

API Recommended Practice 754

Process Safety Performance Indicators for
the Refining and Petrochemical Industries



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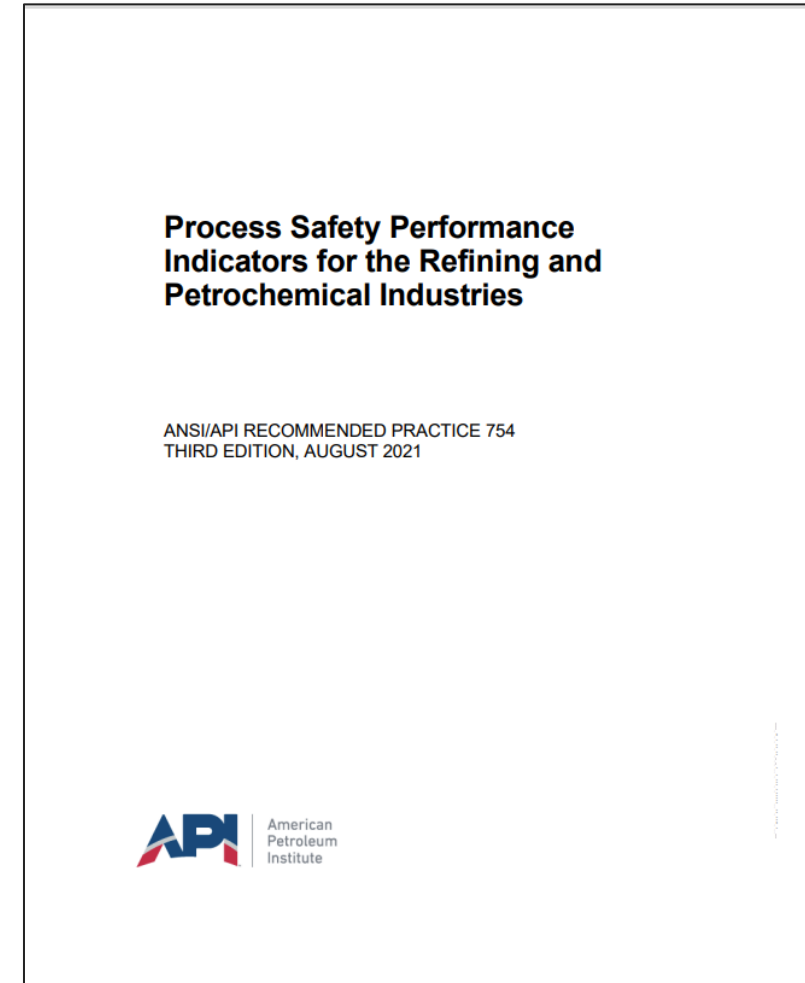
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API Recommended Practice (RP) 754

