OIL & GAS

Quality Management Systems Explained
Efforts by DNV GL/ PHMSA and API

Melissa Gould
03 November 2016
Agenda

- Background
  - Management Systems
  - Process Approach, Risk, and PDCA
  - Quality Management Systems (QMS)

- Why are we focused on Quality?
  - Pipeline Quality Driving Force
  - QMS in the Oil & Gas Industry
  - QMS in the Pipeline Industry

- Recent Activities on QMS for New Pipeline Construction
  - PHMSA/ DNV GL
  - API

- PHMSA Frequently Asked Questions

- Doing More with Less

- Wrap Up
Management Systems

- A management system is a **systematic framework** for managing and continually improving an organization’s policies, processes, and procedures.

- A **formal** management system is a **documented** set of interrelated and interdependent processes with a clearly defined scope.

- It is more than a set of documents: it is a **system of working** that follows the Plan-Do-Check-Act (PDCA) methodology.

---

How an organization ensures things are done properly
The Process Approach, Risk, and PDCA

- Three, interrelated concepts
  - Process approach
    - Defines the organization’s processes to operate as an integrated and complete system (including interactions between interrelated activities)
  - Risk-based thinking
    - Defines the extent of needed process planning and controls, based on risk
  - Plan-Do-Check-Act (PDCA)
    - Manages the processes and the system
      - **Plan**: Defines the system and process objectives
      - **Do**: Implement and control what was planned
      - **Check**: Monitor the processes/results against requirements
      - **Act**: Improve the performance of the processes
Quality Management Systems (QMS)

- A QMS is the **documented set of processes and procedures** required for planning, executing, and continually improving the ability of a process, activity, or product to **meet defined requirements**.

- A properly developed and implemented QMS should:
  - **Document** all requirements in appropriate locations;
  - Confirm employees and contractors receive applicable **training**;
  - **Define** processes, procedures, and activities needed to meet quality requirements;
  - Require proper and timely **communication** between interrelated processes, procedures, and activities;
  - Produce evidence the quality **requirements are met**;
  - **Measure, monitor, and analyze** changes to the requirements;
  - **Audit** and analyze system processes and outcomes; and
  - **Continuously Improve** quality.
Why are we Focused on Quality?
Pipeline Quality Driving Force

- The US pipeline construction industry has experienced unparalleled growth since 2007
  - Increased construction inspections by PHMSA

- Pipeline construction quality was identified as a source of concern
  - PHMSA inspection findings
  - Pressure test failures
  - First year in-service failures
  - Issues identified during in-line inspection or coating surveys

- PHMSA submitted a Request for Proposals (RFP) to industry to address pipeline construction quality through the development of a QMS framework
QMS in the Oil & Gas Industry

- Oil and gas industry-specific QMS standards:
  
  
  - API Specification Q1: Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry; and
  
The Uniqueness of the Pipeline Industry

- Applying current QMS standards to pipeline construction is challenging:
  - Each pipeline construction project is unique.
  - A risk-based and process-based approach allows a QMS to manage the individual quality concerns for each pipeline construction project.

Diagram:
- Long-term Integrity
- Safety
- Consistency
Industry Response Timeline

25-Mar-09
INGAA - Building Better Natural Gas Pipelines Workshop, Houston

21-May-09
PHMSA Advisory Bulletin - Low and Variable Strength Line Pipe

20-Apr-10
PHMSA - Distribution Construction Workshop, St. Louis

31-Jul-14
INGAA – Practical Implementation of a Construction QMS

19-Aug-13
PHMSA QMS – Proposals Due

1-Oct-15
PHMSA QMS – Web De-Brief

1-Oct-13
PHMSA QMS – Contract Awarded to DNV GL

31-Aug-15
PHMSA QMS – Final Report Public

End of 2014
API - C-QMS Task Group Formed (First meeting – 20-Jan-15)

2007
Construction Boom

24-Mar-10
PHMSA Advisory Bulletin - Girth Weld Quality Issues

1-May-12
INGAA – Overview of QMS for Pipeline Construction

15-Sep-16
API RP 1177 – First Ballot Closed
Pipeline QMS and Other Management Systems

- A pipeline construction QMS can be a component in a corporate management system, or can be integrated into a safety management system (SMS).

"8.2.2 Manufacturing and Construction
The pipeline operator shall maintain (a) quality control procedure(s) so that materials and construction are in accordance with the design and purchase specifications.”
“A QMS does not guarantee a flawless product or service without defects, but provides a framework for maximizing the delivery of the product or service.”

