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Refine your approach to process troubleshooting and optimization

Follow this methodology to improve problem diagnosis and communication

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Two of the biggest expenses for any processing plant are failure to quickly and accurately troubleshoot process upsets and equipment problems, and failure to fully realize the operating potential of its processes through optimization. Minor upsets and equipment problems which are not identified and resolved quickly can progress into much larger problems potentially resulting in lost production, off-spec product, equipment loss and even catastrophic accidents.

Additionally, operating a process at suboptimal performance results in elevated operating costs due to increased energy costs, equipment reliability costs, lower yields, longer startups, etc. Therefore, the ability to troubleshoot and optimize process operations are two of the most valuable skills operations personnel can possess.

Many myths surround process troubleshooting and optimization including: "Troubleshooting and optimization are jobs of the engineer"; "I've seen this before, so I know exactly how to solve this problem"; "I don't have enough experience to troubleshoot problems or optimize the process"; and, "We're making money, so why bother with optimization?" This article discusses how myths like these can be costly to processing plants, what your plant can do to improve the ability of your personnel to troubleshoot and resolve process problems, and how your plant can capitalize on one of its most valuable assets for process optimization: its operators. A troubleshooting methodology is also presented that can make operations personnel more efficient troubleshooters, can greatly increase troubleshooting accuracy and can help transfer valuable process knowledge from senior personnel to newer, less-experienced personnel.

The most important factor in an employee's ability to effectively troubleshoot process problems and optimize process operations is a thorough understanding of the process.

Dispelling the myths. Most of the myths surrounding process troubleshooting and optimization can be traced back to three basic sources: dated operating cultures, run-to-failure operating practices and inadequate training. Dated operating cultures are rooted in the perceived roles within operations and maintenance, and the approach each of the roles takes toward troubleshooting and optimization. Run-to-failure operating practices refer to the common operating practice of running equipment to failure to stay online as long as possible, with focus on short-term production goals. Finally, inadequate training refers to lack of good formalized training on troubleshooting and optimization techniques, and general lack of training to support a thorough understanding of the process.

Dated operating cultures. In many plant cultures, troubleshooting responsibilities are rigidly divided among various personnel, and optimization work is typically handled primarily through the engineering departments. Traditionally, when it comes to troubleshooting, operations personnel take sole responsibility for troubleshooting process problems, and maintenance personnel take responsibility for handling most equipment problems. The console operator typically handles minor process problems, and the process engineers handle major process problems. When it comes to optimization, process engineers look for optimization potential in the process, control engineers look for it in the control system, and reliability or maintenance engineers look to optimize equipment reliability and equipment life. This type of strict delegation of responsibility, even if only perceived, can result in increased troubleshooting time, misdiagnosis of problems, lost opportunities for optimization, counterproductive efforts toward optimization and loss of valuable information when personnel leave the company.

The old saying that "two heads are better than one" applies as much to troubleshooting and optimization efforts within a processing facility as it does to any problem-solving venture. One key idea when discussing how the operations team approaches troubleshooting and optimization is the word "team." Like any team, each member of the operations team possesses a unique set of skills, knowledge and perspectives, and also has access to a different set of tools and information. For the team to be successful, it must draw on the strengths of all of its members.

For instance, process engineers possess a detailed understanding of the theory of how the process should operate, while the operators are intimately familiar with the personality and quirks of how the process actually operates. Working alone, either of these groups may struggle because they lack the knowledge and experience possessed by the other group. But by working together, they can draw on each other's strengths to be successful.

This is not only true for the operations team but also applies to interactions between maintenance and operations, and between the different operating teams within the same plant. Each of these groups has knowledge and skills that would be beneficial to the other. Therefore, to ensure your facility reaps the rewards of effective troubleshooting and optimization efforts, it is imperative that your facility not only adopts but also lives an operating culture that encourages this kind of teamwork. Unfortunately, changing from an old culture with rigidly divided roles to a team-oriented culture is very difficult. It requires time, and more importantly, perseverance to stay the course until the new culture is in place throughout your plant.

Run-to-failure operating practice. A growing trend in recent years is for companies to develop operating philosophies that reflect continuous improvement, reliability focus and/or employee empowerment. However, actual practiced philosophy is often drastically different, usually reverting back to the old run-to-failure practice. This breakdown from corporate-defined operating philosophy to the philosophy practiced in plants can usually be attributed to one of two factors.

First, lack of a clear definition of the operating philosophy or, more specifically, how the philosophy applies to individual positions can leave personnel confused about their changing responsibilities and make it difficult to manage personnel performance to the new philosophy. Secondly, the failure to implement the philosophy throughout all levels in the organization creates an environment where lower-level personnel have one understanding of the philosophy and management has another. Either of these factors will lead to personnel migrating back to the old operating practice of run-to-failure with short-term operating focus. Without clear direction, employees are not motivated or held accountable for efficient process troubleshooting or process optimization. This can lead to a great deal of variability in the level of these activities across operations.

