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Guidelines to Understanding Pipeline Safety Management Systems

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Introduction

A pipeline safety management system (PSMS) is a holistic approach to enhancing pipeline safety by promoting safety awareness, vigilance, and cooperation company-wide. A successfully implemented PSMS will highlight safety risks and provide a framework for addressing them with the goal of reducing pipeline incident rate and liability costs.

In 2015, in collaboration and consensus with the U.S. National Transportation Safety Board (NTSB), Department of Transportation's (DOT) U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), state regulators, the public (represented by Bill Hoyle and Stacey Gerard), and pipeline operators, the American Petroleum Institute (API) created API Recommended Practice 1173, Pipeline Safety Management Systems, which outlines what a PSMS is, why it is necessary for the pipeline industry, and how to implement it. The NTSB recommends acting to improve pipeline safety through a PSMS before PHMSA revises 49 CFR 195.452 (Hazardous Liquids Pipeline Integrity Management in High Consequence Areas). In its continued mission for safer transmission and distribution of natural gas across the country, AGA fully supports RP 1173 and the implementation of a PSMS at its member companies. This booklet will serve as brief introduction to the PSMS framework and is meant to include all personnel, including contractors.

I. Why an SMS?

PHMSA data on the rate of both serious and significant pipeline incidents indicates a decline of approximately 50% in overall incident rate as well as in associated fatalities and injuries over the past 30 years. While this trend is encouraging, the natural gas industry continues to strive for safer conditions and zero incidents. In order to protect workers, citizens, the environment, and pipeline integrity, operators must take concrete steps to improve pipeline safety and reduce this incident rate.

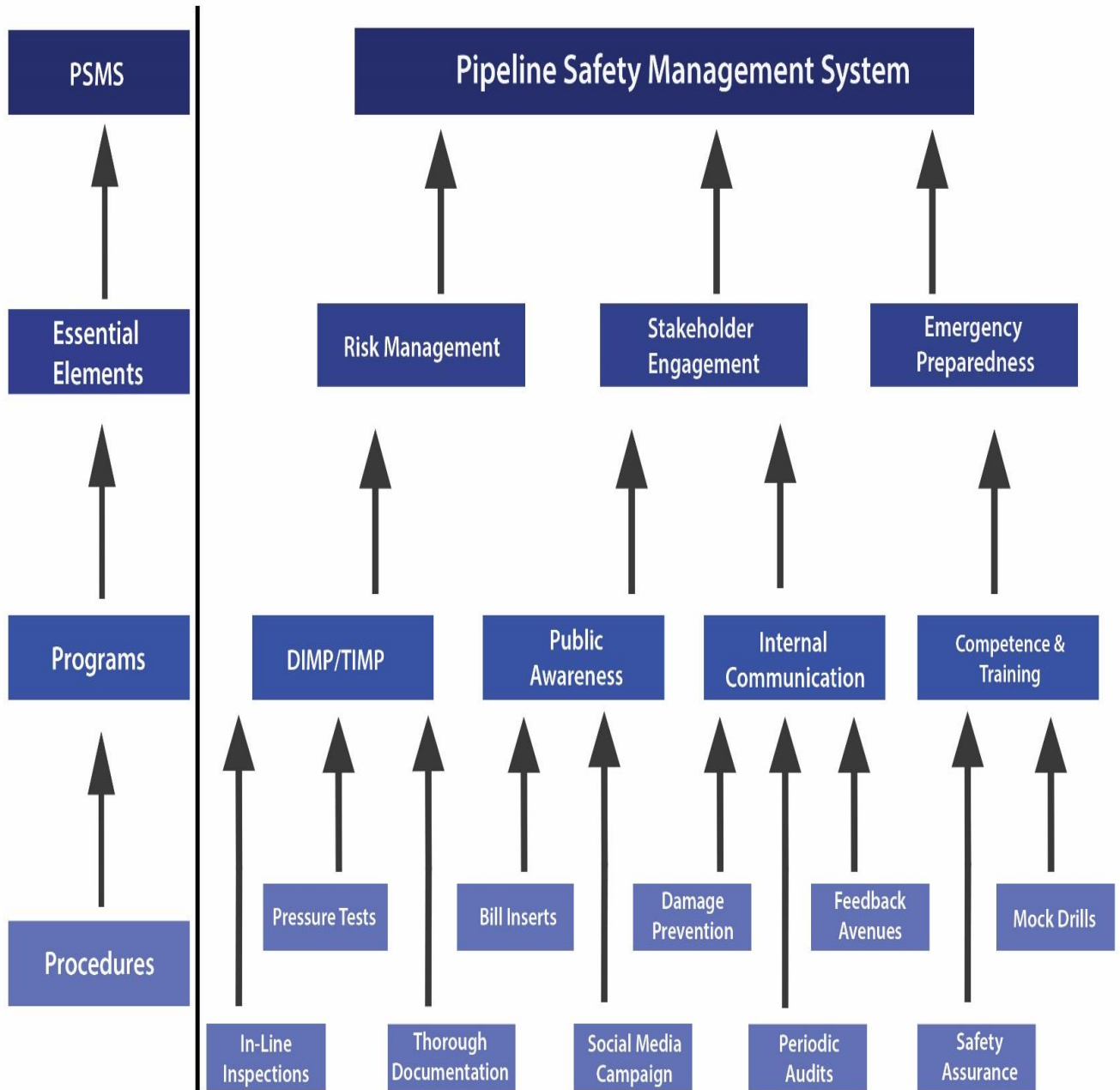
Many other industries have turned to safety management systems (SMS) to foster an industry-wide commitment to safety. The chemical manufacturing, maritime, aviation, and nuclear industries have all adopted some form of SMS. The chemical manufacturing industry's Responsible Care system has helped decrease the frequency of incidents by 66% even while the volume of chemicals shipped has increased 20%. Beyond a reduced incident rate, SMS have been shown to reduce administrative, insurance, and liability costs, enhance company image with customers, employees, and regulatory agencies, and increase productivity.

