Pipeline Construction Inspection

API RECOMMENDED PRACTICE 1169
THIRD EDITION, XXX 202X

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Contents

Pipeline Construction Inspection

1 Scope

This recommended practice covers the basic requirements and their associated references needed to perform inspection activities safely and effectively during onshore pipeline construction. This recommended practice provides the details related to the role of the operator's pipeline construction inspector ("Inspector"), in terms of monitoring and inspection requirements throughout the lifecycle of the pipeline construction process. This document is written to address general inspection duties. Areas of specialty inspection are noted and are beyond the scope of this document (in-line inspection and anomaly evaluation are not included in this document's scope). This includes basic knowledge of, and where to find, detailed information related to each facet of pipeline construction inspection activities.

The scope of this document is limited to gas and liquid pipeline construction. Specifically, content is focused on those items that are relevant to the role of an Inspector as it relates to best practices within the industry in the United States and Canada. This document provides Inspectors with background and context, beyond existing regulation, regarding best practices in the industry. Whereas the content is organized in a manner consistent with construction of new facilities, where relevant, the content can also be applied to construction associated with existing facilities (e.g. maintenance-related activities).

Users of this document include pipeline Owner Companies and those individuals either engaged in pipeline construction inspection or seeking to become certified inspectors. Pipeline Owner Companies and pipeline inspection service companies may also use this document to develop their inspection processes and responsibilities for inspectors, as well as to develop and enhance their inspector training programs.

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 Standard 1104, *Welding of Pipelines and Related Facilities*

CGA [1], *Best Practices*

3 Terms, Definitions, and Abbreviations

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and Definitions

1.1.1
activity quality plan
AQP
Document(s) that establishes procedures, minimum personnel qualifications, roles and responsibilities, inspection methods, and record requirements of construction activities. The intent of an activity quality plan (AQP) is to identify quality concerns and methods of control.

[1] Common Ground Alliance, 908 King Street, Suite 330, Alexandria, VA 22314, https://commongroundalliance.com.

1.1.2
chainage
station numbers
An imaginary line used to measure distance along the centerline of a pipeline and to identify the location of objects such as fences, roads, ditches, utility crossings, etc.

1.1.3
confined space[2]
Any space that meets all three of the following requirements:

- is large enough and so configured that an employee can bodily enter and perform assigned work;
- has limited or restricted means for entry or exit;

NOTE Examples of spaces that may have limited means of entry or exit are trenches, pipes, tanks and vessels, storage bins, and vaults.

- is not designed for or meant to be continuously occupied by employees.

1.1.4
contractor
An entity that includes the primary organization and any subcontractors engaged in pipeline construction covered by this recommended practice.

1.1.5
corrective action
The action to eliminate the cause(s) of a nonconformance and prevent recurrence.

1.1.6

Direct Control

An adequate control against a life-threatening (high-energy) hazard that has all the following features:

1. The control is specifically targeted to the high-energy source
2. The control effectively mitigates exposure to the high energy source when installed, verified, and used properly (i.e., a SIF event cannot reasonably occur)
3. The control is effective even if there is unintentional human error during the work period (unrelated to the installation of the control)

1.1.7
ditch plug
Earth fill placed within a pipeline trench to block the flow of water or allow access or crossing.

1.1.8
exclusion zone
Area where access is controlled due to increased hazard.

1.1.9
heritage sites
Locations of historic or cultural significance as identified by the Operator.

[2] https://ingaa.org/cs-s-14-welding-and-grinding-safety-2/ Section 10 is a good resource on confined spaces

1.1.10
holiday
A discontinuity in a protective coating that exposes unprotected surface to the environment.

1.1.11
inspection and test plan
ITP
Written description of an inspection plan that may include evaluation methods, hold points, project-specific technical requirements, and resources, typically used in manufacturing.

1.1.12
inspector
An individual qualified to monitor, assess, evaluate, verify, discuss, decide, resolve, report, and document pipeline construction activities to establish that the requirements of the design, drawings, specifications, regulations, and industry practices are being met safely, efficiently, and in an environmentally sound manner.

NOTE There are numerous types of inspectors, such as utility, coating, welding, and chief inspectors with employment arrangements including Operator employees, inspection service company-supplied inspectors, or freelance contract inspectors (see annexes for details on other inspector classifications).

1.1.13
Line list
A document describing landowner and easement agreements and restrictions.

material test report
MTR
Documentation of a metal product's physical and chemical properties to indicate compliance with standards as a means of quality assurance.

1.1.14
nonconformance
A recurring deficiency or major deviation from regulation or Operator specification such that safety, environment, structural integrity, quality, or schedule could be impacted.

1.1.15
One Call
A system set up to establish a line of communication (e.g. typically a centralized phone system) between all parties that may be affected by any type of excavation and those who operate underground facilities to reduce injury and damage as a result of unauthorized excavations.

NOTE Refer to equivalent systems for areas outside the United States and Canada.

1.1.16
operator
Organization that owns and/or operates a pipeline.

1.1.17
permit-required confined space
A confined space that has all three of the confined space requirements and has one or more of the following four characteristics:

— contains or has the potential to contain a hazardous atmosphere;

— contains a material with the potential to engulf an entrant;

- has an internal configuration such that an entrant could become trapped or asphyxiated by inwardly converging walls or by bottoms that slope downward, tapering to smaller cross-sections;

- contains any other recognized serious safety or health hazard.

1.1.18
quality
The degree to which requirements are fulfilled by an object's inherent characteristics.

1.1.19
quality assurance
QA
Proactive, process-oriented activities, independent of production, with the goal of preventing nonconformances, including checklists and standards implementation.

1.1.20
quality control
QC
Reactive, product-oriented activities with the goal of identifying nonconformances before work is finalized. Examples of QC activities include inspection and testing.

1.1.21
quality management system
QMS
A framework of policies, processes, and procedures used by an organization to fulfill the requirements for quality.

1.1.22
right-of-way
ROW
The property in which a pipeline company and a landowner both have a legal interest, usually established through a written document known as an easement.

1.1.23
safety culture
The collective set of attitudes, values, norms, beliefs, and practices that a pipeline operator's employees and contractor personnel share with respect to risk and safety.

1.1.23

Site Specific Safety Plan (SSSP)

A tool that documents how the employer/contractor plans to control exposure to risk at a specific site

1.1.24
strength test (high pressure test)
A test is used to establish the operating pressure limit of a pipeline segment. Typically, the test pressure ratio is 1.25 and the duration is 4 hours or longer, but these values may differ depending on applicable codes and/or regulations.

1.1.25
test bus
A mobile bus or trailer that is used to maintain equipment and examinations for hydrostatic testing.

1.1.26
tolerance zone

The space in which a line or facility is located and where construction activities are limited or prohibited.

NOTE Jurisdictions often define tolerance zones.

3.2 Abbreviations

ALARA	as low as reasonably achievable
AQP	activity quality plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
FWPCA	Federal Water Pollution Control Act, also known as the Clean Water Act
HAZCOM	hazard communication
HAZMAT	hazardous material
HDD	horizontal directional drilling
HVAC	high-voltage alternating current
GIS	geographic information system
GPS	global positioning system
IDLH	immediately dangerous to life and health
ITP	inspection and test plan
JSA	job safety analysis
LEL	lower explosive limit
LFL	lower flammable limit
LPG	liquefied petroleum gas
LOTO	lockout/tagout
MAOP	maximum allowable operating pressure
MARSEC	Maritime Security
MAWP	maximum allowable working pressure
MOC	management of change
MTR	mill test report
NDE	nondestructive examination
NDT	nondestructive testing
NORM	naturally occurring radioactive material
NPDES	National Pollutant Discharge Elimination System

OPP over pressure protection

OQ operator qualification

OSHA Occupational Safety and Health Administration

PE professional engineer

PEL permissible exposure limit

PPE personal protective equipment

QA quality assurance

QC quality control

QMS quality management system

RCRA Resource Conservation and Recovery Act

ROW right-of-way

SCBA self-contained breathing apparatus

SDS safety data sheet

SWP3 stormwater pollution prevention plan

TWIC Transportation Worker Identification Credential

TWS temporary workspace

4 Pipeline Construction Inspector—Foundational Information

4.1 General

The items covered in this section are those that are relevant through all phases of the pipeline construction process. Any specific content in other sections of this publication is intended to be used in conjunction with the information provided within this section. Beyond the foundational information, material in Annex A is aligned to the typical construction process as shown in Figure 1.