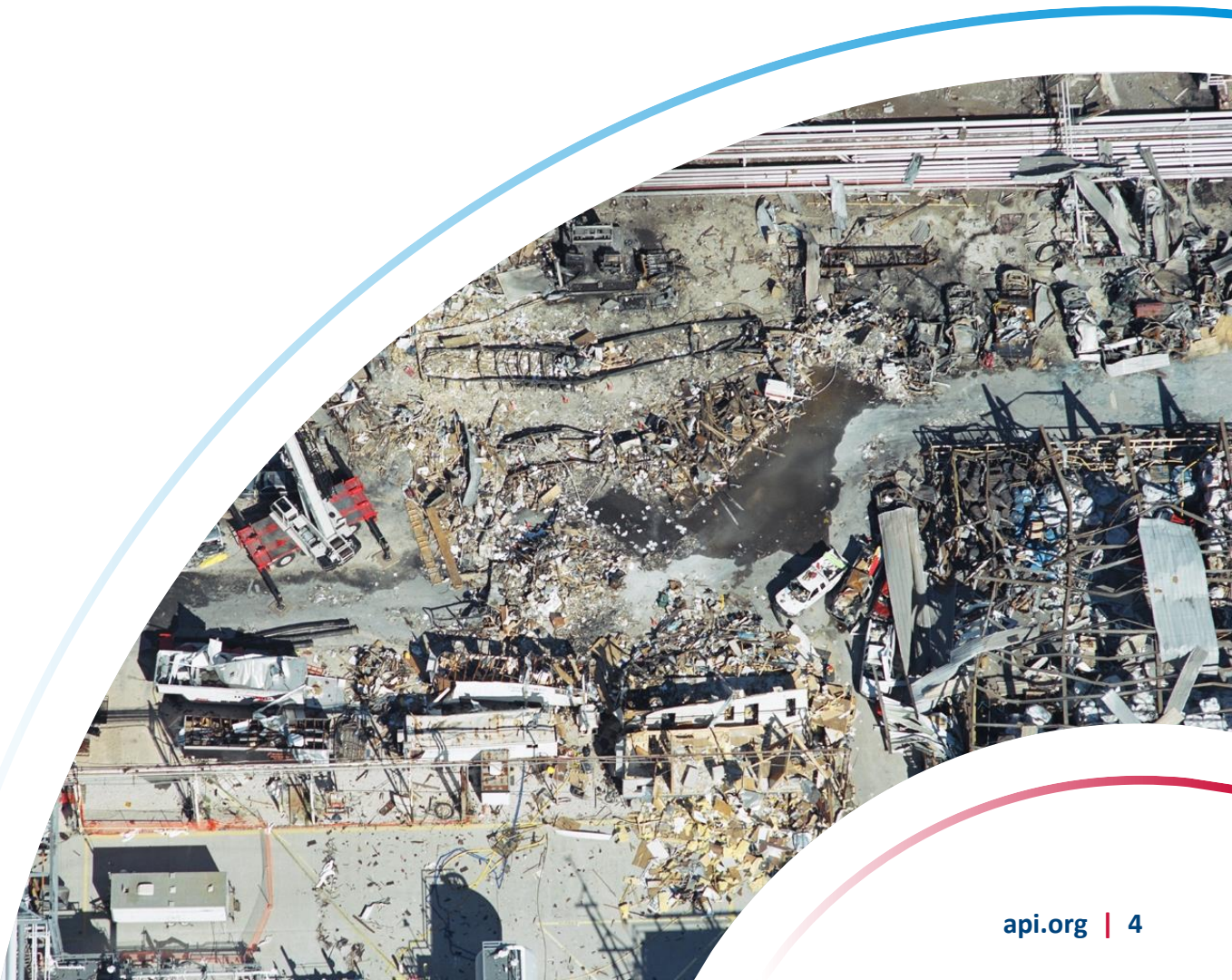
Overview

- Background and Purpose
- Scope and Applicability
- Leading and Lagging Indicators
- Data capture and submission
- Examples and their use



CSB Recommendation to API & USW

“Work together to develop two new consensus American National Standards Institute [ANSI] standards. In the first standard, create performance indicators for process safety in the refinery and petrochemical industries. Ensure that the standard identifies **leading and lagging indicators for nationwide public reporting** as well as indicators for use at individual facilities. Include methods for the development and use of the performance indicators.”



Prior to RP 754

- There was no standardized process safety metric for the industry.
- Some companies and trade organizations had process safety metrics before the CSB recommendation, but definitions varied from organization to organization and were not well aligned.
- Some companies relied on their occupation safety metrics to judge the health of their process safety systems.
- As an industry we did not have a standardized metric or indicator to determine if we were improving as an industry, until API RP 754.



RP 754 Guiding Principles



Indicators should drive process safety performance improvement and learning.



Indicators should be relatively easy to implement and easily understood by all stakeholders (e.g., workers and the public).



Indicators should be statistically valid at one or more of the following levels: industry, company, and facility. Statistical validity requires a consistent definition, a minimum data set size, a normalization factor, and a relatively consistent reporting pool.



Indicators should be appropriate for industry, company, or facility level benchmarking.

Scope/Applicability

- Developed for the refining and petrochemical industries but may also be applicable to other industries where loss of containment has the potential to cause harm.
- Applicability not limited to facilities covered by OSHA PSM or similar national or international regulations.
- Exclusions to focus metrics on Process Safety vs. all other areas.
Examples:
 - Occupational safety incidents (slips, trips, and falls)
 - Transportation incidents specific to transport operations
 - Routine emissions
 - Office of shop type injuries
 - Losses of containment from ancillary equipment not connected to the process
 - Laboratory incidents, Retail service stations incidents
 - New construction that has never been part of a process



Leading and Lagging Indicators

Tier 1 and Tier 2

- Standardized by RP 754
- Suitable for:
 - Broad reporting
 - Industry benchmarking
 - Driving industry initiatives

