OCTAVE

WHITE PAPER

Solving problems before they escalate: A dashboard for process safety



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Executive summary

API Recommended Practice 754 provides solid guidance on leading and lagging indicators of process safety. Monitoring, understanding and acting on leading indicators can reduce the risk of major incidents. While this recommended practice initially focused on the refining and petrochemical sectors, it now gains widespread acceptance in process industries globally.

If organizations had fully understood the risks in front of them and acted sooner, they could have reduced the likelihood of incidents. API RP 754 emphasizes the importance of measuring leading indicators of major hazard risk. By extending the practice with deeper analysis and edge analytics, companies can prevent issues long before they reach the safety shutdown system, reducing costs and increasing profitability.

There is a safer and potentially more profitable way to conduct business along the manufacturing enterprise, and the capabilities have been here all along.

By applying API RP 754 and extending it with edge analytics, organizations can build a process safety management dashboard that gives operators and plant leaders real-time visibility into what is occurring on the plant floor. This insight enables continuous operations and a safer environment.

Sound far-fetched? Not really. It simply requires applying and understanding safety data that is already in front of you. By reviewing traditional layers of protection before an event reaches the safety system, organizations can extract meaningful value.



API RP 754 provides solid guidance and can help reduce the risk of major hazards by identifying underlying causes that could lead to a safety event. While this recommended practice initially focused on the refining and petrochemical sectors, it is now gaining widespread acceptance in other process industries on a global basis.

In a typical layer of protection scenario, when there is a disturbance in the process, you have your first layer of protection with automatic controls. These automatic or regulatory controls try to keep the process in a safe space, or the optimal point to make the most product as possible. If there is a disturbance and the control loops can handle it, then it is possible to simply go back to normal operations. However, if the control loops cannot handle it, this is where an operator intervenes in the process; where the alarm system kicks in and points out changes in the process. If operators cannot handle the disturbance, then safety shutdown systems come into play. If shutdown systems do not work, you have process relief and containment, your pop-off valve flows and you have materials spilling in berms or a diked-off area just trying to keep it on the plant site. If all that fails, you have evacuation.

If a company gets beyond the safety system shutdown and you are looking at process relief and containment or evacuation, you have reached the tier 1 and tier 2 status your company is in the news and massive investigations begin.

Tier 1 process safety events are the most lagging performance indicators and represent incidents with greater consequences resulting from actual losses of containment, according to API RP 754. Tier 2 process safety events represent loss of primary containment events with a lesser consequence but may be predictive of future, more significant incidents. Tier 3 events represent challenges to the safety systems. Indicators at this level provide an opportunity to identify and correct weaknesses within the safety system. Finally, tier 4 indicators represent operating discipline and process safety management system performance.

Minimizing risk at the start

The goal is to reduce the risk of higher-level events by understanding and minimizing risk at tiers 3 and 4. While tier 1 and 2 events put the company in the news, tier 3 and tier 4 events are considered minor but are leading indicators of more significant issues. This is where manufacturers can learn how they are performing at these layers. If they perform well and understand what is happening, they can reduce the risk of a major event.

API RP 754 discusses leading and lagging process safety indicators that help reduce the risk of a tier 1 or tier 2 unplanned or uncontrolled release of any material. The practice highlights the need to document, monitor and understand tier 3 and tier 4 indicators to prevent escalation.

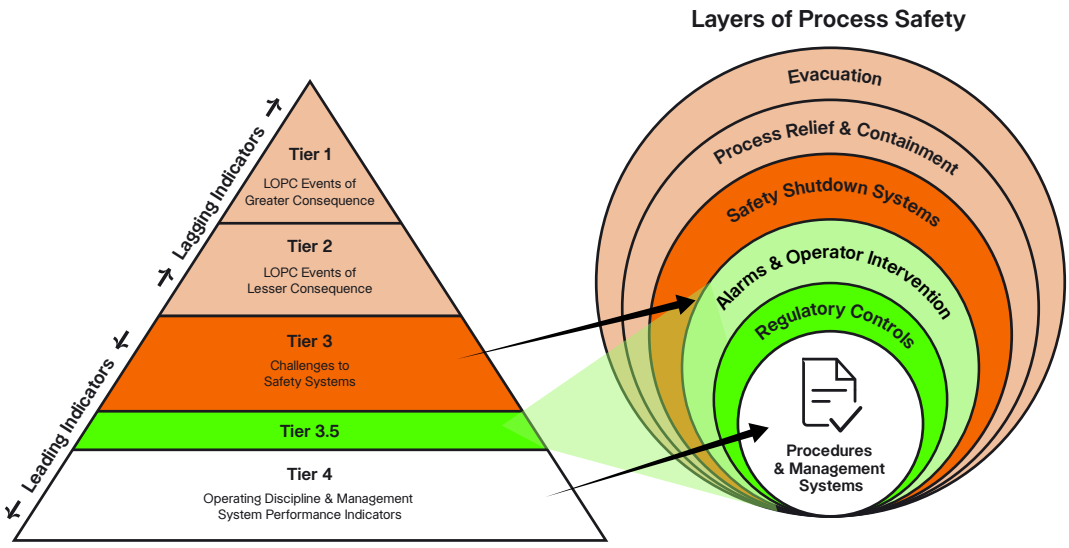
By doing more with leading indicators for process safety than what recommended practices talk about and using edge analytics platforms, it is possible to understand and address minor problems before they become much more significant.