While it is important to have a strong operating philosophy, it is equally important to ensure that all personnel understand how the philosophy relates to their position. Additionally, all managers should be familiar with how the philosophy affects their direct reports, so that they can hold them accountable for performance accordingly. Implementing a new operating philosophy often requires a change in the operating culture—which, as discussed previously, presents several challenges of its own.

Inadequate training. The most important factor in an employee's ability to effectively troubleshoot process problems and optimize process operations is a thorough understanding of the process. In many companies, a thorough understanding of the process for operators is simply defined as knowing the flows through the system along with a cause-and-effect understanding of process operations. Training programs that are not designed to provide personnel with a thorough understanding of their process are also ineffective. However, this level of process knowledge is inadequate for efficient troubleshooting and effective optimization. To see benefits from sound troubleshooting and optimization skills, your employees must possess a detailed understanding of how their processes actually work to convert the feeds into finished products. Without a detailed understanding, troubleshooting will revert to a cause-and-effect style, and optimization efforts will have no sound basis off of which to work.

Providing your operators with this kind of understanding is becoming increasingly difficult. With newer, more advanced control systems, operators spend less time interacting with the process and, hence, are less familiar with it. This situation makes it increasingly important to ensure that operators are thoroughly trained in how the process operates and receive refresher training to ensure continued understanding of their process. A solid training program should build on the basic plant fundamentals courses that all new hires must go through and should be specifically tailored to different positions on the operating team.

For example, all console operators should be required to take the following types of courses: Principles of Hydrocarbon Chemistry, Principles of Process Control, Console Operations, Console Strategy, Process Troubleshooting and Optimization, and Abnormal Situation Management. These types of courses will ensure that your operators have the background needed to understand why the process behaves the way it does and to understand the "why" behind some of the cause-and-effect relationships they know from experience. In addition, this type of training program will equip them to troubleshoot process problems and optimize process operations.

Improving troubleshooting skills. Often troubleshooting training takes the form of cause-and-effect training, where students are taught how to react to specific process problems. Operators frequently favor this type of training because it tells them exactly how to react to a given situation. However, this type of training can potentially create significant hazards and cause operators to take actions that worsen upsets. When individuals are taught in this way, you remove one of their most valuable tools: their ability to think and reason. As mentioned previously, key to effective troubleshooting is a thorough understanding of process operations. Basic troubleshooting skills build on the general problem-solving skills that everyone possesses. Key to successful troubleshooting is consistently using a systematic, proven approach by applying process understanding to solve process-related problems. When operators fail to follow a systematic approach such as the one presented next, they are forced to rely solely on cause-and-effect experience, which can and has resulted in many minor and catastrophic accidents.

Troubleshooting methodology. This troubleshooting methodology consists of seven steps which, when consistently followed, will significantly reduce likelihood of misdiagnosis of an upset and will facilitate transfer of knowledge in the form of shared experiences between operations personnel.

1. *Identify the problem:* The first step in solving any problem is to recognize that a problem exists and then define it.

2. *Identify potential sources/causes:* Once the problem has been identified, the next step is to identify all potential sources/causes. It is important in this step to not omit any potential causes/sources of the problem step to ensure that everything is considered.

3. *Narrow down potential causes:* When the problem has been defined and potential causes have been identified, it is time to narrow down the list of potential causes to the probable cause(s).

4. *Draw preliminary conclusions:* The purpose of this step is to develop a scenario that could reasonably explain how the probable cause(s) defined in step 3 could result in the identified problem.

5. *Prove conclusions:* In this step, the operator uses multiple process indicators (e.g., DCS indications, field indications, sensory information, etc.) to verify that his or her conclusions are correct before taking action. This is the most important step in the methodology because it prevents taking an incorrect action. This step, more than any other, requires an in-depth understanding of the process operation and variable interactions within the process.

6. *Take action:* In this step, the operator takes an action to address the problem and return the process to safe, steady-state operation.

7. *Document problem and solution:* Once the problem has been corrected, the last step is to document the problem, its solution and, most importantly, the troubleshooting process (steps 1–6). This step applies to all upsets, not just those that result in an incident. This step allows all operations personnel to learn from each other's experiences and to potentially identify mistakes made in the troubleshooting process by others.

People have a natural desire to try to solve problems as quickly as possible, so they can be recognized as the "hero." In an operating environment, this natural desire has been reinforced by the historic operating philosophy where the highest priority is keeping the process online as much as possible. This has fostered the "hero" mentality among operations personnel because everybody wants to be the one who solved the problem, fixed the machine and saved the day to ensure that the team meets its operating goals.