The Inspector acts as the Operator's authorized representative, observes the Contractor's progress, and monitors all activities in their assigned areas in accordance with codes and standards; regulatory requirements; Operator safety and environmental requirements, drawings, plans, and specifications; and the terms of the construction contract or agreement. An Inspector may also be asked to assist other specialized Inspectors (e.g. Welding Inspector), as directed.

In addition to executing specific responsibilities in the following sections, the Inspector has key responsibilities in the main areas identified in Table 1 with additional detail provided in the corresponding section.

Table 1—Main Areas of Inspector Roles and Responsibilities

Topic Area	Section Number
Authority	4.2
Code of conduct	4.3
Worker, site, and construction safety	4.4

Topic Area	Section Number
Quality, deficiencies, and nonconformance procedures	4.5
Environmental considerations	4.6
Execution of work	4.7
Administration of contractual obligations	4.8
Records management	4.9
Personnel qualifications and certifications	4.10
Equipment calibration	4.11
Incident reporting	4.12

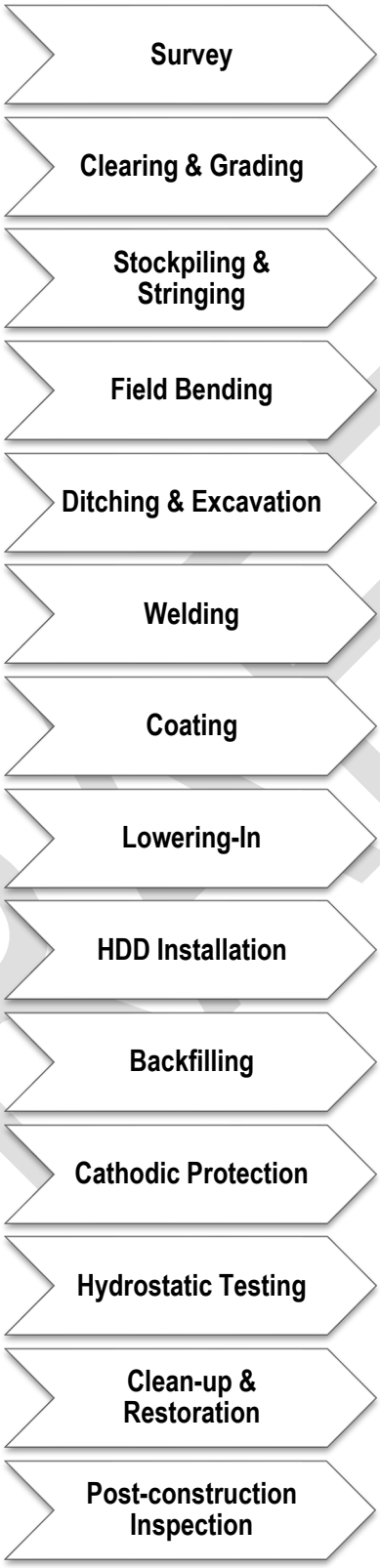


Figure 1—Typical Pipeline Construction Phases

4.2 Authority

4.2.1 General

The Inspector onsite is part of a larger project team; the Inspector should understand their role within the established chain of command and recognize situations that may need to be escalated. This is important for inspection activities and becomes particularly important in the handling of deficiencies/ nonconformances discussed later in this section. In particular:

- Roles of the Contractor and Inspector should be established before performing the tests or measurements to determine whether the work or an item complies with specifications and permit requirements.
- The Inspector should be clear about the level of witnessing required and make sure that the equipment and instruments used by the Contractor are correct and properly calibrated. E.g. Activity Quality Plan
- The Operator should make the Contractor aware of the Inspector's duties and authority (as defined in 4.2) outlining quality, deficiencies, and nonconformance procedures.

4.2.2 Authority to Stop Work

Inspectors are empowered and expected to immediately stop and correct any non-compliant or unsafe activities based on, but not limited to, conditions, situations, or activities that have occurred, are occurring, or may occur that could result in:

- imminent danger to any person;
- imminent danger to property or the environment;
- substandard quality or work techniques that do not meet Operator specifications;
- unanticipated discovery of environmental, cultural, or historical items.

4.3 Code of Conduct

As the Inspector represents the Operator, they should always act ethically, professionally, objectively, consistently, and honestly when performing the required roles and responsibilities. Owner Companies should inform Inspectors of their policies regarding ethics and behavior and understand the consequences of taking part in any activity that would not withstand the scrutiny of Operator management or other observers due to the appearance of the activity. These activities include offers of gifts, entertainment, trips, excursions, etc., offered by contractors, vendors, or suppliers.

The ethical conduct required from Inspectors is governed by the Operator's Code of Conduct, which can include (but is not limited to) the items identified in Table 2.

Table 2—Typical Code of Conduct Considerations

✓	Description
Behaving in an Ethical Manner	
	— Abide by confidentiality agreements (i.e. all information, data, and knowledge of the affairs of the Operator acquired during the performance of work shall be kept confidential and shall not be disclosed to third parties, including social media, without prior written consent from the Operator)
	— Avoid and disclose potential conflicts of interest to employers and clients, such as familial, business, and personal relationships
	— Not accepting gratuities of any kind that may be perceived to affect judgment in the work being performed as an Inspector; if gratuities are offered, this information should be reported to the Operator
	— Endeavor to be fair, reasonable, and objective toward performing work requirements always
	— Do not make assumptions; consult with the Operator if there are uncertainties in the requirements
	— Accept or reject the work performed by the Contractor based on the quality of the work
	— Comply with all relevant codes, standards, systems, permits, contracts, agreements, specifications, procedures, approved drawings, and line lists
	— Document all deviations and when required, escalate in an appropriate manner for approval
	— Notify employer as well as the appropriate operator resource of any ethical concerns and cooperate with investigations and resolution processes
	— Perform duties only within your job scope as directed by the Operator
Professional Approach to Work	
	— Be knowledgeable of the relevant parts of the construction process
	— Be knowledgeable of Operator's standards and specifications
	— Be knowledgeable of relevant industry and government standards
	— Confirm that all applicable permits required to execute the work are in place and onsite prior to commencing the work
	— Uphold Operator's industry practices regarding safety to minimize risk and avoid hazards in the workplace
	— Comply with construction timelines and be knowledgeable of the construction schedule
	— Engage other stakeholders in the construction process, as required
	— Make accurate decisions by being well informed and familiar with all contract documents and design requirements
	— Arrive onsite before the Contractor's crew and remain until after the crew leaves the site for the day, if appropriate
	— Take breaks when the Contractor's crew takes breaks and remain onsite during construction activities that require inspection
	— Obtain current version of all applicable documents before start of inspection
	— If questions arise that cannot be answered, seek those that have the authority to resolve — For conflicts needing resolution, communicate with appropriate operator representative
	— Be proactive in problem solving and raise issues/concerns to the attention of the Operator
	— Inspectors are not to perform contractor construction tasks
Positive Image in Representation of Operator	
	— Behave in a courteous and professional manner to all stakeholders
	— Conduct oneself in a respectable manner during off-time hours
	— Show respect through good driving habits on the right-of-way (ROW) or public roads
	— Check the work area for good housekeeping and tidiness (e.g. equipment and consumables should be correctly handled, stored, and maintained)

4.4 Worker, Site, and Construction Safety

4.4.1 General

One of the key roles of the Inspector is to assist the Operator in ensuring a safe work environment both for its workers as well as the public. The topics in this section should be used to establish the Inspector's knowledge and awareness of hazards inherent to pipeline construction, as well as the safety regulations, industry practices, and responses needed to address these hazards. Inspectors and all personnel are responsible for their personal safety and share responsibility for those personnel around them. Attentiveness, caution, and hazard awareness should be a continuous and integral part of each Inspector's behavior. All onsite Inspectors have "stop work" authority per 4.2.2.

High Energy hazards, often referred to as HE Hazards, are dangers in pipeline construction that can lead to severe safety incidents. Identifying and controlling these hazards is crucial to keep all workers safe from the most hazardous aspects of their jobs. The Inspector should be aware of the high energy hazards associated with the work being performed on the project and verify that appropriate controls are in place to prevent incidents. See EEI Safety Classification and Learning Model.