When applied properly, API RP 754 can address minor problems and head off bigger issues.

That is why focusing strongly on tiers 3 and 4 can solve problems before they develop into a more significant event.

When looking at tier 3, you are talking about safe operating limit excursions, demands on safety systems, inspection testing outside of acceptable limits like pipe thicknesses and vessel walls. When it comes to tier 4, it is all about the operating discipline and management systems. Do you have your Process Hazard Analysis (PHA) completed? Are you complying with work permits? Are you conducting Management of Change (MoC) documentation?

So, between tier 3 and tier 4 the management of documentation and procedures, which is in tier 4, all the way up to the safety shutdown system, which is tier 3, there is a wealth of underutilized performance data, in the protective layers between the paperwork and administrative processes and up to the demands safety systems that often go unchecked. We can call that tier 3.5. In this zone, it is possible to apply the same principles and spirit of API RP 754 to create additional leading indicators that monitor the performance of the protective layers between tiers 3 and 4 like control loops and alarms.



Defining tier 3.5

Organizations need metrics that evaluate regulatory controls, alarm systems and process performance. Metrics can help bridge the divide between tier 3, which is a demand on the safety system and tier 4, which is a listing of system and management procedures.

Control loops remain the first line of defense to protect against a safety issue. A process operating facility typically has hundreds, if not thousands, of control loops. Monitoring, assessing, analyzing and diagnosing these loops for potential issues can be complex and time-consuming. However, they are key to preventing process disturbances from becoming alarms and operator intervention events. Investing in technologies to monitor control loops helps proactively identify poor performers and rectify them. That investment will reduce the risk of disturbances hitting the next layer of protection. Periodic, automatic monitoring of all loops plantwide would allow operators to understand poor loop performance better. Automating the monitoring process with available edge analytic technology reduces much of the complexity of manual monitoring and allows plants to focus on the value added of improving poorly performing loops.

Recommended control loop metrics include:

- **Controllers at limit:** Percentage of time control loops are saturated against the upper and lower limits for longer than five consecutive minutes. These are loops that are effectively not in control of the process.
- **Loops in normal mode percent:** Percentage of time loops are in the correct mode.
- **Loops in manual:** The percentage of control loops in manual mode; any loop in manual is effectively defeating a layer of protection.
- **Key loop performance:** A composite metric proposed communicates the performance of critical loops for several factors including output proximity to limits, time in normal mode, and the difference between the setpoint and process variable.

Adding technology to fix an issue is one thing. Still, there can be really good data to use for leading indicators from infrastructure already in place like an alarm management system. Everyone is doing alarm metrics; they may not realize they can apply those same metrics in the area of process safety to create leading indicators.

Employing alarm management incorporating ISA 18.2 recommended metrics and using edge analytics is one way to gain leading process safety indicators before it reaches a demand on the safety system. Understanding the frequency of alarms taken as an Independent Protection Layer (IPL) or pre-alarms to a safety system activation can be used as a leading indicator for a safety system activation. For example, an alarm flood, where the rate exceeds ISA 18.2 guidelines, could be determined as a near-miss because the flood creates a situation where an operator may not recognize and respond to a critical alarm.

Defining metrics

By defining metrics on how the alarm system is performing, especially if you have defined an IPL credit for an alarm and operator action, it is possible to detect, understand and prevent any degradation of the alarm system and operator response, which could lead to greater risk of a higher-level event. This same concept could be extended to any control loops that may have been taken as an IPL.

ISA 18.2 recommends metrics such as:

- Average annunciated alarm rate per operating position (per day, per hour, per 10 minutes, with acceptability numbers)
- Peak annunciated alarm rates per operating position
- Alarm floods
- Frequently occurring alarms
- Chattering and fleeting alarms
- Stale alarms
- Annunciated alarm priority distribution (alarm occurrences)
- Alarm attributes priority distribution (alarm configuration)
- Unauthorized alarm suppression
- Alarm attribute monitoring (for unauthorized change)

These metrics can be important and tailored more specifically to process safety. For example, there can be a daily review of any IPL-related alarms that occurred, or a review of the highest priority alarms, stale IPL alarms or any changes to highest priority alarms.

Case in point

One safety incident that occurred involved an alarm management nuisance alarm with a rupture disc. The transmitter was battery operated, and when it failed, it would cause an alarm and operators had come to view that alarm as a nuisance that could safely be ignored. During the turnaround at the facility, workers switched to a wired sensor. However, during the startup purge of the reactor, the rupture disc was blown. At that point, the alarm was pinging, and operators assumed it was the nuisance alarm instead of the real one. If they had a robust alarm management program and were looking at the alarms every day on their dashboard, personnel would know the nuisance alarm should have been addressed during the turnaround and it should not be going off. Knowing they could have found the problem and addressed it earlier than the five days it took to identify, during which material from the reactor was released. Ignoring alarms or not having an incident over a period of years or decades can lead to certain levels of complacency. “We have always done it this way, and it is working, so we don’t have to change” could be a common refrain.