II. What is a PSMS? How Do We Implement It?

PSMS is a holistic approach to improving pipeline safety. It emphasizes a systematic approach to the identification, proactive prevention, and remediation of safety hazards inherent in pipeline operation. It involves leadership at each level of an organization, a safety culture promoting non-punitive reporting, and consistent self-evaluation to identify top-priority risks and take steps to

address them. A PSMS has ten essential elements, described later. They are the pillars of RP 1173. Underneath those elements are programs – like integrity management and public awareness – that help an operator achieve the goals set by the essential elements. Underneath the programs are procedures that fortify their respective programs. The purpose of a PSMS is to place existing programs within a more safety-oriented context and generate novel ones to enhance pipeline and worker safety. The following figure illustrates a sample structure of a PSMS along with 3 of the 10 essential PSMS elements. Note that the procedures, programs, and essential elements provided in the figure are neither prescriptive nor comprehensive.

Figure 1. Sample PSMS Structure



It is vital for everyone at an organization -- whether top management, management, or employee -- to know where they fit in in the PSMS.¹

The most general responsibilities for the three identified employment levels are: for top management, to promote safety culture and support the development of policies, programs and procedures consistent with RP 1173 objectives; for management, develop policies, programs and procedures consistent with RP 1173 objectives, to enforce those programs and procedures, receive and evaluate feedback from employees on safety initiatives, and form recommendations based on that feedback to report to top management; for employees, to safely execute the policies, programs and procedures set forth by management, and remain vigilant in identifying, reporting, and remediating safety hazards in pipeline operation. The roles within a PSMS system are summarized in the following two figures, first generally and then applied to incident investigation as an example. The sample responsibilities provided are not comprehensive.

