

Table 1. Selected Performance Model Findings for Refinery Fire and Explosion Incident and Subsequent Investigation (modified from [1, 2])

Performance Factor	Findings
External regulations/standards	<ul style="list-style-type: none"> Corporate safety management system does not ensure timely implementation of external good engineering practices that support and could improve process safety performance.
Organizational safety culture	<ul style="list-style-type: none"> Has not established a positive, trusting, and open environment with effective lines of communication between management and the workforce at all refineries. Has an incomplete picture of process safety performance because the process safety management system likely results in underreporting of incidents and near misses. Personal safety was measured, rewarded, and the primary focus of their safety efforts, but the same emphasis was not put on improving process safety performance. Has not provided effective process safety leadership and has not adequately established process safety as a core value.
Leadership commitment and focus	<ul style="list-style-type: none"> Has not provided effective leadership on or established appropriate operational expectations regarding process safety performance. A lack of supervisory oversight and technically trained personnel during the startup, an especially hazardous period, was an omission contrary to refinery guidelines.
Capable organization and resources	<ul style="list-style-type: none"> Good process safety performance requires adequate resources, including funding for inspecting, testing, maintaining, and repairing or replacing equipment; resources for training and educating personnel; resources for keeping operating procedures up to date; and resources for implementing best or good industry practices. If a refinery is under-resourced, maintenance may be deferred, inspections and testing may fall behind, old and obsolete equipment may not be replaced, and process risks will inevitably increase. The company has not always ensured that the resources required for strong process safety performance at its refineries were identified and provided. Moreover, the company overloaded the U.S. refineries with a host of corporate initiatives. While these initiatives were well intentioned, they diverted attention from a greater focus on process safety issues because the company did not provide adequate resources or guidance for prioritization to the refineries.
Appropriate design and risk management	<ul style="list-style-type: none"> The system (programs to analyze process hazards) as a whole does not ensure adequate identification and rigorous analysis of those hazards. Examination also indicates that the extent and recurring nature of this deficiency is not isolated, but systemic. Corporate process safety management system does not effectively translate expectations into measurable criteria for management of process risk or define the appropriate role of qualitative and quantitative risk management criteria.
Effective process safety systems	<ul style="list-style-type: none"> There were a number of deficiencies in the process safety knowledge and competence of, and training and education programs for, personnel and contractors. Managers did not effectively implement their pre-startup safety review policy to ensure that nonessential personnel were removed from areas in and around process units during startups and that the adequacy of all safety systems and equipment, including procedures and training, process safety information, alarms and equipment functionality, and instrument testing and calibration were verified. The mechanical integrity program did not ensure that deficiencies were identified and repaired prior to failure, resulting in the “run to failure” of process equipment.

Table 1. Selected Performance Model Findings for Refinery Fire and Explosion Incident and Subsequent Investigation (modified from [1, 2]) – continued

Performance Factor	Findings
<p>Operational discipline</p>	<ul style="list-style-type: none"> • A lack of operating discipline, toleration of serious deviations from safe operating practices, and apparent complacency toward serious process safety risks existed at the refinery. • Management did not emphasize the importance of following procedures as evidenced by its lack of enforcement of the MOC policy, its acceptance of procedural deviations during past startups, and its failure to ensure that the procedures remained up-to-date and accurate, contributing to a work environment that encouraged operations personnel to deviate from procedures. • A “check the box” mentality was prevalent, where personnel completed paperwork and checked off on safety policy and procedural requirements even when those requirements had not been met, contributing to a culture of “casual compliance.”
<p>Feedback systems and organizational learning</p>	<ul style="list-style-type: none"> • Significant deficiencies existed on site and corporate systems for measuring process safety performance, investigating incidents and near misses, auditing system performance, addressing previously identified process safety-related action items, and ensuring sufficient management and board oversight. • Reliance on lagging, after-the-fact indicators of process safety performance rather than leading, predictive measures, however, impaired the ability to measure, monitor, and detect deteriorating or degraded process safety conditions • Did not create an effective reporting and learning culture; reporting bad news was not encouraged.