“Thinking of a construction project as a collection of processes is central to the success of the QMS; a benefit being the QMS provides effective organization of the processes required to produce a conforming construction project, using a capable and efficient approach. The QMS is essentially a management tool that organizes work practices, which over time will lead to continual improvements in pipeline and station construction.”
Recent Activities on QMS for Pipeline Construction

DNV GL / PHMSA

API
Recent Activities on QMS for Pipeline Construction

DNV GL / PHMSA

API
PHMSA / DNV GL Project Objectives

- Develop guidance pertaining to issues related to construction quality of a new pipeline and how these issues could be addressed through standards, specifications, and in the field;

- Develop general guidelines for a QMS for pipeline projects to provide greater assurance of consistent and acceptable quality;

- Suggest enhancements to regulations and standards to improve the overall quality of new pipelines through application of a QMS.
DNV GL Information Gathering Stage

- Literature Review

- Industry Surveys and Follow-up Interviews
  - Operating companies
  - Contractors
  - Regulators (PHMSA and NEB)
  - Industry Groups (AGA, AOPL, API, CEPA, INGAA, NAPSR, PLCA, PRCI, and PSTrust)
QMS Development

- QMS Framework
  - Intended to assist pipeline operating companies, contractors, and suppliers in the development and implementation of a company-specific QMS for pipeline construction.

- Associated Guidance Document
  - Provides the user with examples and information relevant to developing and applying a QMS
  - Framework with 115 pages of guidance information included
Project Deliverable

- Report Body
- Appendix A – QMS Framework
- Appendix B – Guidance Document

Either a stand-alone management system or the construction quality component in a company’s corporate management system

Developed for use by operating companies of varying size and scope
- Requirements are “what” not “how”
- QMS elements apply to each company, but the application should be appropriate for the size of the operator, the scope of the project, and the risk to the public and environment
Scope

Materials Procurement and Inspection
- Manufacturer and Supplier Selection
- Manufacturer Procedure Specs. (MPS)
- Inspection and Test Plans (ITP)
- Traceability
- Manufacturing and Inspection
  - Welding
  - NDT
  - Pressure Testing
  - Surveillance
- Marking and Identification
- Transportation

Construction
- Construction Specifications
- Contractor Selection
- Construction Inspections
- Construction Activities
  - Receipt and Offloading
  - Storage
  - Construction Surveying and Staking
  - Ditching
  - Stringing
  - Field Bending
  - Fusion Processes
  - Welding
  - Joining
  - NDT
  - Field Coating
  - Coating Holiday Inspection and Repairs
  - Ditch Padding
  - Lifting and Lowering In
  - Local Pipe Attachments
  - CP System and Corrosion Monitoring
  - Post-Commissioning Condition Monitoring
  - Pipe Weighting

Pre-Commissioning
- Pressure Testing
- In-Line Inspection
- Above Ground Surveys
- Excavations
- As-Built Surveying
- Backfilling
- Tie-Ins
- Special Cases
- Horizontal Direction Drill (HDD)
- Cased Crossings
- Fabrications
- Tracer Wires
- As-Built Documentation *
- Final Tie-Ins (Golden Welds) *

* Final construction activities may coincide with pre-commissioning activities.
QMS Reviews

- Multiple levels of review
  - Any quality issues or nonconformances identified should be elevated to the next level of review to be appropriately addressed.
The quality management of pipeline construction requires documentation at two levels: the **QMS level** and the **project level**.
Guidance Document

- Appendix B of the PHMSA / DNV GL Report is Appendix A with additional guidance information.
- Recommendations, suggestions, and examples that may be considered when developing the details of how to meet the requirements of the framework.

5.3.2 Control of QMS Documents

The operating company shall establish procedures for the control and dissemination of QMS documents, including:

- Identification of documents that are required for the effective implementation of the QMS;
- Identification and review of documents that require access control and/or distribution control;
- Approval of documents, including assurances of legibility and accessibility;
- Identification of the current revision of each document, including procedures for removal of obsolete/invalid documents from circulation and use; and
- Maintenance of documents, including back-up and archival of critical or obsolete documents.

Guidance

The operating company may already have a document control process/system in place for existing company document or records which can be used to manage the QMS documents.
Comprehensively address the construction deficiencies identified since 2009 and derived from the 2009 New Construction Workshop, the 2010 Distribution Workshop, and findings provided by PHMSA/NAPSR.