Figure 2. General personnel engagement

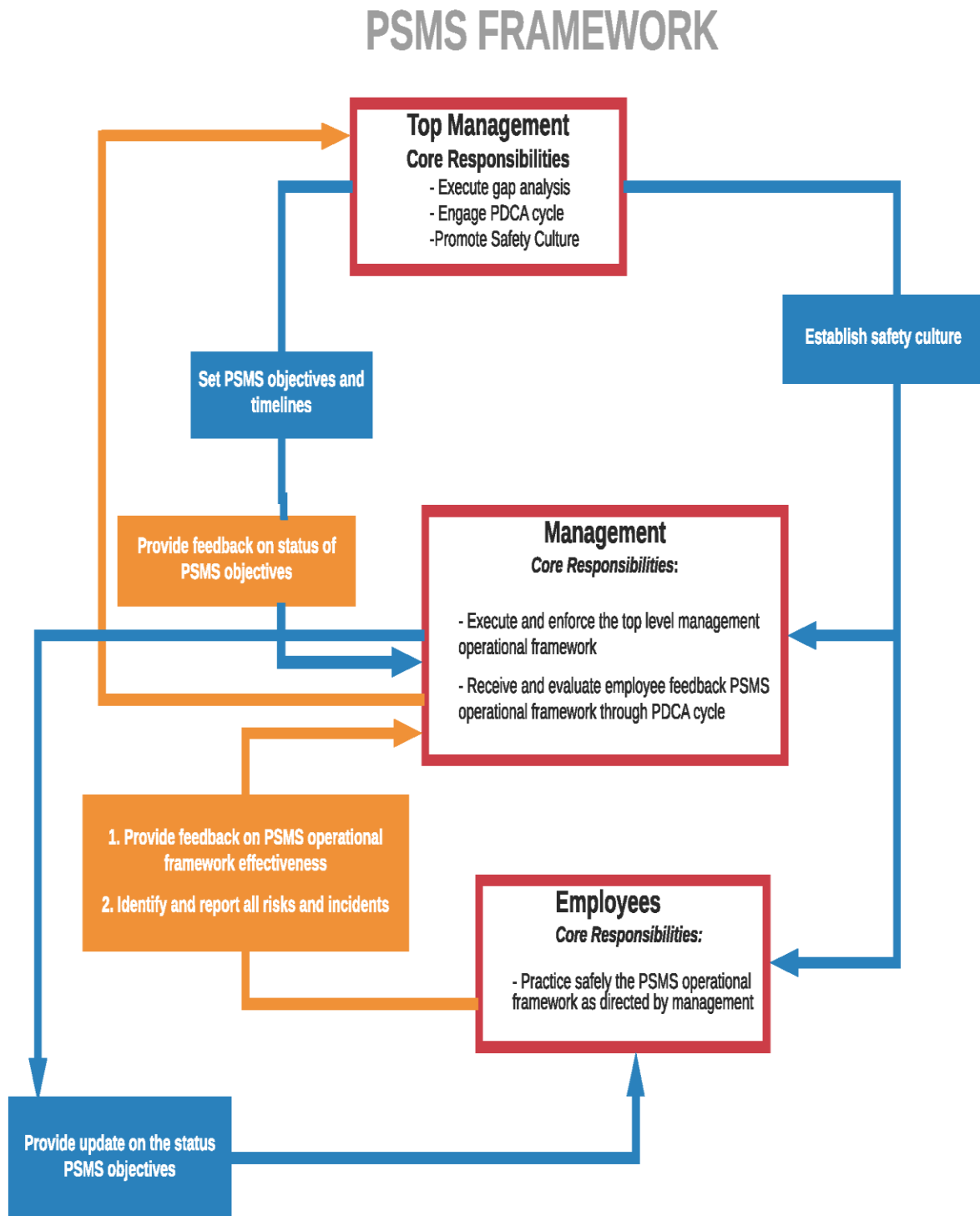
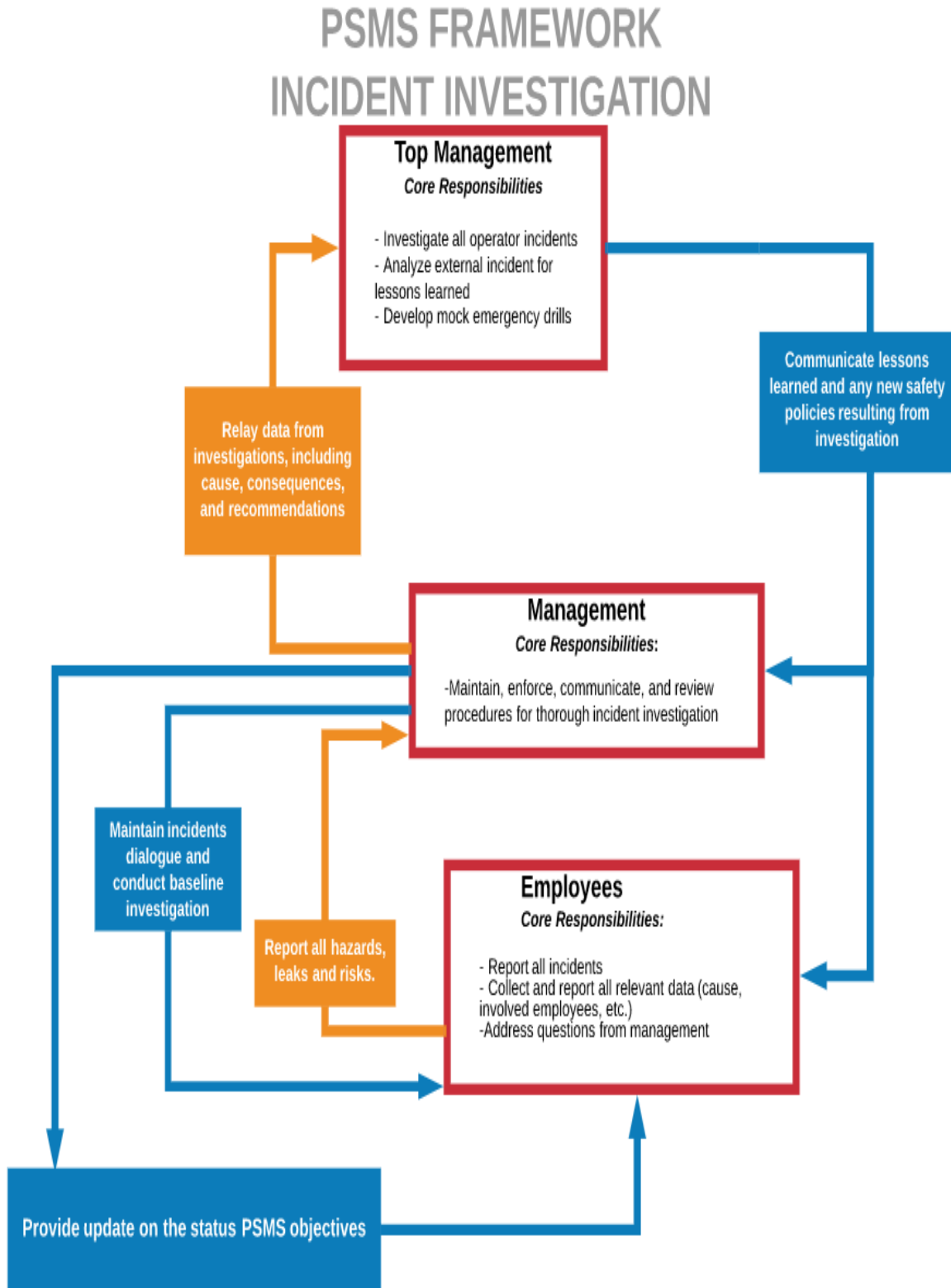


