gas has decreased in recent years.

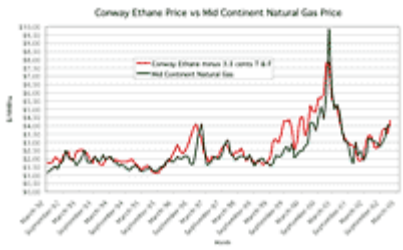


Figure 1

ALTERNATIVES TO ADDRESS MARKET DYNAMICS

There are several ways by which this commodity risk can be mitigated including contract restructuring with producers, improving the process design of the plant, and employing advanced automation technologies. The fastest way to begin improving the profitability of the plant is through the adoption of advanced automation strategies.

The situation that the gas processing industry is currently faced with (i.e. rapidly changing commodity prices, low processing margins, antiquated control systems) is very similar to what the petroleum refining industry faced in the early 1990's. The petroleum refining industry deployed advanced control and optimization strategies to increase plant profitability and to allow them to respond more effectively to changing market conditions.

The same type of strategies can be employed in the gas processing industry. The issue is that the size of the plants, and the contract structure for the feed gas, makes these strategies much more difficult to justify. Plus, these plants have control systems that are primarily pneumatic with very little digital controls. Therefore, before any advanced control or optimization strategies can even begin to be considered, a significant investment has to be made in modernizing the plant's control system. Given that the majority of the plants in Oklahoma are processing between 15 MMSCFD and 150 MMSCFD, they do not have the economies of scale that a refiner has for justifying both the control system upgrades and the advanced technologies required to improve profitability.

REAL TIME OPTIMIZATION SELECTED

Several control strategies were explored to improve the profitability of ONEOK's operations such as cold spin technology, multi variable control, model predictive control, feed forward control and real time optimization. The majority of these strategies focused on either single process units within the plant, or were not comprehensive enough to respond appropriately to changing commodity pricing.

Traditional control technologies are most effective at keeping a plant operating at certain temperatures, pressures and flow levels. Real time optimization strategies determine the optimal temperatures, pressures, and flow levels given the contract mix on the front end of the plant, fluctuating commodity pricing, fluctuating ambient conditions, and the ability of the equipment to perform (given current fouling and equipment performance degradation). Both are valid options to consider and are applicable under the right conditions.

Real time optimization determines what the setpoints targets should be in a market of wildly fluctuating commodity prices. Therefore, in the present and foreseeable future, the current processing market dynamics favor real time optimization technology rather than advanced control technology. eSimulationSM's unique real time optimization strategy had been proven to be economically viable for cryogenic plant applications, so we chose to install it at our Panther Creek processing facility.

eSIMULATION'S REAL TIME OPTIMIZATION SYSTEM

eSimulation℠ employs the Application Service Provider (ASP) business model to deliver near real time optimization results via a standard web browser at a cost that is viable for mid-stream processing applications. The optimizer is based on a rigorous process model that considers the non-linear aspects of the typical gas processing application. The model is tied to an economic objective function that reflects the contract mix on the front end of the plant and current pricing. The optimizer displays suggested operating targets and current equipment performance metrics on a secure area of eSimulation's website. eSimulation's includes all the engineering services required to keep the process model matching the plant and for the system to function properly in a variety of operational modes i.e. ethane recovery and ethane rejection.

eSimulation's real time optimization technology has been deployed to a variety of gas processing facilities. The benefits have been dramatic as evidenced by the following Profit Scorecard in Table 1:

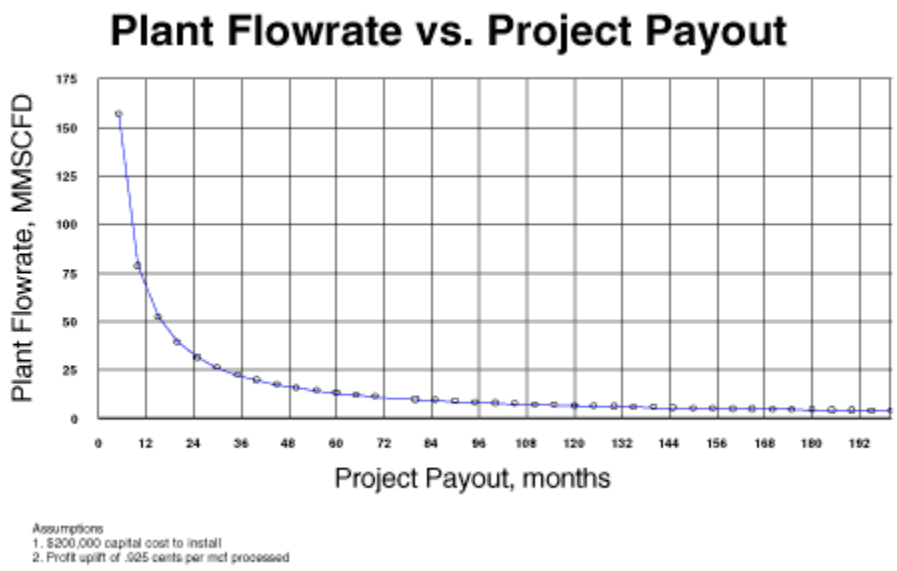
Table 1

As shown in the Profit Scorecard, the average uplift of 0.997 cents per inlet mcf is possible if the plant has the necessary control system infrastructure to support it. One strategy to outfit the plant with the required control equipment is as follows:

- A PLC or DCS platform to accommodate those signals required for the optimization system and supply the necessary plant data
- P/I converters required to convert the existing, and required, pneumatic transmitter signals into electronic format.

If you assume the cost for adding this equipment to a pure pneumatic plant is $200,000, the payout time for the project can be calculated for the combined instrumentation upgrade and eSimulation service fees using the average uplift described in the Profit Scorecard:. Figure 2 describes the results of this calculation.

Figure 2



PANTHER CREEK OPTIMIZATION

Oneok decided to implement eSimulation's service at our 90 MMSCFD Panther Creek gas processing facility in Western Oklahoma to evaluate its potential economic benefits for our operations. The Panther Creek plant which was originally built by C.E. Randall in 1974. It was chosen because it is one of the larger Keep Whole

plants on our system. It's control system was upgraded in 1998 when it was moved to its current location and this minimized our implementation costs for the evaluation.

The eSimulation service was commissioned in June of 2002 and it showed immediate benefits in improving the profitability of our plant operations by optimizing recovery rates vs. fuel expenditures. The first month that it operated our plant was operating in ethane rejection mode and our profits from the Panther Creek facility rose over $1,250/day.

These increased profits came primarily from fuel savings on our residue compression and from an increase in our ability to reject ethane without losing propane. In ethane recovery mode we saw profitability at the plant increase over $500/day due to increased recovery efficiency and fuel efficiency at the plant. Furthermore once the plant data was reviewed, several other process improvement projects were identified. One such project includes adding a mixer to mix the gas and liquids prior to the cold separator to improve our ethane recovery efficiency.

Additionally we experienced other benefits from implementing the eSimulation service. One of the features of the service is that it functions as a historian and maintains a record of all the plant operating data. This data is able to be quickly retrieved via the internet website and can be quickly sorted into more usable formats. This data management feature has been of benefit to many groups within Oneok:

- The plant accounting group has been able to use the data to more quickly generate their income statements and producer royalty checks.
- The NGL marketing group is able to better track the NGL production from the Panther Creek plant. This is allowing them to avoid penalties due to overestimating or underestimating their liquid production.
- The financial analysis group is able to quickly gain the plant actuals, and plant production trends, for use in their revenue forecasting reports.
- The process engineering department has been able to troubleshoot problems at Panther Creek plant more quickly since they are now able to observe the plant data online rather than having to make a trip out to the facility.
- The process engineering department has been able to use the strategies suggested by the optimizer to optimize other similar facilities owned by Oneok
- Operations maintenance on the process equipment can be more effectively scheduled since we have the ability to monitor and trend equipment performance degradation.
- The measurement group is able to use the information from eSimulation as a check of their own systems to help determine the accuracy of their measurements.

- Management is able to directly view the plant operations data rather than relying on reports generated by other departments.

Based on the success that Oneok has experienced with eSimulation's service at Panther Creek we have contracted for eSimulation to provide their service at up to 6 more processing facilities including the Maysville plant that we jointly own with ChevronTexaco. Additionally, once the process control infrastructure is in place at these plants, Oneok is planning to further improve profitability of these facilities by cost effectively employing other process control technologies such as MVC, MPC, Cold Spin etc. These technologies, coupled with the real time optimization system, will further enhance our ability to operate efficiently and enable us to reduce our labor expenses.