Managing System Integrity for Hazardous Liquid Pipelines

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Introduction

The goal of any pipeline operator is to operate the pipeline so that there are no adverse effects on the public, employees, the environment, or customers. The goal is an error-free, spill-free, and incident-free operation of the pipeline.

An integrity management program provides a way to improve the safety of pipeline systems and to allocate operator resources effectively to:

— identify and analyze actual and potential precursor events that can result in pipeline incidents,

— examine the likelihood and potential severity of pipeline incidents,

— provide a comprehensive and integrated method for examining and comparing the spectrum of risks and risk reduction activities available,

— provide a structured, easily-communicated way for selecting and implementing risk reduction activities,

— establish and track system performance with the goal of improving that performance.

This recommended practice (RP) outlines a process that an operator of a pipeline system can use to assess risks and make decisions about risks in operating a hazardous liquid pipeline to achieve a number of goals, including reducing both the number and consequences of incidents. Section 4 describes the components of an integrity management program. This RP also supports the development of integrity management programs required under 49 CFR 195.452 of the U.S. federal pipeline safety regulations.

This RP is intended for use by individuals and teams charged with planning, implementing, and improving a pipeline integrity management program. A team may include engineers, operating personnel, and technicians or specialists with specific experience or expertise (such as corrosion, in-line inspection, and right-of-way patrolling). Users of this RP should be familiar with applicable pipeline safety regulations (e.g. 49 CFR 195). This RP is also designed to serve as a roadmap to relevant consensus standards, recommended practices, guidance documents, technical reports, advisory bulletins, and safety regulations that can help operators manage integrity for hazardous liquid pipelines.

Guiding Principles

The development of this RP was based on certain guiding principles. These principles are reflected in multiple sections and are provided to give the reader the opportunity to view pipeline integrity from a broader perspective.

Integrity should be built into pipeline systems from initial planning, design, and construction. Integrity management of a pipeline starts with the sound design and construction of the pipeline. Guidance for new construction is provided in several consensus standards, including ASME B31.4, as well as pipeline safety regulations. As these standards and guidelines are applied to the design of a pipeline, the designer should consider the area the pipeline traverses and the possible impacts that the pipeline may have on that area, and the people that reside in its vicinity. New construction is not a subject of this RP, but the design specifications and as-built condition of the pipeline provide important baseline information for an integrity management program.

Effective integrity management is built on qualified people using defined processes to operate maintained facilities. The integrity of the physical facility is only part of the complete system that allows an operator to reduce both the number of incidents and the adverse effects of errors and incidents. The total system also includes the people that operate the facility and the work processes that the employees use and follow. A comprehensive integrity management program should address people, processes, and facilities.

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An integrity management program should be flexible. An integrity management program should be customized to support each operator's unique conditions. Furthermore, the program should be continually evaluated and modified to accommodate changes in the pipeline design and operation, changes in the environment in which the system operates, and new operating data and other integrity-related information.

Continuous evaluation is required to ensure the program takes appropriate advantage of improved technology and that the program remains integrated with the operator's business practices, and effectively supports the operator's integrity goals.

The integration of information is a key component for managing system integrity. A key element of the integrity management program is the integration of all relevant information in the decision-making process. Information that can impact an operator's understanding of the important risks to a pipeline system comes from a variety of sources. The operator is in the best position to gather and analyze this information. By integrating all of the relevant information, the operator can determine where the risks of an incident are applicable and are the greatest and make prudent decisions to reduce these risks.

Preparing for and conducting a risk assessment is a key element in managing pipeline system integrity. Risk assessment is an analytical process through which an operator determines the types of adverse events or conditions that might impact pipeline integrity, the likelihood that those events or conditions will lead to a loss of integrity, and the nature and severity of the consequences that might occur following a failure. This analytical process involves the integration and analysis of design, construction, operating, maintenance, testing, and other information about a pipeline system. Risk assessments can have varying scopes, varying levels of detail, and use different methods. The ultimate goal of assessing risks is to identify and prioritize the most significant risks so that an operator can make informed decisions about these issues.

Assessing risks to pipeline integrity is an iterative process. The operator continuously gathers new and refreshed information about the pipeline system through operating, maintenance, and testing experience. This information should be factored into the understanding of system risks. As the significance and relevance of this newer information to risk is understood, the operator may need to adjust its integrity plan accordingly. This may result in changes to inspection methods or frequency or additional modifications to the pipeline system in response to the data. As changes are made, different pipelines within a single operating company and different operators will be at different places with regard to the goal of incident-free operation. Each pipeline system and each company should implement specific goals and measures to monitor the improvements in integrity, and to assess the need for additional changes. The following applies to operators:

— Operators have multiple options available to address risks. Components of the facility or system can be changed; additional training can be provided to the people that operate the system; processes or procedures can be modified; or a combination of actions can be used to optimize risk reduction.

— Operators should address integrity issues raised from assessments and information analysis.

— Operators should evaluate anomalies and identify those that are potentially injurious to pipeline integrity.

— Operators should remediate or eliminate injurious defects.

— Operators should periodically assess the capabilities of new technologies and techniques that may provide improved understanding about the pipe's condition or provide new opportunities to reduce risk. Knowledge about what is available and effective will allow the operator to apply the most appropriate technologies or techniques to a specific risk to best address potential impacts.

Pipeline system integrity and integrity management programs should be evaluated on a continual basis. Operators are encouraged to perform internal reviews to ensure the effectiveness of the integrity management program in achieving the program's goals. Some operators may choose to use the services of third parties to assist with such evaluations.

Managing System Integrity for Hazardous Liquid Pipelines

1 Scope

This recommended practice (RP) is applicable to pipeline systems used to transport hazardous liquids as defined in U.S. Title 49 CFR Part 195.2. The use of this RP is not limited to pipelines regulated under 49 CFR 195 and the principles embodied in integrity management are applicable to all pipeline systems.

This RP is specifically designed to provide the operator with a description of industry-proven practices in pipeline integrity management.

The RP is largely targeted to onshore pipelines along the right-of-way, but the process and approach can be applied to pipeline facilities, including pipeline stations, terminals, and delivery facilities associated with pipeline systems. Certain sections of this RP provide guidance specific to pipeline stations, terminals, and delivery facilities.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Bulletin 5T1, *Imperfection and Defect Terminology*

API Standard 653, *Tank Inspection, Repair, Alteration, and Reconstruction*

API Recommended Practice 1110, *Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide*

API Standard 1163, *In-line Inspection Systems Qualification*

API Recommended Practice 1166, *Excavation Monitoring and Observation for Damage Prevention*

API Recommended Practice 1173, *Pipeline Safety Management Systems*

API Recommended Practice 1176, *Assessment and Management of Cracking in Pipelines*

ASME B31G, *Manual for Determining the Remaining Strength of Corroded Pipelines: A Supplement to ASME B31, Code for Pressure Piping*

ASME B31.4, *Liquid and Slurry Piping Transportation Systems*

ASME B31.8S, *Managing System Integrity of Gas Pipelines*

ASTM E1049-85, *Standard Practices for Cycle Counting in Fatigue Analysis*

NACE SP0169, *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*

NACE SP0204, *Stress Corrosion Cracking (SCC) Direct Assessment Methodology*

NACE SP0502, *Pipeline External Corrosion Direct Assessment Methodology*