Figure 3. Incident investigation personnel engagement



A. Scalability and Flexibility

In the creation of RP 1173, API recognized the diversity in size and structure of pipeline operators. API RP 1173 gives operators the flexibility to apply PSMS principles to their specific circumstances as appropriate, across any spectrum of size, location, and preexistence of safety mechanisms. A PSMS can be tailored to any operator, from those with a handful of employees to those with thousands.

Operators will find that many of their existing operations align with RP 1173 and may need few, if any, adjustments. Other practices may require more intense overhaul to meet PSMS objectives, and additional programs may have to be generated in accordance with RP 1173 guidelines.

However, AGA stresses that many pre-existing operator policies and structures may not have to be modified.

In discussing pilot PSMS implementation, AGA has discovered that its members are using diverse approaches to refurbish their safety programs to meet PSMS goals. AGA has made available to members a PSMS pilot implementation data report to illustrate how operators have begun rolling out their systems. Some operators have hired or designated staff dedicated specifically for PSMS, others have delegated the role to existing company employees, and others have used a combination of the two. RP 1173 is designed to be flexible, in that operators can pursue a personalized PSMS in whatever manner best suits their organization.

AGA stresses that PSMS implementation is not a larger burden on smaller companies. RP 1173 is designed to be scaled to company size. The extent of the PSMS objectives described later in this booklet and the resources they require (e.g. documentation and record keeping, training and competence, and operational controls) are all inherently correlated with operator size.

B. Safety Culture

The natural gas industry champions safety as its core value. Implementing a PSMS strengthens an organization's safety culture by demonstrating organization-wide commitment to the safety of the pipelines, all employees, the public, and the environment. All personnel and policies feed into an organization's safety culture with both specific and common contributions.

A strong safety culture is established at the top. Management must actively and continually practice safety by acting on recommendations, allocating the requisite resources, and opening a constructive dialogue with employees. Once a safety culture is established, all company stakeholders contribute to safety by maintaining a vigilance in identifying risks at all points in the supply chain.

AGA's Board of Directors affirmed their and the natural gas industry's commitment to safety culture in their 2011 Safety Culture Statement. They wrote "Working safely and keeping our pipeline systems, customers, and the public safe means committing to the safety culture for

ourselves, our family, our friends, our companies, and our communities”. More information about safety culture and AGA’s full statement are available on the AGA website.

C. Gap Analysis

Identifying and assessing gaps between an operator’s current operational framework and those stipulated by RP 1173 is critical to developing an effective PSMS. To perform this gap analysis, operators should understand the components of RP 1173, map their existing practices to the components, and then identify where current practices do not meet the standard set forth in RP 1173. Operators should engage these deficiencies in a Plan-Do-Check-Act (PDCA) cycle, described in the next section, and target them for compliance with the recommended practice.

AGA has a spreadsheet program available free to members to help conduct initial gap analysis. The tool will help operators compare their programs to the RP 1173 elements.

D. Plan-Do-Check-Act Cycle

PSMS relies on the Plan-Do-Check-Act (PDCA) cycle to evaluate and address safety hazards. The cycle has four eponymous phases:

Plan - setting safety goals, establishing metrics by which to best measure progress, and creating methods and practices for data collection.

Do - executing the activities outlined in the Plan section.

Check - comparison of the collected data against the goals set in the Plan step and an evaluation of the organization’s successes and areas for improvement in its safety operational framework and culture.

Act - comprehensive action to address the gaps identified in the Check phase and improve safety deficiencies.

Per the cycle, the Act phase transitions into new plan phase, working off the improvements made in the previous cycle.