PHMSA RFP
QMS Framework Topics

- Responsibilities of the parties involved (owner/operator, contractor(s), and supplier(s))

- Management commitment

- Communications, documentation, and management of change of the QMS

- Resource management and training

- Project implementation

- Continuous improvement via assessment of the achievement of quality objectives during the implementation of the QMS and construction project(s)
Construction Activity Quality Plans

- Developed for each construction activity
- Refers to activity procedure and other pertinent information
- Guidance tables provided address:
  - Potential quality concerns that may be encountered during the construction activity
  - QA/QC and mitigation options that may be selected to improve the quality
  - Training and competency requirements for personnel performing the activity
  - Inspection requirements
  - Training and competency requirements for the personnel performing the inspection
  - Applicable records

“A specific quality plan shall be developed for each construction activity performed on the project...”

“Guidance
Tables are provided below for each listed construction activity which may assist the operating company and contractor, as applicable, to develop a quality plan for each construction activity. The listed information provided may not be all-inclusive for each activity.”
Construction Activity Quality Plans (cont.)

- Instead of a lengthy construction specification, each quality plan can be provided to the personnel involved in the activity
# Example – Minimum Considerations for Development of Ditching Activity Quality Plan

| Potential Quality Concerns | • Ditch profile not in compliance with company specification or pipeline map  
|                           |   ○ Depth and/or width incorrect  
|                           |   ○ Points of inflection out of alignment  
|                           |   ○ Undulating or rocky ditch bottom  
|                           |   • Spill pile improperly placed or layers improperly segregated  
|                           |   • Equipment unsuited for terrain or soil condition  
|                           |   • Flooding of ditch  
| QA/QC and Mitigation Options | • Contractor selection process used to select appropriate, competent contractor  
|                           | • Audit of contractor responsible for ditching which would include inspection of equipment and procedures  
|                           | • Review of expectations and route with ditching contractor  
|                           | • Verify ditch location as it is created  
|                           | • Consistent documentation procedures/ forms for inspections and verifications  
| Training/Competency of Personnel Performing Activities | • Able to operate ditching equipment  
|                           | • Experience with ditching activities  
|                           | • Knowledge of company specifications and procedures  
|                           | • Competence and licensure in alternative ditching methods, if applicable, such as ditch blasting  
| Inspection Requirements | • Verification of ditch location with regards to marked route  
|                           | • Verification of ditch profile (depth, width, points of inflection, and bottom condition)  
| Training/Competency of Inspection Personnel | • Understanding of company specifications  
|                           | • Ability to take required measurements  
| Records Requirements | • Daily Inspection Reports  
|                           | • Abnormalities or deviations from specifications, recorded as NCR, to be addressed prior to pipe lowering-in activities  

Ungraded
Applying the QMS

- Each project is **unique!**
  - It is the operating company’s responsibility to consider unique quality issues applicable to their projects and address them accordingly through their company-specific QMS.

- Other construction activities may be relevant and should be addressed on a project by project basis, utilizing the principles of the QMS framework.

- The quality practices of the operating company, materials suppliers, and construction contractors should all align.
Recent Activities on QMS for Pipeline Construction

DNV GL / PHMSA

API
API RP 1177 Task Group

- An American Petroleum Institute (API) task group was formed in 2015 to develop a recommended practice for pipeline construction QMS
  - API RP 1177 “Recommended Practice for Steel Pipeline Construction Quality Management Systems”
  - The PHMSA/DNV GL Report is a referenced
  - The content/format is also based on API Spec Q1 and API Spec Q2

- First ballot from August 3, 2016 through September 14, 2016

- Ballot resolution process in progress
API RP 1177 – Sneak Peek – “Organization”

- Intentionally Vague
- Defined as the entity using the RP to develop their own QMS for pipeline construction.
  - owner company
  - operating company
  - engineering and/or construction contractor
  - supplier
- When the company-specific QMS is developed, the term “organization” should be replaced with the responsible entities such as operating company, owner company, contractor, or supplier.
- Elements of this RP can be met in aggregate by the organizations constructing the pipeline.
API RP 1177 – Sneak Peek – Document Scope
API RP 1177 – Sneak Peek - PDCA

Quality Management System

- PLAN
  - Policy Leadership
  - Management Responsibility
  - Goals, Objectives, and KPIs
  - Document & Record Control
  - Change Management

- DO
  - Pipeline Construction (Sec. 5)

- CHECK
  - Audits (Sec. 6.5)
  - Monitoring, Measuring, and Metrics (Sec. 6.2)

- ACT
  - Management Review (Sec. 6.3)
  - Improvement (Sec. 6.4)

Construction Project

- PLAN
  - Risk Assessment and Management (Sec. 4.7)
  - Planning (Sec. 6.1)

- DO
  - Verification of Engineering and Design (Sec. 6.3)
  - Contract Development and Review (Sec. 5.4)
  - Procurement of Materials & Equipment (Sec. 5.5)
  - Pipeline Construction (Sec. 5.6)