Tier 3 and Tier 4

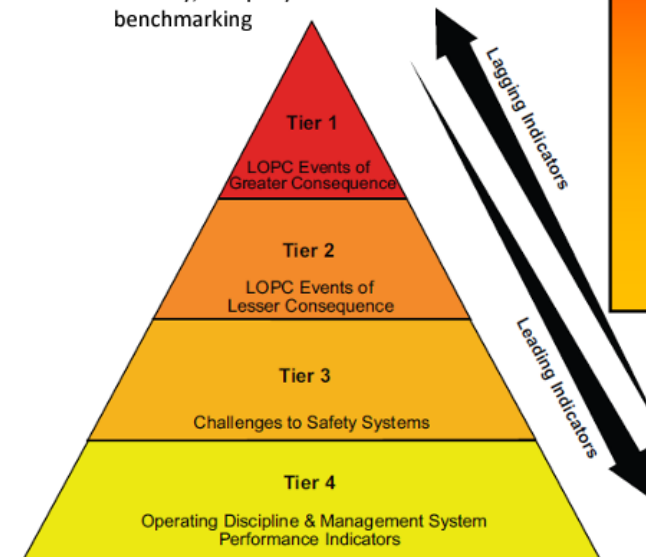
- Company defined
- Suitable for:
 - Internal company or site level reporting
 - Company or site level benchmarking
 - Driving company Process Safety improvement initiatives

FACT SHEET



Recommended Practice 754

- Indicators should be statistically valid at one or more of the following levels: industry, company, and site
- Indicators should be appropriate for industry, company or site level benchmarking



- The count of **Tier 1** process safety events is the most lagging performance indicator and represents incidents with greater consequence resulting from actual losses of containment.
- The count of **Tier 2** process safety events represents 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.
- **Tier 4** indicators represent operating discipline and management system performance.

Lagging Indicators

Tier 1 and Tier 2 Incident Categorization

CONSEQUENCE	TIER 1	TIER 2
<i>An unplanned or uncontrolled release that results in:</i>		
Injury – Employee or Contractor	Fatality / Days Away	OSHA Recordable
3 rd Party Hospitalization	Any	---
Officially Declared Community Evacuation or Shelter in Place	Any	---
Fire or Explosion	Damage > \$100,000	Damage > \$2,500
PRD Discharge or Upset Emission with <ul style="list-style-type: none"> • Rainout, • Discharge to unsafe location • On-site shelter in place or onsite evacuation • Public protective measures 	Discharge or Emission > Tier 1 TQ on Table 1	Discharge or Emission > Tier 2 TQ on Table 1
An unignited release of material in any one-hour period	LOPC > Tier 1 TQ on Table 1	LOPC > Tier 2 TQ on Table 1

Leading Indicators

Tier 3 and Tier 4

- Conformance to API 754 requires that a company develop and use Tier 3 and Tier 4 process safety metrics.
- Tier 3 and Tier 4 Indicators are too facility specific for developing industry acceptable criteria or for industry benchmarking.
- As a result, API 754 only provides general guidance and does not define this level of indicator, leaving each company or facility to define metrics that are appropriate for the type and age of the facility, the operating history and other aspects of the operation.

Leading Indicators

Tier 3 Indicators

- A Tier 3 PSE typically represents a challenge to the barrier system that progressed along the path to harm but is stopped short of a Tier 1 or Tier 2 PSE consequence.
- Indicators at this level provide an additional opportunity to identify and correct weaknesses within the barrier system.
 - Typical indicators may include
 - Safe Operating Limit Excursions
 - Primary containment inspection or testing outside of acceptable limits
 - Demand on safety systems
 - Other LOPCs

Leading Indicators

Tier 4 Indicators

- Tier 4 indicators typically represent performance of individual components of the Operating Discipline and Management System and are comprised of Operating Discipline and Management System performance
- Indicators at this level provide an opportunity to identify and correct isolated system weaknesses.
- Tier 4 indicators are indicative of process safety system weaknesses that may contribute to future Tier 1 or Tier 2 PSEs.
- Example indicators may include:
 - Process Hazard Evaluations Completion
 - Process Safety Action Item Closure
 - Training Completed on Schedule
 - Procedures Current and Accurate
 - Work Permit Compliance
 - Safety Critical Equipment Inspection
 - Safety Critical Equipment Deficiency Management
 - Management of Change (MOC) and Pre-start-up Safety Review (PSSR) Compliance
 - Completion of Emergency Response Drills
 - Fatigue Risk Management

API RP 754 Annex E: Examples

- Annex E is perhaps the most used and valued part of the RP for the end user
- The Annex includes about 100 example situations that clarify nuances involved with using the RP.
- The examples are segregated by topic and help companies as they interpret the written word of the RP.
- Most of these examples resulted from questions about how to use or interpret the RP. Questions from folks like you.