In addition to safety items detailed in the following sections, the Inspector should keep in mind the overall safety culture (see "safety culture" definition in 3.1.22) as well as the items identified in Table 3.

Table 3—Typical Safety Considerations

✓	Description
General	
	Confirm roles and responsibilities with respect to safety in the execution of the work for each member of the activity crew
	Actively participate in safety meetings
	Confirm and actively participate in safety meetings prior to commencing sensitive work (e.g. tie-ins, excavations requiring shoring, line evacuation, hot cuts)
	Be aware of changes in work activities or site conditions that were not identified in the daily tailgate meeting or job safety analysis (JSA) along with any changes to precautions that need to be taken as a result of these changes
	Promote a safe working environment of continuous improvement through communications of project issues and solutions
	Confirm that any required emergency medical services are in place
	Inspect and monitor safety practices and monitor conformance to project Health and Safety standards and plans
	Monitor for compliance to safety regulations
	Monitor for compliance to manufacturer's requirements (e.g. for specific work activities and materials used), where applicable
	Confirm that emergency/after-hours contact information is posted in site offices and provided to active Contractors
	Monitor for compliance to personal protective equipment (PPE) requirements
	Confirm that "safety zones" (i.e. fenced or otherwise marked areas based on the specifics of the project) are in place and maintained at known hazardous locations
	Confirm that site personnel have access to key safety documents such as safety data sheets (SDS), emergency procedures, and first aid procedures
	Be aware of any hazardous materials (HAZMAT) and associated SDS, including location, handling, and additional requirements (e.g. Emergency and First Aid procedures)
	Be aware of, and identify, any specific and necessary precautions for new and/or short-service employees

✓	Description
Safety Audits	
	Participate in Project Site-Specific Safety Audits, as required
	Communicate project Safety Site Audit results and Corrective Action Plans, as applicable

High Energy Hazards and Controls Inventory – Hazards Common to All Phases

High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
Motor vehicle incident (occupant) over 30 mph	*9*	*Rollover frame, seatbelt restraint, airbag*	*Posted Speed limits*		
On-ROW vehicular accidents (e.g. ATV's) under 30 mph	*9*	*Rollover frame, seatbelt restraint*	*Posted Speed limits*		
Working on foot near bell holes	*8*	*None*	*Exclusion zone with caution tape*		*Direct control typically used for working in pedestrian and traffic areas*
Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*
Contacting existing electrical lines (below ground)	*6*	*De-energization/ schedule & verify utility outage*	*Daylighting, Locates, hydro-vac, exposing, potholing*		*Sometimes a concrete pipe/sleeve is used to protect underground electrical lines. checking existing utility plans*
Fire with sustained fuel source	*11*	*Vehicle and equipment bonding, Automatic fire suppression system & Fire detection and alarm systems*	*Portable fire extinguishers, Emergency response plans and training, Fire-resistant clothing*		

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure 2- The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Hazard Common to All Phases

In support of a safe work environment, the Operator's safety policies typically include (but are not limited to) those identified in Table 4.

Table 4—List of Typical Operator Safety Policies/Practices/Procedures

✓	Description
	H_2S Safety
	Working Alone Policy
	Fall Protection Practice
	Restricted Work Areas Policy
	Confined Space Entry Practice
	Hearing Conservation Practice
	Manual Lifting and Carrying Practice
	Lockout/tagout (LOTO) Procedure
	Vehicle and Equipment Safety Practice
	Drug and Alcohol Policy
	Job Safety Analysis (JSA)
	Short-service Employee Policy
	Fatigue Management Plan
	Incident Reporting Policy, including for Near Misses
	Other Operator- or project-specific requirements, as applicable

4.4.2 Job Safety Analysis

4.4.2.1 General

Job safety analysis (JSA) shall be conducted per Operator and Contractor requirements, and inspectors shall participate. This analysis determines potential hazards and the plans and mitigative measures needed to address these hazards. Pipeline Operator documents supplement these safety awareness concepts.

The practice of analyzing and planning hazardous jobs, use of written procedures or permits, job review and discussion among key personnel, and walk-through inspections make personnel aware of potential hazards and the precautions needed to address them.

A new JSA should be conducted if conditions change, additional hazards are identified, or there is a change to the project scope.

NOTE Alternative terms for similar concepts include "authority to work" and "job hazard analysis."

4.4.2.2 Hazard Recognition

Inspectors should evaluate the following areas to avoid incidents and raise awareness of hazards.

a) Job site—Job site incidents, including, but not limited to, slips, trips and falls, pinch points, elevated work surfaces, excavations, steep slopes, planned lifts, atmospheric conditions, etc.

b) Environmental—Changing environmental conditions, such as flooding, wind, dust, fires, and other potential conditions that could affect personnel and their work performance.

c) Site-specific hazards—Physical features, such as terrain, waterway crossings, utilities (including overhead powerlines), general ROW conditions, and other features the pipeline construction activities will encounter as they traverse the selected route.

d) Climatic and other work condition hazards—The impact of adverse conditions, such as extremely hot weather (which could cause heat exhaustion and heat stroke) and cold weather (frostbite, hypothermia, encumbrance from extra clothing, etc.) on personnel.

e) Materials and material handling—Materials, including, but not limited to, their use, movement, and handling within the job site to consider adverse exposure and potential handling incidents. This may include, but not be limited to, pipe, valves, fittings, equipment, and hazardous materials (HAZMAT). Use of safety data sheets (SDS) should be included along with hazard communication (HAZCOM) principles to inform workers of potential hazards and protective measures to be followed. Also, be aware of HAZMAT exposed during work activities.

f) Work task review—An overall review of all major tasks to be performed since most construction activities involve moving equipment and lifting and carrying heavy loads in the proximity of personnel, trenches, holes, welding, metal sparks, and other hazardous activities.

g) Emergency conditions—Preparation for response to safety-related incidents. Inspectors should be familiar with the emergency response plan, including, but not limited to, emergency phone numbers and locations of response equipment, such as water, fire extinguishers, first aid supplies, etc.

4.4.2.3 Contractor Requirements

Inspectors should be familiar with the contract provisions regarding contractor(s) and their safety procedures and Operator expectations. The Contractor should be monitored for adherence to their internal requirements, as well as project-specific requirements.

4.4.3 Loss Prevention

Inspectors should have a basic knowledge of general loss prevention systems and may require additional training in Operator-specific processes. Inspectors should be familiar with these systems, which are designed to aid in observation, analysis, and reporting of occurrences or actions that could harm or damage property, equipment, or materials.

4.4.4 Occupational Safety

4.4.4.1 Safety Meetings

Inspectors should be capable of organizing and conducting safety meetings, prior to beginning work, to cover such topics as potential hazards likely to be encountered, precautions necessary to lessen their threat, use of personal protective equipment (PPE), lessons learned, near misses, and other topics relevant to the safety of workers, the general public, the inspection team, and potential property damage.

Inspectors should actively participate in all levels of safety planning in which they are engaged. Inspectors should actively participate in all safety meetings.

4.4.4.2 Personal Protective Equipment

JSAs identify hazards that necessitate the use of PPE. PPE for a particular location or activity is identified for the project by the Operator, Contractor, and/or regulatory requirements (i.e. the more stringent of the requirements). PPE is to be worn by all individuals (e.g. company personnel, contractor employees, agency personnel, or visitors) during and near all construction-related activities.

Inspectors shall be knowledgeable about PPE requirements, uses, and limitations. PPE for pipeline construction activities includes, but is not limited to, approved equipment detailed in Table 5 and is project

specific based on the anticipated hazards (i.e. JSA per Section 4.4.2). Inspectors are expected to intervene when personnel are not wearing appropriate PPE as identified in Table 5.

PPE shall comply with an appropriate manufacturing standard. PPE is marked with the name or number of that standard so it can be readily identified by its users or an inspector. Users shall select PPE which can be easily identified to comply with the applicable standard for that equipment. If an inspector suspects that PPE is either not being used appropriately or is not made to an appropriate standard, they shall stop the activity and ensure that corrective actions are taken before work recommences.

Never use PPE which is defective or damaged. If PPE is non-compliant, defective, or damaged, dispose of it or destroy it and replace it immediately.

