Originally appeared in HYDROCARBON PROCESSING® February 1997, pg 17 & 144. Posted with permission.

Y. Zak Friedman, Guest Columnist

Advanced process control: it takes effort to make it work

Conventional wisdom has it that investments in advanced process control pay out in weeks. Pour in the money, and things will begin to happen. Years of work as an advanced control consultant have taught me that many sites face a different reality. Their inferential controls disagree with the lab; constraint holding schemes are not trusted by operators; real-time optimizers do not drive the unit to optimal operation. Control failures have alienated operators and process engineers, and once negative attitude sets in, every advanced control effort is an uphill battle.

What are the reasons for such failures? Advanced control is a collection of tools dealing with constraint and quality control. It seems trivial enough to implement constraint holding programs for bottlenecked equipment. On paper, pushing bottlenecked equipment to its limit always shows a large profit. Precise quality control should permit lucrative yield increases. Where have these sites gone wrong?

A major contributor was corporate streamlining. This has led to reduced maintenance efforts, which has symptomatically led to sluggish, ineffective control. Control engineers who do not have time for analysis, respond to problems by de-tuning the controls. They keep service factors high by weakening incorrect controls to the point of being harmless.

Our advanced control audits have found a pattern which boils down to lack of support:[1]

• Poor tuning and other problems in the DCS infrastructure that supports the advanced controls

• Analyzer reliability problems

• Lack of HAZOP analysis, and subsequently, no trouble avoidance logic

• Lack of standardization, aggravated by poor documentation

• Incorrect inferential models

• No reporting system in place to identify and repair problems.

In some sites the deterioration was so complete that management lost faith and reduced support manning even further.

I also noticed another interesting pattern. The weaker the team, the higher the dream. Sites that could not sustain simple advanced controls are thinking about, or in some cases already busily implementing, real-time optimization applications.

I prefer to distinguish between advanced control and real-time optimization. Real-time optimization is a term referring to the use of rigorous simulation models to first analyze unit performance, and second adjust the degrees of freedom to their optimal value. Advanced control has been with us for two decades, and has, at times, been very successful. Real-time optimization has yet to be proven as useful. Efforts to optimize plants in closed loop started as early as thirty years ago, but have repeatedly failed. They are thwarted by inadequate computing power, lack of reliable simulation models and complex operations. The current movement started in the early ’90s, having received a boost from ever-increasing computer power and open equations simulation technology.

In the past three years, I had the opportunity to investigate the degree of success of some highly promoted software packages. That study identified a number of obstacles:[2]

• Lack of procedures for estimating refinery intermediate product prices. Without these, the optimization of a process unit in isolation is meaningless.

• Inability to forecast feed quality to a process unit. The simulation then fails to duplicate key unit instrument readings, and optimizes erroneously.

• Difficulty of applying steady-state models to a dynamic problem.

Eventually the problems will be solved, and no company wants to be behind when minute-by- minute optimization finally becomes possible. In any case, the field should be recognized for what it is: experimental methodology that requires highly skilled support. It has the potential to become a lucrative control application.

Improving performance. What, then, can we do to improve advanced control and optimization performance? The following set of rules is so obvious that one is embarrassed preaching it, yet it is violated often enough.

1. Management would do well to match its technology ambition against the number and quality of people it is willing to dedicate. What

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is the point in purchasing technology that no one in house can support?

2. Once people are assigned to work in advanced control, that should be their main focus. Double dipping does not work.

3. Deal first with DCS problems. Do not attempt advanced control on top of ill-configured or poorly-tuned basic controls.

4. Do not attempt real-time optimization before your advanced controls work. That calls not only for 95% service factors, but also applications that push against real constraints, handle major disturbances, provide correct inferential controls and genuinely help operators run the unit.

5. Spend much time analyzing what could go wrong and install logic to face such situations. Promise operators that control schemes will never act in an unsafe manner. Then work to keep your promise.

6. Establish standard procedures for advanced control designs, interfaces, HAZOP analysis and real-time protecting tools, engineering and operator documentation, etc. That improves safety and reduces maintenance in the long run.

7. Set up good monitoring and historizing tools to help troubleshoot advanced control problems.

8. Set up procedures for operators, process engineers and others to report problems. Treat those reports seriously. Fix problems quickly and keep operators informed of the nature of problem and repair method.

9. Set up procedures for reporting real advanced control economics. How would one convince management to increase maintenance effort without showing that advanced controls improve plant economics?

10. Contractors' work must culminate in a complete technology transfer and detailed documentation.

For sustained economic return, there is still no alternative to good engineering, dedicated maintenance and lots of attention to details.

LITERATURE CITED

[1] Friedman, Y. Z., "Avoid advanced control project mistakes", *Hydrocarbon Processing,* October 1992.

[2] Friedman, Y. Z., "What's wrong with unit closed loop optimization?", *Hydrocarbon Processing,* October 1995.

***The author** is a consultant in process control and online optimization with Petrocontrol, Hoboken, New Jersey. He has pursued research in using process models for real-time closed loop control and optimization of refinery units, and in standardization of control technology. His experience spans 25 years in the refining industry, working for such employers as Exxon Research and Engineering and KBC Advanced Technology. Dr. Friedman holds a BS degree from the Israel Institute of Technology and a PhD degree from Purdue University.*