The following two figures illustrate the PDCA cycle, first in a general sense and then with a sample application to integrity management as it relates to in-line inspection (ILI).

Figure 4: The PDCA Cycle

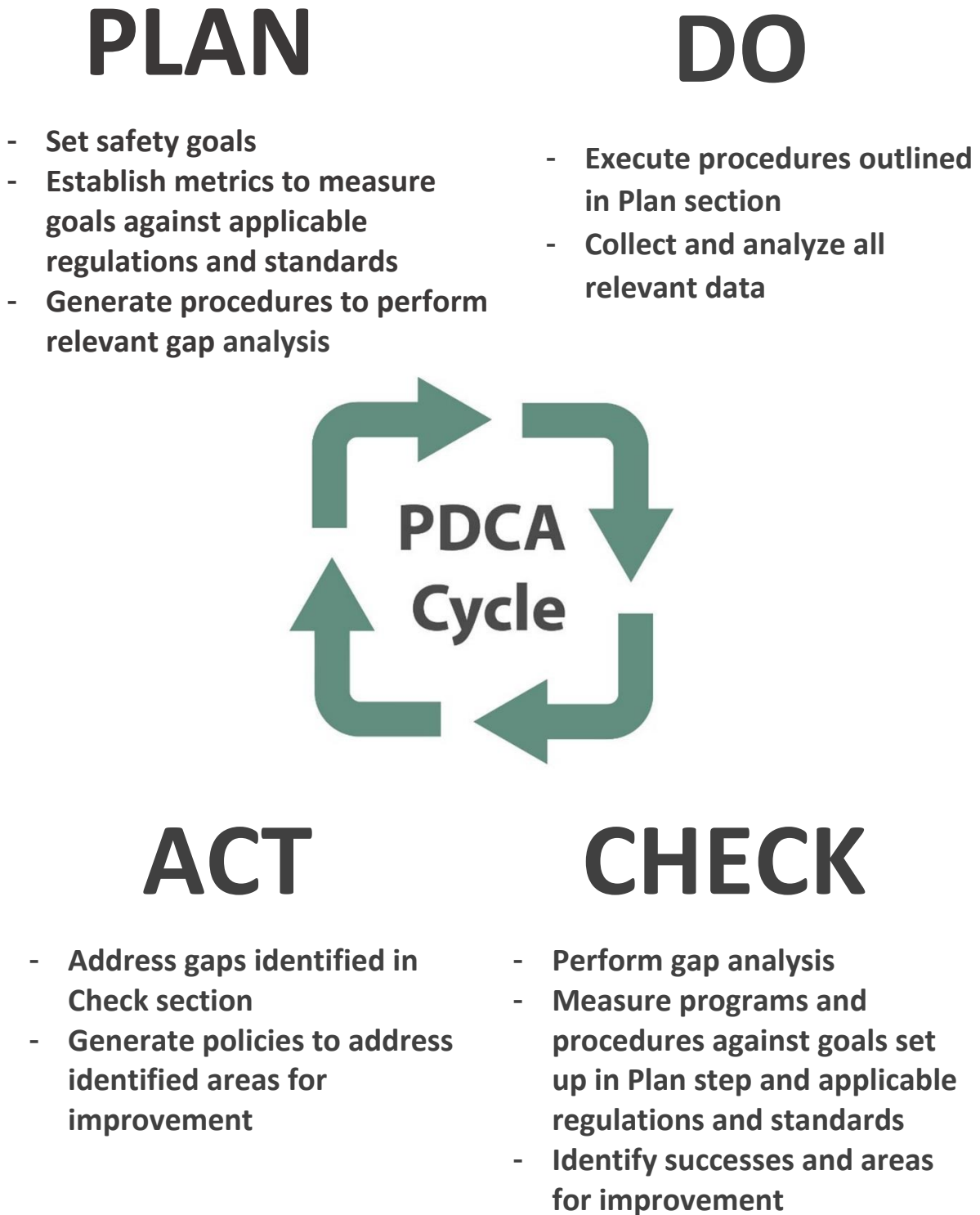
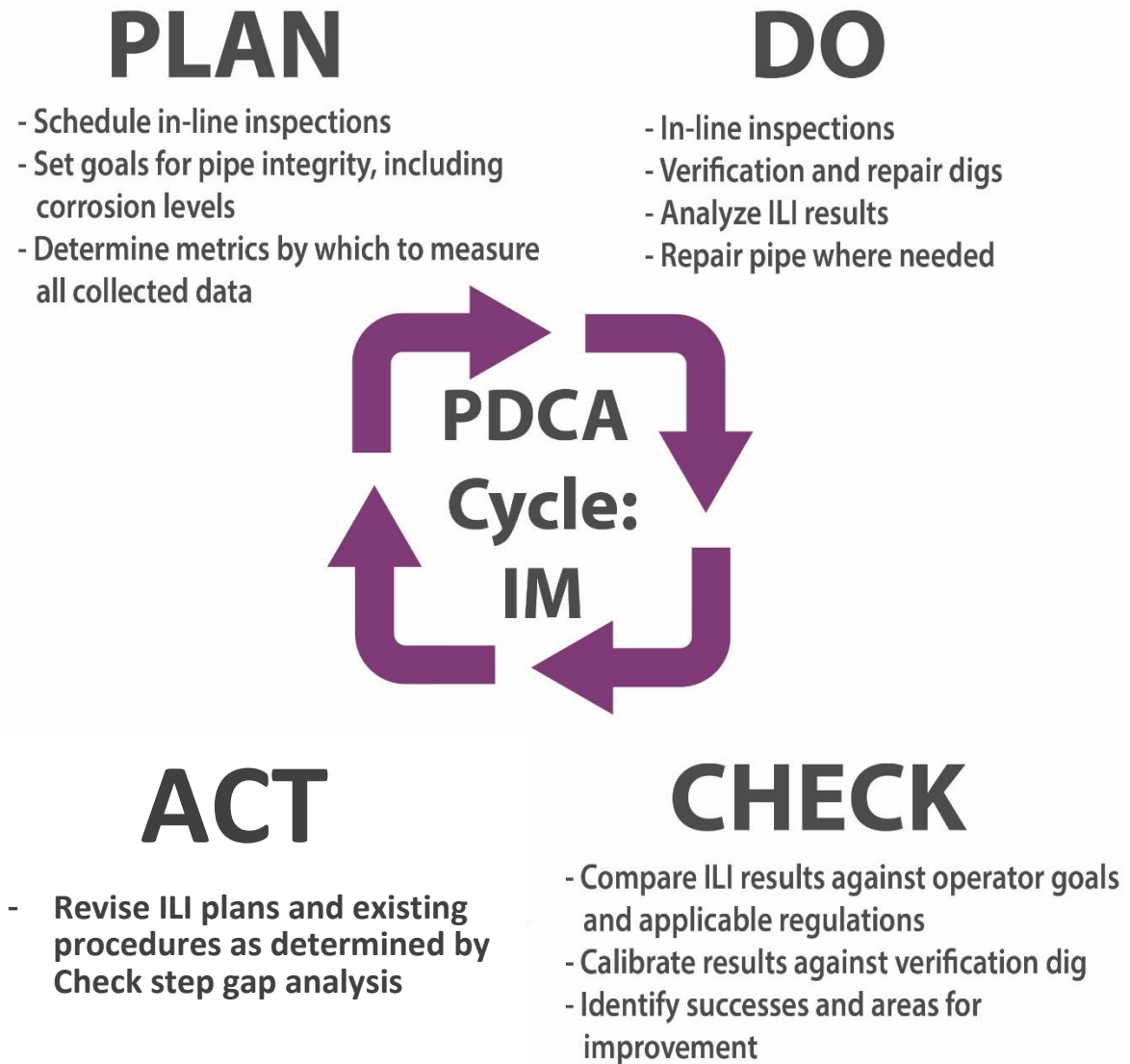