Table 5—Typical Examples of Personal Protective Equipment

✓	Description
Eye and Face Protection[3]	
	Safety glasses
	Safety glasses with rigid side shields, goggles, face shields, and welding goggles and hoods
Head Protection[4]	
	Approved hard hats (generally required when injury could occur from impact or electrical shock; normally worn always)
Foot Protection	
	Boots or shoes of leather or leather-type construction that cover the entire foot along with safety toes (normally worn always)[5]
Hand Protection	
	Approved gloves (task dependent)
Hearing Protection (based on noise level survey)	
	Ear plugs
	Ear covers with suitable noise reduction factors
Safety Apparel	
	Long pants and shirts with sleeves extending over the shoulders
	High visibility vest or other outer most high visibility clothing

[3] Eye and face protection equipment should comply with ANSI Z87.1 or CSA Z94.3-M9 or equivalent standards.
[4] Hard hats should comply with current ANSI Z89.1 and/or CSA Z94-1-052 or an equivalent standard, unless an activity-specific hard hat is more appropriate.
[5] Foot protection equipment should comply with ASTM F2412-05, ASTM F2413-05 (compression and impact ratings I/C 75), CSA Z195-09 or equivalent standards.
6 When performing welding or cutting activities use suitable materials to minimize skin burns see ANSI Z49.1

✓	Description
	Fire retardant clothing
	Chemical resistant suits
	Leather for metal spark protection
Respiratory Protection (may require specific training)	
	Dust masks
	Air-purifying respirators
	Air-supplied respirators
	Self-contained breathing apparatus (SCBA) respirators
	Personal gas monitors

Certain situations that require specialized PPE beyond the typical items listed in Table 5 include:

- confined space entry (refer to 4.4.5.7);
- working over water (e.g. life jacket, buoyancy device, safety net);
- elevated conditions (e.g. fall protection system).

4.4.4.3 Vehicle Operation

Inspectors operate various types of vehicles off and on the pipeline ROW, including vehicles that may be company owned, rented/leased, or personal vehicles. Inspectors should be aware of Operator policies and procedures governing the use of vehicles and be licensed appropriately. Inspectors should be able to identify vehicles that may not be suitable for operation and are driven with due care and attention and according to the conditions of the road and weather.

4.4.4.4 Fatigue and Fitness for Duty

Inspectors should be able to recognize when personnel appear either physically or mentally unfit to perform work and other activities associated with work, including driving. Operators should communicate fatigue management plans with inspectors and contractors so that all personnel are operating at full capacity.

4.4.4.5 Near Misses

Inspectors should be familiar with near-miss programs, which formalize observation, analysis, reporting, and communication of occurrences that had the potential to, but did not, lead to injury or damage. These programs can improve awareness and avoid future reoccurrences. Near misses should be discussed and communicated with relevant personnel and documented per the Operator's and contractor's policies.

4.4.5 Site and Construction Safety

4.4.5.1 One Call

One Call is an excavation notification system set up to coordinate excavators' activities with utility Owner Companies to prevent damage to underground facilities. Inspectors should be knowledgeable of these systems and know the appropriate One Call contact information for the area of pipeline construction activity. Inspectors should confirm that the contractor has the current One Call ticket number and has cleared or marked the area with the pipeline and utilities.

NOTE One Call applies only in the United States and Canada.

4.4.5.2 Site Security

Inspectors should have knowledge of the measures needed for public and worker safety as well as safeguards for equipment, property, and materials such as the following:

- procedures for site security and other safekeeping procedures, including use of surveillance and monitoring devices, security personnel, barriers, locking devices/systems, fencing, and other methods to deny access to materials, supplies, and equipment;
- traffic control, barrier, and marking procedures;
- familiarity with and requirements for Transportation Worker Identification Credential (TWIC) and Maritime Security (MARSEC); this is only necessary when working in facilities covered by these requirements; Owner Companies should provide training on the pertinent requirements;
- inspectors are responsible for recognizing and reporting security concerns to the operator, including but not limited to:

1) terrorist threats;
2) threats of sabotage;
3) threats of violence, including workplace violence;
4) labor disruptions, protests, or work stoppages.

4.4.5.3 Isolation of Hazardous Energy Sources

Inspectors should be aware of when and how electrical, mechanical equipment, or pressure in the system is de-energized and isolated to prevent unexpected start-up or release of stored energy that may cause a hazard. This should include systems requiring lockout/tagout (LOTO) or Operator equivalent practices for electrical hazards.

LOTO processes are also in place for equipment owners (e.g. contractors) working on heavy equipment. Regardless of the specific equipment, the fundamental principle of LOTO processes is to confirm that all individuals involved with a piece of equipment install a lock on the system. This lock is only removed by the individual responsible for installing the lock once their scope of work is complete. This provides an inherently safe system in that the system is not energized or put into service until all work is complete.

4.4.5.4 Safe Use of Tools

Inspectors should monitor the following for both safety and job efficiency purposes.

Pipeline construction requires many kinds of tools, from hand tools to various power tools (electric and pneumatic), and numerous hazards exist.

Key factors for avoiding these hazards include:

- use of the right tool for the job;
- use of tools in good condition;
- correct use of the tool;
- use of safety features such as guards and welding hoods;
- proper use of PPE by personnel as per 4.4.4.2.

4.4.5.5 Safe Use of Equipment

Inspectors should monitor the condition and operation of work equipment. Work equipment from large trucks and tracked dozers/side booms to trenching equipment and other machinery may be used from one end of the job site (spread) to the other.

Safety considerations include:

- employee qualification by training or experience to operate equipment or machinery;
- personnel actions and ability to smoothly and properly operate the assigned machine (i.e. an indication of the level of training, operating proficiency, awareness of surroundings, and ability to follow hand signals and safety rules);
- equipment condition, maintenance level, and protective equipment in place;
- a complete safety inspection is required prior to operating equipment/machinery;
- correct equipment and operation for the job (e.g. lifting capacity, boom positions, stabilizer use, load limitations).

4.4.5.6 Movement, Storage, and Inspection of Tools, Equipment, and Materials

It is a contractor's responsibility to inspect and maintain their equipment. Inspectors should be aware and observant of the movement, storage, condition, and inspection of tools, equipment, and materials being used in pipeline construction work, even though these materials may be owned and used by the construction contractor.

4.4.5.7 Confined Space Entry Requirements[6]

[6] https://ingaa.org/cs-s-14-welding-and-grinding-safety-2/ Section 10 is a good rundown on this topic

Inspectors should be familiar with the confined space requirements for pipeline construction. A confined space is a space that can be bodily entered by an individual but is not designed for continuous occupancy and has a limited and restricted means of entrance or egress. Definitions for a confined space and a permitted confined space are located in Section 3. Common confined spaces on a pipeline construction site include trenches, pipes, vaults, and containment boxes.

Inspectors should be aware of specific Operator or Contractor requirements for permits and plans related to confined space entry prior to commencing work. Permit requirements for confined spaces are determined based on life critical safe work conditions. The Contractor should establish a plan for confined space entry (e.g. isolation of energy sources, required signage, means of access/egress), which is submitted to the Operator for review and, in some cases, approval, for use on the project. Inspectors should participate in confined space safety planning and meetings.

Inspectors should also be aware that confined spaces may contain an atmosphere that is hazardous (toxic, explosive, oxygen deficient, or otherwise harmful to personnel). Common activities within permitted confined spaces include welding, grinding, abrasive blasting, coating, heating, and NDE.

Inspectors should be aware that permits are required for confined space entry when either a hazardous atmosphere exists, it contains material where an occupant could be engulfed, or is configured where an occupant could be trapped.

Inspectors should confirm that a plan is in place to undertake a rescue from a confined space. This includes the required equipment, administration of first aid, and how to get medical treatment from a competent individual, if needed.

4.4.5.8 Atmospheric Testing

Inspectors should be knowledgeable about conditions that may require atmospheric testing. Atmospheric testing, particularly in cases involving confined spaces, hot work, and work in hazardous areas, is required to evaluate the hazards of a workspace. A hazardous atmosphere means an atmosphere that may be immediately dangerous to life and health (IDLH) or exceeds permissible exposure limits (PELs). Inspectors should also be aware of the time-weighted average exposure breathing hazards. Conditions that may require testing are included in Table 6.