However, complacency can start to dissolve if you are able to show the metrics. That is when the light bulb goes on. Operators see alarms every day; when they start to see the alarm system is getting under control by having a good alarm management program that is starting to fix problems, they get really excited and want to take ownership of the process.

Plant personnel can take their meaningful metrics to help understand the risk and collect data to get a grasp of sources of risk beginning to seep into a process.

By collecting information in the gap between tiers 3 and 4 – the first two layers of protection – it is possible to understand performance and be able to review that information every day, on demand and communicate that information effectively through a good process safety management dashboard.

Payback to boosting regulatory controls

Every manufacturer has a meeting to cover three major topics: safety, the environment and cost.

Metrics involved with the API RP 754 are woven into all three. If you run the plant safely, you have good environmental compliance. If you have environmental and safety compliance, you will also have good cost compliance. Good control loops can help drive all three. The reality is there is a direct line into malfunctioning controls and more profitable operations. There is a payback in improving regulatory controls in addition to improving your safety profile.

If your process is more stable and optimally producing product, you will spend less on material and energy costs, leading to a more profitable plant. Well-performing loops capable of handling disturbances will reduce alarms, operator intervention events, safety system activations, process relief and environmental excursions. They help keep stuff "in the pipe" and that improves process safety performance.

Improving this layer and making sure this layer is robust and optimal will also improve how multi-variable controls and advance process control applications function. There is a definite payback to making regulatory controls function well.

When it comes to alarms and operator intervention, there is less of a direct line. However, when your alarm systems are under control, the plant runs better. You do not have as many unplanned shutdowns because an operator missed something that is important. You have fewer demands on the safety system because the operator is able to respond to the alarm effectively because they are not getting deluged with a bunch of nuisance alarms.

Process safety management dashboards

With better information comes better decisions. Solid edge analytics systems can handle automation and then report real-time conditions within these layers, which feed these details to process safety management dashboards. Analytics is not only a time saver but can also allow plant personnel to better assess the risk of ongoing operation and target improvements to reduce risk. The systems need to be in place to help improve performance, not just measure it.

To get to a safer place and understand and address issues in that tier 3.5 zone, organizations can use control loop monitoring packages that look at loop stability and response and give an operator-centric view of how well that loop behaves. If it spends quite a bit of time in manual, if the operator must constantly adjust the set point or if it causes too many alarms, it probably could work better. Understanding the problem by applying the proper measurements makes it possible to improve performance.

In addition, there are technology solutions like boundary and alarm management software that aggregates, validates and displays physical, design and safe operating limits that allow the application to automatically detect and report deviations, such as an alarm setting that is higher than a safety instrumented system trip point. An effective alarm system optimization strategy can make operators more effective during abnormal situations. Better mitigation of abnormal conditions not only improves the safety performance of a facility but also the operating efficiency.

There is also technology to provide accurate, real-time insight and validation of independent protection layer functions that provides the means to analyze safety function performance, ensure documentation of proof testing and manage required test schedules. That is where process safety management dashboards come into play.

There are plenty of companies that might report on their process safety dashboards once a month. They spend a few days a month and put together a high-level dashboard. That is fine; however, in the end they are putting together dashboards of information already a month old. The catch is incidents happen in real-time. Month-old data does not communicate the risk of operating today, right now. Incidents happen in real-time and with ongoing operations. Imagine having all this information on demand at your fingertips in real-time so you can make the best possible decisions.

Clear view

With an effective process safety management dashboard, plant personnel would get a clear view of what was happening on the site. They would avoid an incident report analysis that reads: “They didn’t have an effective safety program,” or “they didn’t follow what they said they wanted to do,” or “something changed in the process or something changed in the administrative processes and for some reason, it wasn’t picked up by all the supporting processes.”

Process safety management dashboards can be put together without a whole lot of effort so that when plant personnel comes in every day, they can get a good overview of the important metrics around the leading indicators. This provides a lens into the risk of the ongoing operation. By looking at a dashboard and understanding the current risk, teams can determine whether an area of the plant needs to shut down to fix any small problems to keep the facility running safely. Management dashboards can effectively communicate, “here is the risk of the operations today and here is where the risk comes from.” That can drive management and operators to take action and address issues to operate their facilities safely.

Today, plant personnel can extract data from edge analytic platforms which allows them to quickly aggregate and contextualize leading indicators of process safety to reduce the risk of tier 3 safety system activations. Understanding the performance of all layers of protection can lead to improvements in safety, environment and cost. That is the next generation of safety performance.

About Octave

Octave is a leader in enterprise software, turning data into decisive action and intelligence into your edge. Our software solves for and simplifies complexity, from the design and build to operations and protection of people, property and assets – for any scope, at any scale. For decades, we've partnered with customers to sharpen performance, elevate efficiency and amplify results. From factory floors to entire cities, our solutions are tuned to scale up what's possible from day one onward.

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