Figure 5: The PDCA Cycle applied to Integrity Management (ILI)



E. Essential Elements of a PSMS

There are ten essential elements of a PSMS as dictated by API RP 1173. Together, they constitute a framework for safe operation of a natural gas pipeline. What follows is a description of each essential element. It is annotated with sample strategies for successful implementation of the element. The highlighted portions of the text correspond to the strategy denoted by the same color highlight. The sample strategies are neither prescriptive nor comprehensive. Operators should consider their size, location, and existing policies and generate strategies tailored their individual circumstances.

1. Leadership & Management Commitment

A PSMS requires the commitment and support of all personnel to succeed.

To that end, top level management shall:

- Execute gap analysis of company programs through interviews with business unit leaders and assessment of existing programs against PSMS standards.
- Promote a positive safety culture and demonstrate continual commitment to the PSMS
- Establish objectives and timelines for its PSMS, with policies for appraisal, and recognition aimed at promoting the PSMS and a policy which includes clear consequences of failure to abide by company safety policy
- Engage the PDCA cycle with regards to evaluating and maturing the PSMS
- Implement risk management, remediation, resource allocation, communication, and incentive policies that adhere to and promote the remaining PSMS essential elements

To that end, management shall:

- Execute daily the PSMS objectives and policies set forth by upper level management
- Engage the PDCA cycle with regards to pipeline operations
- Receive and analyze feedback reports from employees on PSMS policies

To that end, employees shall:

Sample Strategies to Accomplish PSMS Objectives

Perform audits of company policies

Regularly hold company meetings affirming commitment to employee safety

Generate forms to risk featuring designated KPIs

Utilize communication channels designated by management

- Practice the procedures implemented by management
- Identify, report, and control safety risks
- Provide feedback on the efficacy of PSMS policies

2. Stakeholder Engagement

Operators must identify and engage internal and external stakeholders in their PSMS in order to most comprehensively identify risks and additional areas for improvement. This includes communicating responsibilities, plans, and results of safety initiatives.