Table 6—Potential Conditions for Atmospheric Testing

✓	Description
	Flammable gas, vapor, mist, or dust in excess of lower flammable limit (LFL)
	Hydrocarbon gas in excess of permissible lower explosive limit (LEL)
	Oxygen deficient/excess environments where oxygen levels are immediately dangerous to life and health (IDLH)
	Other atmospheric conditions or concentrations of toxic contaminants that may be IDLH, such as H_2S and benzene

All equipment used for atmospheric testing shall be calibrated and operationally checked prior to use according to manufacturer's specifications. The atmospheric tests and operational checks that precede the issuing of a permit should be as close as practical to the time the work is to begin and recorded on the entry permit.

Oxygen shall be no less than 19.5 percent and no greater than 22 percent before entry. The oxygen level shall be measured before the flammability test is conducted.

Entry shall not be allowed if lower explosive limit (LEL) is greater than 10 percent unless the confined space has been rendered inert. See 10.4 above.

Where atmospheric testing is relevant, Inspectors should be knowledgeable about the facets of atmospheric testing in Table 7.

Table 7—Facets of Atmospheric Testing

✓	Description
	Be aware of products and materials present on the job site that could be exposed during work activities and create hazards to personnel safety, for example: • Flammable liquids, including gasoline, diesel, or refined products • Gaseous products including natural gas, carbon dioxide, or propane • Products transported by an adjacent pipeline • Exhaust gases from equipment
	Be aware of physical properties of toxins (e.g. lighter/heavier than air) and permissible exposure limits (PELs), including use of safety data sheets (SDS) information
	Measurement and monitoring techniques for atmospheric testing
	Use of testing equipment and procedures to calibrate testing equipment, including calibration frequency and verification
	Precautionary measures to be taken (i.e. considering the findings from testing and monitoring) both prior to entry into, or work within, a hazardous atmosphere

4.4.5.9 Hot Work[7]

Hot work is any task where the potential for a fire hazard is heightened (i.e. the presence of an ignition source as well as readily combustible material), requiring a permit prior to performing the work. Examples of hot work include, but are not limited to, welding, grinding, torch heating, and oxyacetylene cutting.

[7] INGAA Foundation CS-S-14 Welding and Grinding Safety is a good reference for this… include?

Inspectors should confirm who has the authority to issue a hot work permit for each location/ phase of work. Inspectors should be aware of hot work being performed on site, when permits are required, and potential mitigation measures associated with hot work. Inspectors should verify compliance with the hot work permit. Hot work performed on or around existing assets may require the use of lockout/tagout procedures. See Section 4.4.5.3 for further details on LOTO.

See API RP 2009, *Safe Welding, Cutting and Hot Work Practices in the Petroleum and Petrochemical Industries*, or ANSI Z49.1-2001: *Safety in Welding and Cutting*, for further discussion of hot work.

4.4.5.10 Fall Prevention and Protective Systems[8]

Pipeline construction work sites commonly have fall and tripping hazards primarily due to extensive excavations, rugged and varied terrain features, and the constant movement of the work. Inspectors should be aware of Operator requirements addressing these hazards.

Inspectors should observe, recognize, assess, and intervene based on:

- the nature and extent of fall hazards;
- fall protective systems such as barricades and guardrails, safety nets, fall prevention markers, limitations on access, and other protection systems in place (e.g. personal fall arrest systems) as well as construction personnel awareness of potential fall hazards;
- general housekeeping within the work area and adequacy of work site illumination to minimize fall and tripping hazards.

4.4.5.11 Scaffolding and Ladders

Scaffolding and ladders are occasionally used in pipeline construction. Inspectors should be familiar with scaffolding requirements, how it is to be used safely (e.g. scaffolds should be inspected before each shift), and proper erection, moving, dismantling, or alteration by competent/qualified scaffold erectors. Inspectors should be aware of Operator and Contractor requirements covering safe use of scaffolding.

Inspectors should be familiar with safe ladder use and ensure that the proper equipment is used for the work situation. Inspectors should be aware of Operator and Contractor requirements regarding safe use of ladders.

4.4.5.12 Protective Measures for Ionizing Radiation

Inspectors should be aware of valid certification and licensing requirements for nondestructive testing (NDT) personnel handling radioactive sources. Inspectors should also be aware of signage and safety monitoring rules and requirements, as well as the rules and regulations for the locality that they are working in. Inspectors should verify (NDT) technicians have established and implemented proper safety protocols e.g. barriers for radiation protection.

Inspectors should be familiar with and inspect the NDT contractor's conformance with radiation exposure dosage limits, monitoring methods, precautions needed, and documentation of radiation exposure.

4.4.5.13 Protective Measures for Naturally Occurring Radioactive Material

Inspectors should be aware of Operator requirements for identification, monitoring, and mitigation of risk associated with a naturally occurring radioactive material (NORM). This includes awareness of radiation exposure dosage limits, monitoring methods, precautions needed (e.g. signage), and documentation of radiation exposure.

Typical controls that can be used as protective measures in the presence of NORM include:

- development of written NORM work plan (need for plan determined by hazard assessment, and approved work plan applies to work being performed where NORM is above the exemption limits);

[8] INGAA CS-S-6 has good material on fall protection ; https://ingaa.org/cs-s-6-guidance-for-working-at-heights-and-fall-protection/

- implementation of training (a NORM training program includes courses on NORM awareness, NORM surveying, and NORM radiation safety officer duties);
- use of engineering controls (preventing human exposure using equipment and systems, such as shielding from piping);
- minimizing exposure to be as low as reasonably achievable (ALARA) (e.g. limiting time spent near NORM, working at maximum possible distance);
- use of PPE e.g. respirators, protective suit

4.4.5.14 Transportation, Use, and Storage of Flammable and Combustible Liquids

Inspectors should observe and confirm that contractors are complying with the requirements for the way flammable and combustible liquids are being used, moved, and handled, including use of approved storage.

- Flammable liquids—Liquids having a flashpoint below 100 °F (37.8 °C) are known as Class I liquids. The most common is gasoline.
- Combustible liquids—Liquids having a flashpoint at or above 100 °F (37.8 °C) and are known as Class II liquids. The most common are diesel fuel; Class III liquids include jet fuel and motor oil.

Inspectors should know how these liquids are used, transported, and stored, which requires ongoing observation and corrective action when safety is jeopardized. Additional areas of interest for Inspectors include fueling practices, condition of equipment, containers, signs, spillage, and grounding requirements (e.g. vehicles and equipment require ground straps when work is performed near power lines due to risk of static charge).

4.4.5.15 Transportation, Handling, Labeling, Storage, and Use of Compressed Gases

Inspectors should be aware of the proper use, movement, handling, and approved storage of pressurized gases.

Typical compressed gases used in pipeline construction include oxygen and acetylene for welding/cutting operations, nitrogen for purging, liquefied petroleum gas (LPG) for heating/drying, and compressed air for pneumatic tools, grit blasting, tire inflation, painting, etc. Inspector’s knowledge of the properties of these gases aids in their safe handling, storage, and use.

All compressed gas cylinders and tanks should be properly secured and labeled when transported and stored with valve protective caps in place when cylinders are not in use. Cylinders, safety release devices, and piping should be regularly inspected to verify that the equipment and its appurtenances are in acceptable condition. For flammable compressed gas, vehicles and equipment require ground straps when work is performed near power lines due to risk of static charge.

Equipment used for nitrogen supplied from truck tanks (i.e. large cylinders) such as piping, connections, and appurtenances should be checked for compliance with design drawings and specifications, proper installation, and be periodically inspected and tested.

Compression equipment should be in serviceable condition for the service needed with operable safety devices in place. Hoses, piping, and connections should be checked for suitability for service and safe placement to prevent damage or rupture. Use of compressed air should follow established safety practices.

4.5 Quality, Deficiencies, and Nonconformance Procedures

4.5.1 General

The Inspector plays a critical role in managing the quality of work performed and materials used during pipeline construction. Work performed with an inspector present strengthens quality assurance (QA) and quality control (QC). The Inspector monitors adherence to the requirements as well as the critical elements of the Operator’s Quality Management System (QMS). Items that are typically relevant to Quality Documentation for an Inspector are listed in Table 8.

Table 8—List of Typical Operator Quality Documentation

✓	Description
	QMS Manual
	Activity Quality Plan (AQP)
	Inspection and Test Plan (ITP)
	Orientation with approved and current Operator-specific requirements, processes, procedures, contract documents, and drawings relevant to their role

Any questions that may arise regarding quality and acceptability of work, materials furnished, and services provided are decided upon by the Inspector, inspection team, and/or Operator. As the Inspector identifies any deviations, Operator-specific escalation processes shall be followed.

