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Refining Reliability and The Opportunity of Big Data

Beck: Total plant uptime can translate to equipment and system reliability. Photo: Shutterstock

During the CERAWeek 2017's conference in Houston brought together energy industry leaders—from ExxonMobil's new CEO, to the Russian and Saudi Oil Ministers, to market forecast gurus.

One surprising headline that emerged were statements made by several energy CEOs that operational advances would be achieved through the adoption of data analytics. Figures as high as 30% improvement in asset performance were thrown about. But how can this be achieved? Refineries generate a wealth of data. There is data on equipment, maintenance frequency, unit performance process parameters and costs. According to a senior manager at a large refining operating company, "we are now swimming in data about our key units. But we are struggling to know what to use it for."

Improving Reliability in a Refinery

When refiners talk about reliability, the big questions are often: how do we define reliability and how do we measure it in terms meaningful to a refinery?

Ultimately, there are two meaningful measures of improvement in a refinery: financial and safe operations. Both of these measures are dependent on the entire system of the refinery. While measuring the reliability of a component, an item of equipment and a process unit, is good and meaningful, only when the entire system of the refinery is accounted for does it translate into overall financial improvement. Companies need to break down reliability into KPIs (Key Performance Indicators) that enable them to understand and improve components. The following questions also need to be considered: What is the reliability of a particular pump? How often does it require maintenance? Under what conditions does its performance degrade or does it break down? What is its lifespan? What is the overall availability of the refinery, percentagewise?

Total plant uptime can translate to equipment and system reliability, reducing the need for maintenance downtime, improving maintenance effectiveness, planning and performance, optimizing the maintenance and operating plans, and faster response to disruptions. This can begin during design, if the client sees the value in maintainability and reliability being considered during this stage.

Higher production capacity or production yield from the asset can include better operating strategies, reconfiguration of the process, process technology breakthroughs, de-bottlenecking, plant expansion and better control strategies. Safer operations including design-for-safety, hazard and risk analysis, and asset integrity result in fewer incidents, lower risk, and regulatory compliance.

The responsibility for different asset performance metrics is often split among different business executives, and often no one individual is accountable for the optimization of an asset. The refiner needs a way to look at the entire asset, considering uptime, production yields and safety, and cutting across the multiple metrics.

Approach for Analyzing Reliability

Consultants have devised an approach to looking at reliability they call “RAM” (reliability, availability and maintainability). These methods take an item-by-item approach to reliability to determine the inherent reliability of each element of a refinery. They look at what would be the potential cause of an item fail, and how a system can be designed, maintained and operated to minimize the risk and impact of that failure.

The inherent problem with this approach is that it is being applied to a complex chemical and physical system—the refinery of 2017, in which the equipment and processes are integrally related including feed, demand, supply chain logistics and weather. A holistic, process-wide modeling approach is needed to understand which elements of the system risk the refinery’s uptime the most. And it all needs to be related back to cost. What is the cost of reducing risk in each aspect of the refinery, how do those risks relate to each other, and therefore what is the optimal way to spend available capital to minimize production and financial risk. In other words, by using a process system-based reliability model, the best capital decisions can be made quickly, and executives, financiers and insurers can understand the risk quantitatively.

Additionally, by considering risk probability together with the systems view, the universe of outcomes is considered.

This approach is very practical, and not difficult. With the help of an advanced reliability modeling tool, some of the largest refineries and petrochemical complexes successfully and effectively, it represents the convergence of process modeling, probability analysis, and asset management data

Connecting Reliability Back to the Data

Equipment and process units are being increasingly instrumented. Cheaper sensors and the desire of equipment operators for more monitoring data are fueling an explosion in data. Much of this data relates directly back to equipment performance and reliability. It provides the fuel to run these system-wide reliability models, which in turn identify and quantify the low hanging fruit for margin improvement. Both tactical and strategic decisions can be made with confidence and speed.

With the correct advanced reliability modeling tool, refiners have been able to:

- Streamline turnaround events to maintain those items with the highest uptime risk, space out turnaround events and optimize warehouse-sparing decisions.
- Make better CAPEX decisions, to allocate redundant systems and spares where they will have the biggest financial impact and to optimize buffering with the process design and the logistics.
- Stage the startup of large facilities to reduce the risk of behind-schedule startup, thereby reducing revenue and cash flow risk.

Ron Beck is the Energy Industry Marketing Director at AspenTech.