Internal Engagement – The operator shall maintain two-way communication with internal stakeholders, which includes channels for employees to raise safety concerns and employee feedback on current PSMS initiatives.

External Engagement – The operator shall maintain two-way communication with external stakeholders, which includes engaging regulatory bodies and opening a constructive dialogue with representatives of the public.

Sample Strategies to Accomplish PSMS Objectives

Foster an atmosphere of non-punitive reporting

Be aware of and compliant with all existing and new regulation

Leverage public awareness campaign opportunities to speak to PSMS principles.

3. Risk Management

Risk management is a set of practices to understand, evaluate, and mitigate safety threats to a pipeline. An effective risk management program is critical to reducing pipeline incident rate and to implementing an effective PSMS.

Operators must engage the PDCA cycle regarding risk management. Operators are to identify, assess, mitigate, and reassess threats to pipeline safety with emphasis on the likelihood of occurrence and severity. This minimally includes review of incident response preparation, identification of high consequence areas, and a review of equipment operability.

Sample Strategies to Accomplish PSMS Objectives

Engage employees who work on the pipeline for their first-hand knowledge

Utilize KPIs to evaluate the safety of equipment and pipes

Designate high and low risk areas in order to effectively allocate resources where they are most needed

Risk assessments shall be reviewed annually and updated as required by results of the PDCA cycle.

4. Operational Controls

Operators will generate operational policies consistent with the safety objectives set forth in the PSMS or will modify existing policies to be consistent with the PSMS.

Operating Procedures – Operators shall maintain procedures that promote safe work practices in all areas of pipeline management, including initial start-up, normal operation, emergency operation, normal shut-down, and restoration of service following maintenance or outage.

System Integrity – Operators shall maintain pipeline systems that are designed, manufactured, fabricated, installed, operated, maintained, inspected, and tested in accordance with the PSMS framework.

Management of Change – Operators shall maintain procedures for management of change (MOC). MOC procedures should address all changes permanent and temporary of a technical, physical, procedural, and organizational manner. MOC procedures should consider and evaluate the reason and implication of change, acquisition of required work permits, requisite documentation, and communication of the change to relevant parts of the organization.

Sample Strategies to Accomplish PSMS Objectives

Utilize periodic audits to ensure compliance with RP 1173.

Communicate new responsibilities, procedures, or objectives that may exist due to the change

5. Incident Investigation, Evaluation, and Lessons Learned

Learning from experience is critical to the natural gas industry's zero incidents goal and is a core principle of any PSMS.

Investigation – Pipeline operators must maintain procedures for investigating incidents and near-misses that include identification of cause and contributing factors, generation and documentation

Sample Strategies to Accomplish PSMS Objectives

Establish a culture of incident reporting. Utilize subject matter experts and applicable employees to monitor incident trends and causes

of findings and lessons learned, evaluation of emergency response procedures and preparedness, recommendations for improvement, and plans to implement the recommendations.

Follow-Up – The operator shall ensure that actions to implement safety improvement recommendations in accordance with PSMS objectives are implemented and track their progress.

Additionally, operators shall establish and execute procedures evaluating incidents from other operators. This process should include dialogues with the relevant regulators, public, and members of the affected organization. Other operators represent a significant source of information for industry-wide lessons learned.

Engage the PDCA cycle with data collected from field employees and generate a revised operational framework

Evaluate external incident reports, including from the NTSB, PHMSA, and the applicable operator

6. Safety Assurance

Operators must demonstrate and validate their safety procedures against the objectives of the PSMS and applicable regulations and recommended practices.

Audits – Operators shall perform periodic audits of their PSMS and adherence to RP 1173 with the intent to verify the integrity and efficacy of its PSMS operational framework. The criteria, scope, methods, and frequency of the audits are left to the operator, but the audit interval shall not exceed three years. Audits may be performed by external parties such as subject matter experts or by internal parties such as qualified employees not involved in the operational unit being audited.

Evaluations – Operators shall evaluate the efficacy of their risk management program by means of stakeholder engagement results, risk analysis, MOC, incident investigations, and implementation of recommendations and lessons learned. Operators shall also periodically evaluate their organization's safety culture.

Key performance indicators (KPIs) for audits and evaluations must include fatalities, injuries, property

Sample Strategies to Accomplish PSMS Objectives

Utilize the PDCA cycle and perform gap analyses

Utilize AGA's Best Practices Program, available to members, as a litmus test for these metrics

damage from planned and unplanned releases, and should include other metrics reflective of leading practices.