4.5.2 Escalation Processes

Escalation processes are often used by contractors or operators to identify nonconformances on the job site. Inspectors are expected to escalate the nonconformance notifications when safety, the environment, structural integrity, quality, or schedule could be adversely impacted and cannot be adequately addressed with resources on the job-site.

Specific escalationprocesses vary, and Inspectors should familiarize themselves accordingly. Escalation processes are typically structured as follows:

1) immediate corrective action, which may include Stop Work as per Section 4.2.2;
2) verbal warning;
3) written notification;
4) raising awareness to leadership and the Operator for corrective actions.

Inspectors are required to reject work, materials, and services that do not meet the standards, contract terms, specifications, drawings, or other requirements of the project. Decisions by the Inspector, inspection team, or the Operator regarding quality, acceptability, and materials provided are final and conclusive.

4.5.3 Personal Violations

The Inspector should observe and report individuals for personal violations. The typical examples of personal violations are included in, but not limited to, the items identified in Table 9.

Table 9—Examples of Personal Violations

Type	Description	Potential Consequence/ Outcome
Conduct	Not wearing appropriate PPE	Removal of worker from worksite
	Wearing incorrect attire (e.g. muscle shirts, shorts, or clothes made of synthetic fibres)	
	Using headphones while on duty	
	Roughhousing on the worksite	
	Not wearing seatbelts	
	Not respecting environment or historical resources	
	Being under the influence of drugs or alcohol	Permanent removal of worker from worksite
	Harassment in the workplace	
	Disregard for health, safety, and environmental procedures	
	Insubordination	
	Behaving in a manner that can cause serious harm or injury	
Worksite	Not having proper guards or shrouds	

Type	Description	Potential Consequence/ Outcome
	Not maintaining "safety zones" (i.e. fenced or otherwise marked areas based on the specifics of the project) at hazardous locations	Stopping use of or removing the vehicle or equipment from the worksite
	Nonfunctional backup alarms on tracked equipment and rubber-tired vehicles	
	Not having canopies for clear operator vision on machinery	
	Not having fire extinguishers or other required safety equipment	
	Using defective tools or inappropriate use of tools	
	Equipment leaking fluids	
	Any unsafe condition or practice, as determined by Operator or Inspection Resources	Construction shutdown
	Construction activities not compliant with applicable safety, contract, procedural, and regulatory requirements	

4.5.4 Regulatory Agency Inspections

Inspectors should follow pipeline Operator procedures in handling regulatory inspection of pipeline construction activities. These agencies have the authority to come on the job site to inspect activities and documents/records. Inspectors should be able to determine the agency involved, determine their objectives, verify credentials, and know the requirements set forth by the Operator on providing information and safe job site access to the agency conducting the inspection. All persons and visitors onsite are subject to the relevant safety and PPE requirements.

4.6 Environmental Considerations

4.6.1 General

The Operator views compliance with applicable environmental regulations as a priority and is committed to constructing project facilities in compliance with environmental permit requirements. The Operator is responsible for identifying environmental and pollution control requirements prior to initiating work activities and communicating these requirements to the Inspectors.

One individual may be assigned the role of Environmental Inspector; all parties share a responsibility for stewardship of the environment including, but not limited to, those items detailed in Table 10.

Table 10—List of Typical Environmental Activities

✓	Description
General	
	Inform and instruct all personnel of environmental concerns, special conditions, regulations, Operator specifications, and specific permit conditions applicable to the construction area and the work itself
	Maintain contact with the project lead/manager
	In case of unanticipated disturbance or damage caused by construction activities, contact the Operator and mitigate as soon as possible to restore affected areas to their original condition (to the extent possible) in a manner satisfactory to the Operator, Landowners, Land Holder, and regulatory authorities
	Report all environmental nonconformances and unexpected environmental findings (e.g. unexpected soil contamination) to the Operator
	Confirm Contractor's personnel conform to applicable environmental requirements
Air	
	Confirm that disturbance or damage to the environment is minimized (e.g. air pollution, noise pollution)
Water	
	Monitor conditions to minimize disturbance or damage to the environment (e.g. turbidity limits)
	Confirm that pump intakes are adequately protected to prevent aquatic life impacts (e.g. intake screens)

✓	Description
	Confirm that dewatering is performed in accordance with Operator procedures
	Confirm that equipment is not fueled or serviced within specified distances of water bodies
	Confirm that HAZMATs are stored away from specified distances of water bodies
	Confirm all specified vehicles have a minimum specified amount of commercial sorbent material to address spills on water
	Confirm that construction activities avoid interference with the normal flow of water in any natural or man-made watercourse (outside of permitted activities)
	Be aware of constraints to construction work due to water-based migratory species restrictions
	Be aware of procedures for handling encounters with water-based endangered species and/or their residences
	Visually monitor for water contamination (e.g. sheen appears on surface of a water body)
Land	
	Confirm that disturbance or damage to the environment is minimized (e.g. uncontrolled fires, soil erosion, habitat damage or loss)
	Confirm that construction entrances are maintained to prevent tracking mud and debris onto public roadways
	Confirm that all construction debris (e.g. rags, oil cans) and garbage are collected and disposed of to an approved facility off the ROW
	Observe for persons feeding or harassing livestock or wildlife; if observed, report incident immediately
	Report all wildlife deaths and nuisance animals
	Confirm that all specified vehicles have the required amount of commercial sorbent material to address spills on land
	Confirm that Fire Prevention and Firefighting Plans are updated, including details of monitoring, prevention, and response concerning: — ROW preparation — Manpower and equipment — Training of personnel — Emergency procedures
	Be aware of constraints to construction work due to land-based migratory species restrictions
	Be aware of procedures for handling encounters with land-based endangered species and/or their residences
	Confirm methods for establishing safety zones and associated mitigation (e.g. fences) address mechanisms for animals entering the construction area, where required
	Be aware of possible soil contamination (e.g. unusual discoloration or smell)
	Be aware that erosion control measures are installed properly and maintained

4.6.2 Permits

Operators are responsible for verifying that environmental permits have been granted prior to commencing work and transmitting permits to inspectors and contractors. Inspectors shall confirm that permit conditions are met.

Inspectors should be familiar with and knowledgeable of the types of permits applicable to the project and the governmental agencies overseeing these permits. Typical regulatory and jurisdictional permits issued or applied for by the Operator (in some cases some of these would be obtained by the Contractor) may include:

- Work Permits on Public Land;
- Work Permits on Private Land;
- Fenced Enclosure Permits;
- Encroachment Permits;
- Water Crossing Permits (including navigable waters);

— Water Use Permits.

Inspectors should be knowledgeable of Operator procedures and expectations for inspections by responsible agencies, applicable legislation, including determining the objective of the inspection, checking credentials, and knowing who should handle escorting the inspection personnel and answering their questions.

Inspectors should also be knowledgeable of permit conditions, documentation requirements, and closeout procedures, including any deadlines.

4.6.3 Site-specific Concerns

Operators conduct examinations of the job location for potential environmental concerns, which can include issues of cultural importance, endangered species, and resource use. The results of these examinations are communicated to the Inspector and the Contractor.

Contract provisions generally highlight those statutes that were considered during the project planning phase. They may be incomplete, and Inspectors should use their judgment to determine the presence or potential of hazards that were not identified to them by the Operator.

4.6.4 Cultural and Heritage Concerns

Operators should communicate local cultural and heritage concerns to the Inspector. Inspectors should be familiar with procedures regarding cultural and heritage concerns and the appropriate course of action following their identification. Various regulatory guidelines seek to avoid, minimize, or mitigate adverse effects on historic sites or properties and often set out the archeological issues relating to economic development and the resultant construction activity. Inspectors should be familiar with Operator plans related to cultural and heritage artifacts. In the case of an unanticipated discovery, construction work may be paused per 4.2.2.

NOTE In many jurisdictions, a plan for unanticipated cultural resources and human remains is required during the permitting process.

4.6.5 Environmental Contamination

Operators should communicate environmental contamination concerns to the Inspector. Inspectors should be familiar with procedures regarding environmental contamination and the appropriate course of action following its identification.