- CHECK
  - Inspection (Sec. 5.7)

- ACT
  - AQP Refine Exercise
  - Legal and Organizational Requirements

Ungraded
High Level Comparison – DNV GL/PHMSA vs. API (vs. INGAA)

- **DNV GL / PHMSA**
  - Written as a standard or recommended practice
  - Driven by PHMSA
  - Includes considerations for plastic pipe

- **API RP 1177**
  - Written as a recommended practice (requirements and suggestions)
  - Consensus document
  - Limited to steel pipelines

- **INGAA’s reports provide background information and guidance on how to apply a QMS to new pipeline construction**
  - Not written as a standard or recommended practice
PHMSA Frequently Asked Questions
PHMSA Frequently Asked Questions

- Pipeline Construction FAQs
  - [https://primis.phmsa.dot.gov/construction/faqs.htm](https://primis.phmsa.dot.gov/construction/faqs.htm)
  - 24 Questions

- Intended to:
  - Provide insight into PHMSA's approach to the issues they describe
  - Facilitate understanding of the code
  - Enhance communication with all stakeholders
  - Provide information to operators concerning PHMSA's inspection approach

- Does not alter CFR or represent interpretations of the code
PHMSA FAQ #6

6. Aren’t construction procedures adequate?

PHMSA has found that the procedures for most pipeline construction projects are adequate and reflect the recommendations of consensus standards. The procedures are not always followed, though. This could be a result of inadequate training or understanding of the procedures by those who must implement them.

- A QMS sits over an organization’s procedures and other project documents
  - Provides a framework to manage the documents, processes, and activities
  - Procedures (and other documents) can be updated/improved through the continual improvement process of a QMS
PHMSA FAQ #7

7. Isn’t Quality Control supposed to find problems?

Quality Control (QC) is used on pipeline construction projects to assure that the quality of construction meets required specifications. It is an extra layer of defense beyond having adequate procedures and doing things correctly. QC can find problems, which are indicative of problems in the construction. The correct response is to identify the reasons why the construction problems are occurring and correct them. It is not acceptable to simply rely on QC to find problems as the only means of assuring quality construction.

Original: 8/7/09

- A perfect pipeline could be constructed without any QC activities
  - Appropriate plans and procedures
  - Competent personnel

- QC (inspection) helps to identify issues when they arise
18. Can better management practices help assure quality?

Yes. Application of Quality Management Systems (QMS) can help assure quality. QMS is more than QA/QC of the finished product. It includes assuring that procedures are correct, reflect the provisions of relevant standards, and are followed during construction.

- A QMS does not guarantee a perfect pipeline
  - Provides a framework to manage and control the construction processes
  - Allows for better response when issues arise
  - Provides a path for continual improvement to avoid repeat issues
Doing More with Less
Cost avoidance is a potential residual benefit of a structured QMS for a pipeline construction project, because the primary focus of the QMS is to minimize failures/rework, improve conformance to company and industry specifications and to maintain compliance with regulations.

Potential QMS Benefits (INGAA)

Potential Benefits:

- Process Improvement
- Enhanced Stakeholder Satisfaction
- Increased Efficiency

Reduced failures and rework = increased safety and reliability of the energy supply
Continual Improvement!

- System and project level:
  - Consistent documentation
    - Reduction in “reinventing the wheel”
    - Identification of improvement opportunities
  - Reduced failures and rework
    - Sharing learnings between projects
    - Identification of areas to focus resources

- Evaluation & improvement of system effectiveness
Wrap Up
Next Steps

- Review the DNV GL / PHMSA report

- Review the INGAA literature

- Keep yourself updated on the API RP 1177 Progress

- Focus on your company’s quality culture
Quality Culture

- Improvement of construction quality, requires a “quality culture” to be developed and fostered in the pipeline construction industry
  - Operating companies
  - Manufacturers
  - Suppliers
  - Contractors

- Quality should be elevated to a level equivalent to that of safety, at which time it would become acceptable and expected to stop work for a quality issue.
Summary

- Construction quality has been a focus of the pipeline industry since 2007. A proven method for improving quality in other industries is through the implementation of a QMS.

- The unique nature of pipeline construction makes the application of previously developed QMS standards difficult.
  - PHMSA / DNV GL Report
  - Upcoming API RP 1177

- Many resources are available to help in the development of a company-specific QMS.
  - Start documenting what you currently do, compare current practices against QMS requirements, and fill in the gaps.
  - Foster a quality culture.

- Upfront costs can be offset by increased efficiency, process improvement, and reduced rework and failures.