7. Management Review and Continuous Improvement

Management must engage the PDCA cycle to evaluate progress in achieving performance goals and objectives.

Input – Management shall conduct reviews at least annually of the effectiveness of the PSMS, with consideration of goals and objectives of the PSMS, implementation of recommendations from past management reviews, results of risk management reviews and incident investigations, status relative to key metrics and KPIs, results of internal and external audits, and of regulatory changes that could affect the PSMS.

Output – Management shall produce from this review an assessment of the efficacy of its PSMS including the identification of areas for improvement. It shall include any improvements to the operational framework made to better coincide with the PSMS.

Management shall also evaluate advances in technology and how they can be tested and implemented within the organization and its PSMS structure.

Sample Strategies to Accomplish PSMS Objectives

Seek data from all levels of employment, from policy making in top-level management to operations with field employees

Distribute this report to employees to highlight areas for increased vigilance and to reinforce top-management's commitment to safety

8. Emergency Preparedness and Response

Operators shall maintain procedures for responding to and mitigating a pipeline incident and communicate said procedures to all employees.

These procedures should be based on the applicable laws and regulations as well as the objectives and policies of the organization's PSMS. The procedures shall include, among others, communication plans, training and drills including involvement of external agencies and organizations, protection processes relating to safety, health, and the environment,

Sample Strategies to Accomplish PSMS Objectives

Communicate emergency procedures to the response team, command center, IT, legal, HR, supply chain, contractors, local emergency responders, government agencies, and others deemed necessary

Regularly execute mock emergency drills. Consider including local

processes for lessons learned and improvement, and plans for periodic review and update of response procedures.

responding units. Notify the public of what to do in case of a safety hazard

9. Competence, Awareness, and Training

The PSMS outlined in this booklet works effectively only if the personnel are educated, trained, and experienced enough to safely and correctly implement its procedures. Operators must therefore ensure that their employees are competent in the applicable elements of the PSMS for their position. Further, operators must educate employees on newly emerging or changing risks, opportunities to improve procedures, and consequences of failing to safely follow procedure.

Sample Strategies to Accomplish PSMS Objectives

Test competence through mock emergency drills

Hold seminars, roundtables, or team meetings

10. Documentation and Record Keeping

Operators shall maintain a record keeping system for the collection, storage, protection, retrieval, retention time, and disposition of documents relating to the PSMS. Documents must be reviewed and approved prior to issue and use and be available when needed. Example documents include statements of safety policies and objectives, procedures established in accordance with PSMS, regulatory requirements, and any other records deemed relevant to PSMS by the operator.

Sample Strategies to Accomplish PSMS Objectives

Consider minimizing the manual handling of records and maximizing automation in order to reduce human error and make files more accessible

Ensure quick and accurate document access is available. Regulations are becoming increasingly focused on thorough records.

III. Summary

A PSMS is not a rigid code, but rather a holistic approach to safety. It is not a program or procedure, but rather a framework within which existing and new programs and procedures will collaborate to enhance pipeline and worker safety.

It has ten essential elements that contribute to a strong safety culture and safe, efficient operations. Beneath each essential elements are programs that will foster improvement in that element, and beneath those programs are procedures that will fortify the respective programs. It is important to

note that much of an operator's existing operational framework may be compliant with RP 1173. For example, many operators will find that their risk management programs satisfy the stipulations of the recommended practice. It is up to the operator to perform gap analyses and determine where any deficiencies lie and then utilize the PDCA cycle to correct them. RP 1173 is designed so that this implementation can be tailored as necessary to each operator's circumstances. It is flexible and scalable and can be implemented by operators in any location and of any size.

All personnel within an organization take a role in a PSMS. Top management must demonstrate their commitment to safety culture and generate policies consistent with PSMS objectives. Management must enforce these policies and communicate recommendations for improvement to top management. Finally, employees must safely execute these policies, procedures and communicate to management any risks or incidents identified in pipeline operation.

A successful PSMS should be fluid. As technology improves, company structure changes, or regulations change, so should the operational framework associated with an operator's PSMS. It should reflect the safest way to carry out natural gas transmission and distribution given the operator's present state. Accordingly, a core principle of a successful PSMS is continuous improvement.

Analogous safety systems in other industries have been proven successful: the chemical manufacturing, maritime, aviation, and nuclear power industries have all seen decreases in incident rates while relying on safety management systems, even as business in those industries has increased. Furthermore, some operators may realize cost savings as a by-product of their improvements of more efficient and effective safety practices.

AGA members are strongly encouraged to adopt RP 1173 and implement a PSMS.

ⁱ Contractors are to be included in an operator's pipeline safety management system and are specifically, mentioned in section 6.2, Internal Stakeholder Engagement, and section 8.4 of API 1173; Use of Contractors.