Inspectors should strive to prevent environmental contamination. In the event of an incident, Inspectors should immediately report the incident to the Operator and be aware of Operator's mitigation procedures. Inspectors should have a basic awareness of how to identify contamination and who to contact in an event of an incident. Inspectors should:

— know the procedures to obtain samples, request analytical work, and recognize, handle, and monitor contaminated substances such as soil, pipe coating, fuels, solvents, and other waste and/or contaminants;

— confirm that waste generation and disposal activities related to the pipeline project are performed in accordance with Operator expectations as well as regulatory and permit requirements;

— check the plan of action for the remediation of suspected or actual contamination; Inspectors should have knowledge of who to contact and what response, if any, the Inspector may need to take in the event of an incident;

— monitor good housekeeping practices to collect and remove waste, including those classified as hazardous, from the work site at regular intervals.

4.6.6 Use of Natural Water Sources

Inspectors should be knowledgeable of the rules governing water withdrawal from and discharges to any natural water sources for water used on the project . The environmental lead representative is responsible

for setting the standards for withdrawal and discharge. See applicable regulatory requirements and permit conditions.

- Inspectors should be knowledgeable of withdrawal and/or discharge/disposal requirements within permits and Operator procedures, including limitations on amounts of water used or discharged and the measurement of those quantities.
- Inspectors should be knowledgeable of discharge velocity, turbidity, and other restrictions, including, but not limited to, sediment and other foreign substances, control and planned treatment, filtration, or other methods needed to meet water quality provisions.
- Inspectors should be familiar with sampling methods, procedures, and protocols to comply with permit and/or regulatory provisions.

4.6.7 Erosion, Sediment, and Runoff Control on the Pipeline Right-of-Way

Inspectors should have knowledge of activities associated with pipeline construction that may impact the environment such as: excavation work, earthmoving, clearing, and other similar activities associated with pipeline construction that have the potential to impact the environment. Inspectors should be observant of these activities to avoid incidents. Inspectors should be familiar with key practices that aid in safeguarding the environment:

- the installation, uses, and maintenance of erosion, sediment, and runoff controls, such as diversion devices, silt fences, and other equipment for control of surface water;
- familiarity with environmental protection plans such as stormwater pollution prevention plans (SWP3), including federal and state plans (where construction is taking place);
- local revegetation requirements, water body bank restoration requirements, and pipeline Operator practices consistent with the needs of the ROW, landowners, and local practices should be reviewed by the inspection team.

4.6.8 Flora and Fauna Concerns

Operators should communicate flora and fauna of concern to the Inspector and Contractor. Inspectors should be familiar with procedures regarding the identification of flora and fauna of concern and the appropriate course of action following that identification.

4.6.9 Solid and Hazardous Waste Concerns

Operators should communicate solid and hazardous waste concerns to the Inspector and Contractor. Inspectors should be familiar with procedures regarding solid and hazardous waste concerns and the appropriate course of action following their identification.

4.6.10 Hazardous Materials

Inspectors should have a general understanding of the following:

- designation of HAZMAT;
- identification and listing of hazardous waste per local jurisdictional requirements;
- HAZMAT table, HAZCOM, and emergency response information.

4.7 Execution of Work

4.7.1 General

Monitoring work for conformance is critical for ensuring quality of construction that is necessary for long-term safety, environmental compliance, reliability, and integrity of the pipeline asset.

Recommended practices relevant for each phase of construction are identified in the following sections in significant detail; additional activities that the Inspector may undertake include:

- disseminate and explain Operator specifications and project-specific documentation to other Inspectors (where required); it is key that the correct version of construction drawings and specifications are utilized;
- advance planning and organization of all construction activities, including inspection, survey, and radiographic duties; materials availability; tie-ins and service disruptions; and commissioning and start-up;
- maintain lines of communication with key stakeholders as appropriate, including, but not limited to:
    1) Construction Manager/Chief Inspector (or designate);
    2) Contractors and Subcontractors;
    3) Landowners;
    4) Land Agents;
    5) Third-Party Owner Representative (where applicable);
    6) Pipeline System Operations Personnel;
    7) Project Managers and Engineers;
- follow site-specific communications protocol as defined in the project.

4.7.2 Management of Change

Management of change (MOC) is a method of controlling risks (e.g. safety, health, environmental) associated with temporary or permanent changes to factors such as design, technology, materials, equipment, physical configuration/layouts, site conditions, procedures, personnel, or organizational structure. Inspectors should understand Operator MOC requirements, including documentation, approvals, and communication of changes, and why adherence to them can prevent incidents. See API RP 1173 section 8.

4.7.3 Media Relations

Inspection personnel do not interact with representatives of newspapers, TV, or other media seeking information, unless expressly allowed to do so by the Operator. Inquiries from the media should be received in an open, honest way but referred to project management, public relations staff, or others designated by the Operator to handle these situations.

4.8 Administration of Contractual Obligations

4.8.1 General

It is part of the Inspector's role to confirm that the Contractor is carrying out construction activities/operations according to contractual obligations. The Inspector's role in the administration of contractual obligations is summarized in Table 11, and may include the need to be knowledgeable of the types of agreements and contracts issued or applied for by the Operator as detailed in Table 12.

Table 11—Inspector Role in Administration of Contractual Agreements

✓	Description
	Maintain documentation, communicate progress, and provide schedule updates per Operator requirements
	Confirm that Operator agreements [e.g. Crossing (Encroachment) agreements, third-party utilities agreements, Landowner agreements], based on the line list, are executed
	Verify, approve, and forward Contractor work items and materials daily to the Operator's authorized representative
	Perform material take-off and ascertain status of all materials

✓	Description
	Obtain approval from the Operator's authorized representative or designee prior to commencing any extra work activities
	Confirm that only the most current revision of Issued for Construction drawings, approved contract documents, and specifications are referenced for construction
	Confirm that all proposed deviations from specifications, design changes, or material substitutions are discussed and approved by the Operator's authorized representative or designee prior to proceeding with the work
	Communicate lessons learned and foster an environment of continuous improvement, including participating in post-job review meetings

Table 12—Typical Agreements/Contracts Issued or Applied for by Operator

Type	Description
Agreements	Railroad Crossing Agreements—These agreements are needed to cross any operating or abandoned railroad tracks along the proposed pipeline route
	Pipeline Crossing Agreements—These agreements are needed to cross any existing operating or abandoned underground and aboveground pipelines along the proposed pipeline route
	Utility Crossing Agreements—Needed to cross any operating or abandoned underground utilities along the proposed pipeline route
	Power Line Crossing Agreements—Needed to cross any overhead power lines along the proposed pipeline route
	Road Use Agreements—Needed to use applicable public roads during construction to access pipeline construction sites
	Road Crossing Agreements—Required to construct pipeline under public or private roads during construction along the proposed pipeline route
	Land Use Agreement—Land use type of agreements, which may include provisions for: — Pipeline Lease Agreement — Pipeline Installation Lease Agreement — Pipe Stockpile Site — Camp Site — Approved Working Hours
Contracts	Pipe Stockpiling
	Construction Survey
	Emergency Medical Service
	Clearing/Grading
	Pipeline, Facility, or Integrity construction activities
	Nondestructive examination (NDE)
	Caliper Pigging
	Fabrication
	Compaction Testing
	Trenchless Crossings
	Contracts associated with (small) miscellaneous reclamation activities

4.8.2 Road and Highway Use

Inspectors should have knowledge of permit requirements and restrictions for transportation of dangerous goods, heavy equipment, stringing trucks, and tracked equipment as to any size and weight restrictions relative to the roads and bridges being used by these types of vehicles.

4.9 Records Management

A critical element of the Inspector's role is to support Operator record keeping, which is critical to the long-term management of the pipeline. Details captured during the construction phase can be critical pieces of information when maintaining the pipeline's long-term structural integrity. While specific record keeping requirements are identified within each section, general requirements are listed in Table 13. Where record keeping is incomplete, poor, or absent, construction inspector duties shall be deemed to be incomplete.