This mentality, however, is detrimental to good troubleshooting and greatly increases likelihood that the problem will be misdiagnosed or that an action will be taken that worsens the situation or causes disruptions in other units. To solve the problem as quickly as possible to be the "hero," many people look for shortcuts in the troubleshooting process. Some of the common shortcuts include taking actions to prove their theory, relying solely on past experience (i.e., "I've seen this before, so this is the fix."), relying on a single process indicator, or simply making guesses. Shortcuts like these pose several potential risks, including turning a relatively minor disruption into a catastrophic accident such as the incident at Three Mile Island. The troubleshooting methodology was designed to address these concerns by preventing actions from being taken until the operator has reasonably proven that the action is the correct one to take. However, training operators on the methodology is not enough. It must be constantly reinforced, and individuals need to be held accountable for adhering to the methodology.

Realizing your process's full potential. One of the most valuable assets for process optimization in any processing plant is the process operator. However, in most plants the operators are also one of the most underutilized assets for long-term optimization efforts. Operators interact with their process more than any other group in a plant; therefore, they are the most familiar with the operating characteristics ("personality") of their processes. This intimate knowledge makes them valuable in optimizing process operations for long- and short-term performance improvement. Optimization efforts for operators can be divided into two separate categories: unit optimization and optimizing controls. Unit optimization refers to the activities operators perform daily to meet daily orders in the most cost-efficient manner possible. Optimizing controls refers to looking for ways to improve process control either through controller tuning, control system design, process operation/design and/or equipment design/selection.

Unit optimization. Operators must juggle four separate optimization goals daily for their process. These goals are:

- Optimizing production goals—refers to managing feedstock and products for maximum profit. These goals are manipulated by controlling yields, throughput, product quality and product inventories.
- Optimizing operating goals—affects profit through controlling process efficiency and direct operating costs (e.g., supply costs, energy costs, etc.).
- Optimizing equipment reliability goals—refers to caring for and operating equipment to ensure reliable operation at the lowest possible operating cost.
- Optimizing equipment preservation goals—refers to equipment operation and care directed toward extending useful life of the equipment.

These goals, while interrelated, are defined separately because each requires a different approach, which can sometimes conflict. For the operator team to successfully optimize daily unit operations, it must know which goals truly have top priority. It is also important for the management team to provide explanations, including business and market conditions, behind the decisions that direct the daily orders. This ensures that the operations team understands how its efforts affect plant performance. This also allows the operations team a chance to question certain decisions if it feels that the management team was lacking important information about the process.

Optimizing controls. This type of optimization has traditionally been thought of as the sole domain of the plant engineers. However, this thinking results in a severe underutilization of the operating staff. As mentioned before, operators are in the best position in the plant to observe potential areas for process improvement and, with their operating experience, are often able to make viable suggestions as to how to accomplish the needed improvements.

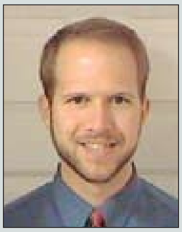
Unlike the unit optimization, the operators' role in optimizing controls is more indirect. While operators have the ability to recognize and make suggestions for potential improvements, they often lack the training and education needed to bring the ideas to fruition.

To do that, operators often need the help of the plant engineers, who can determine engineering and cost feasibility, and identify potential alternatives. The converse is also true: Engineers can use operators as a valuable resource for developing their own ideas for improvement. The key element for achieving these types of optimization activities is communication. Management needs to communicate to operators their role in this type of optimization; engineers need to communicate with operators the feasibility of ideas for improvement along with what is being done to address the issues; and operators need to communicate with management and engineers when they see potential optimization opportunities.

Moving into the future. As industry progresses, need for training to support troubleshooting and optimization activities will increase dramatically. As control systems become more advanced—thereby performing more of the general control actions—the console operator's role will change considerably. The operator's chief responsibility will no longer be to react to process upsets, but will be to proactively address minor disturbances in the process before they manifest into upsets and to continually look for ways to improve process operations.

However, operator training programs will have to change and grow to address the new needs of the console operators given their changing roles. With advanced control systems performing more of the routine adjustments, operators will lose valuable interaction time with the process. To compensate for this loss, additional training and refresher training using process emulators or simulators will have to be provided to replace the experience previously gained through process interaction. Additionally, training will have to evolve to provide operators with the tools and guidance they need to be successful in their new roles.

The other key component necessary to ensure that your company moves into the future as smoothly as possible is the manner in which the management team handles the transition. As discussed earlier, once management has developed an operating philosophy encompassing the core goals and values, it is imperative that this philosophy and how it applies to the individual positions within the plant be communicated to everyone in the organization. The final phase in the transition is to begin managing performance of all personnel to the new operating philosophy, and providing training and guidance when needed to keep individuals on track. ■



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