Annual PSE Data Collection

- Each year in the Spring, API collects Process Safety Event (PSE) data from companies (member and non-member) with U.S. Refining and Petrochemical operations.
- The annual survey covers Tier 1 and Tier 2 events. Tier 3 and 4 metrics are not collected or reported.
- The survey collects information on:
 - Each facility including the type of facility, location, capacity and exposure hours.
 - Each PSE including the date of the event, the process unit, the material released, the type of equipment involved, the mode of operation, the consequences of the event, and up to 3 causal factors.
- The data collection is done via spreadsheet, which is common between API and another trade association, American Fuel & Petrochemical Manufacturers (AFPM).
- Companies that wish to participate in both surveys only need to submit once.
- The spreadsheet is available on [API's website](#) along with other information on API RP 754.



PSE Data Collection Fields

Facility Information

- Company Name
- Site Name
- Site Address
- City
- State/Province
- Zip Code
- Country
- NAICS Code or Equivalent
- Facility Type
- Total Employee Hours
- Total Contractor Hours
- Refining Capacity (bbls/cal. day)

Event Characteristics

- Site Name
- Event Date
- Event Time
- Event Description
- Additional Comments
- Type of Process
- Mode of Operation
 - Normal sub-category
 - Start-up sub-category
- Point of Release
 - Detail 1 and 2 sub-categories
- Type of Material
- Causal Factors
 - Three causal factors with three levels

PSE Data Collection Fields

Tier 1

- Employee/Contractor DAFW
- Employee/Contractor Fatalities
- Third-Party Hospital Admissions
- Third-Party Fatalities
- Community Evacuation/Shelter-In-Place
- Fire/Explosion (> \$100,000 direct cost)
- Engineered Pressure Relief
 - Rainout
 - Discharge to a Potentially Unsafe Location
 - On-Site Shelter-In-Place or On-Site Evacuation
 - Public Protective Measures
- Upset Emissions
 - Rainout
 - Discharge to a Potentially Unsafe Location
 - On-Site Shelter-In-Place or On-Site Evacuation
 - Public Protective Measures
- Tier 1 Release (Category 1-7)
- Tier 1 Severity Weight
 - Safety/Human Health
 - Direct Cost from Fire or Explosion
 - Material Release Within Any 1-hr Period
 - Community Impact
 - Off-Site Environmental Impact

Annual PSE Data Collection

Tier 2

- Employee/Contractor Recordable Injury
- Fire/Explosion (\$2,500 to \$100,000 direct cost)
- Engineered Pressure Relief
 - Rainout
 - Discharge to a Potentially Unsafe Location
 - On-Site Shelter-In-Place or On-Site Evacuation
 - Public Protective Measures
- Upset Emissions
 - Rainout
 - Discharge to a Potentially Unsafe Location
 - On-Site Shelter-In-Place or On-Site Evacuation
 - Public Protective Measures
- Tier 2 Release (Category 1-8)

API's Annual PSE Reports

- API provides respondents with two reports
 - Annual API PSE Report: aggregate PSE data for the current year and previous four years
 - Benchmark Report: each company's data compared to the industry as reported to API
- A one-pager with key metrics is posted on API's website
 - $PSE\ Rate = PSE\ Count \times 200,000 / Hours\ Worked$

U.S. Refining PSE Summary Data

	2018	2019	2020	2021	2022	5-Year Average
Number of Companies	31	28	29	28	26	28
Number of Refineries	100	99	101	96	95	98
Refinery Capacity Response Rate	95%	93%	93%	94%	93%	94%
Tier 1 PSEs Reported	91	102	85	96	92	93
Tier 1 PSE Rate per 200,000 Workforce Hours	0.0560	0.0608	0.0612	0.0770	0.0682	0.0639
Tier 2 PSEs Reported	281	264	182	219	233	236
Tier 2 PSE Rate per 200,000 Workforce Hours	0.1728	0.1574	0.1311	0.1756	0.1728	0.1618



2022 PROCESS SAFETY EVENTS REPORT FOR THE U.S. REFINING INDUSTRY

JUNE 2023



Insights from PSE Data

- As part of the API-AFPM Advancing Process Safety (APS) Initiative, the PSE data is reviewed to identify potential areas of improvement and insights for the industry.
- Examples:
 - Review of data resulted in an expansion of the piping system Type of Process, as well as the Causal Factors fields.
 - Various sub-groups were formed within APS to focus on other areas of improvement, such as Mechanical Integrity (MI) and Human and Operational Performance (HOP).
- Learnings documents and webinars are produced on topics of interest such as winterization, tank overfills, and startup mode.