Table 13—Typical Activities Associated with Supporting Records Management

✓	Description
General	
	Monitor for timely completion and submission of all required documentation
	Confirm that all forms, reports, and submitted data are as complete and accurate as possible
	Record all as-built information pertaining to the construction progress
	Provide information on an ongoing basis that assists in closing Contractor claims
	When Contractor deficiencies and/or nonconformances have been identified, monitor, document, and follow-up on Operator agreed-to actions until closed
	Coordinate project data collection and provide reports to the Operator's authorized representative or designee as per specific timelines
	Gather data to support a post-construction evaluation and lessons learned document
	Review base scope and schedules to actual work performed and provide feedback
	Complete production-related information on inspection forms and reports, and note: — Equipment and consumables used by the Contractor — Contractor personnel present onsite
	Confirm that Near Miss Reports are completed and submitted
	Confirm that Incident Reports are completed and submitted
	Obtain formal approval and written agreement from the Operator's authorized representative or designee prior to commencing any extra work activities
Daily	
	Complete Inspection reports (e.g. materials, workmanship, areas, survey stations inspected)
	Complete Construction Progress reports (e.g. materials, workmanship, and areas inspected)
	Review daily time sheets, where applicable (e.g. typically required on Time and Materials projects)
Weekly	
	Confirm that weekly reports identify potential progress, resource[9], and schedule issues as well as safety, environmental, and quality concerns
	Maintain, coordinate, and communicate weekly progress and schedule on constructionactivities to the Operator's authorized representative or designee
Project End	
	Prepare an end of project report if required

[9] Manpower, Equipment, and Material concerns

✓	Description
	Identify lessons learned and/or participate in sessions in support of lessons learned

4.10 Personnel Qualifications and Certifications

4.10.1 General

Confirming the qualifications of individuals allowed onsite is an important element of ensuring a safe construction operation as well ensuring that the work meets an acceptable level of quality. For example, welding operations have specific requirements for the qualification of welders and the work they undertake. These personnel qualifications/certifications are identified in the following sections where relevant and completed prior to construction unless there are onsite changes. The Inspector is typically responsible for the items in Table 14.

Table 14—Typical Activities in Support of Confirming Qualifications/Certifications

✓	Description
	Engage with supervisor to confirm specified training
	Confirm training certificates, as appropriate
	Confirm qualifications for covered tasks as appropriate
	Intervene per detailed checklists in this document where symptoms of incorrect training are manifested

Qualifications and certifications should also comply with applicable regulatory requirements. Compliance with Operator Qualification (OQ) Plans is required in the United States. Where applicable, Inspectors should use the following to facilitate their verification process for key personnel performing work on the project.

4.10.2 Operator Qualification

Inspectors should be knowledgeable of Operator's OQ (operator qualification) management processes, including, but not limited to, the verification and validation of covered tasks and span of control. The Operator is responsible for communicating the OQ requirements to the Inspector and Contractor. Inspectors should know which tasks related to their purview are covered tasks and the required documentation (e.g. inspection activities for tie-ins, application and repair of external coating, line locating, excavation of foreign utilities, backfilling a trench). Inspectors should be aware of Operator procedures related to new and/or short service employees.

4.10.3 Verification of Construction Personnel Qualifications

Assurance of certification or qualification is a necessary step in achieving proper performance and project quality objectives. Inspectors should check and verify the certifications and/or other qualification documentation of certain crucial pipeline construction personnel and technicians performing specialized work, including quality and materials examination and testing. The key areas to verify certification and qualification include, but are not limited to, those shown in Table 15.

Table 15—Key Certifications and Qualifications

✓	Description
	Welding personnel
	Heavy equipment operators
	Blasting/explosive personnel
	Excavation (competent personnel)
	Nondestructive examination (NDE)/nondestructive testing (NDT) technicians
	Coating personnel

✓	Description
	Corrosion control technicians
	Safety professionals
	Environmental specialists
	Pipeline inspectors

Pipeline regulation, code, standard, and practice references contain various provisions for use of certified, qualified, and/or competent personnel, including pipeline construction inspectors.

4.11 Equipment Calibration

Often activities during pipeline construction require specialized equipment for measurement. For example, coating holiday testing equipment (used to detect coating film discontinuities that may compromise pipe integrity) is a critical part of ensuring long-term safety of the pipeline. In these situations, the Inspector should confirm that only properly calibrated test equipment is used onsite and supporting calibration records are available. Based on the equipment, there may be daily, monthly, and/or annual calibration requirements per Manufacturer and/or Operator specifications.

The Inspector should also confirm that the Contractor's operators are properly trained and knowledgeable with application and operation techniques, their equipment, and materials as per 4.10.

4.12 Incident Reporting

Should an incident occur, the Inspector should notify and assist the Operator in conducting a formal and objective Incident Report. The Inspector should keep in mind the items identified in Table 16.

Table 16—Typical Incident Considerations

✓	Description
	Take immediate action to attend to injuries and/or contact emergency services
	Stop work as appropriate
	Immediately report all safety and environmental incidents such as: injuries, vehicle incidents, near misses, spills/releases, and any unsafe conditions
	Confirm that site evidence is preserved, pictures are taken, and documentation and witness statements are gathered and retained as soon as practical
	Participate in incident investigations as required
	If site shutdown occurs, obtain authorization from Operator when site can be returned to services

References—Foundational Information

NOTE The reference information provided in Table 17 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table 17—List of References—Foundational

Document No.	Type	Title
American Petroleum Institute (API)		
API 1104	Standard	Welding of Pipelines and Related Facilities
API 1161	Recommended Practice	Recommended Practice for Pipeline Operator Qualification (OQ)
API 1173	Recommended Practice	Pipeline Safety Management Systems

Document No.	Type	Title
API 1177	Recommended Practice	Recommended Practice for Steel Pipeline Construction Quality Management Systems

Table 17—List of References—Foundational *(continued)*

Document No.	Type	Title
American Society of Mechanical Engineers (ASME)		
ASME B31Q	Standard	Pipeline Personnel Qualification
ASME B31.4	Standard	Pipeline Transportation Systems for Liquids and Slurries
ASME B31.8	Standard	Gas Transmission and Distribution Piping Systems
Canadian Federal Regulations		
N/A	Regulation	Canadian Environmental Protection Act
N/A	Regulation	Fisheries and Oceans—Land Development Guidelines for the Protection of Aquatic Habitat
N/A	Regulation	Canada Water Act
N/A	Regulation	Migratory Birds Convention Act
N/A	Regulation	Canada Occupational Health and Safety Regulations
N/A	Regulation	Transport Canada—Transportation of Dangerous Goods Regulations
N/A	Regulation	Navigation Protection Act
N/A	Regulation	Species at Risk Act
Canadian Standards Association (CSA)		
CSA Z662	Standard	Oil and Gas Pipeline Systems
***Code of Federal Regulations* (*CFR*)**		
29 *CFR* Part 172	Regulation	Hazardous Materials Table
29 *CFR* Part 1910	Regulation	Occupational Safety and Health Standards
29 *CFR* Part 1926	Regulation	Safety and Health Regulations for Construction
33 *CFR* Part 321	Regulation	Permits for Dams and Dikes in Navigable Waters of the United States
40 *CFR* Part 300	Regulation	National Oil and Hazardous Substances Pollution Contingency Plan
49 *CFR* Part 192	Regulation	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
49 *CFR* Part 195	Regulation	Transportation of Hazardous Liquids by Pipeline
50 *CFR* Part 21	Regulation	Migratory Bird Permits
50 *CFR* Part 402	Regulation	Interagency Cooperation—Endangered Species Act of 1973, as Amended
Common Ground Alliance (CGA)		
CGA *Best Practices*	Guideline	Chapter 3, One Call Center
Federal Energy Regulatory Commission (FERC)		

18 *CFR* 380.12 (i)	Regulation	Upland Erosion Control, Revegetation, and Maintenance Plan
18 *CFR* 380.12 (d)	Regulation	Wetland and Waterbody Construction and Mitigation Procedures

Table 17—List of References—Foundational *(continued)*

Document No.	Type	Title
Interstate Natural Gas Association of America (INGAA)		
N/A	Report	Safety Every Step of the Way
INGAA Foundation		
CS-G-01	Guideline	Construction Safety & Quality Consensus Guidelines—Basic Personal Protective Equipment (PPE)
CS-H-03	Guideline	Construction Safety & Quality Consensus Guidelines—Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) Safety Guidelines
Report 2013.01	Report	Building Interstate Natural Gas Transmission Pipelines: A Primer
N/A	Report	Overview of Quality Management Systems—Principles and Practices for Pipeline Construction
CS-R-16	Guideline	Construction Safety & Quality Consensus Guidelines—Steep Slope Construction
National Energy Board (NEB)		
OPR-99	Regulation	National Energy Board Onshore Pipeline Regulations [1]
***United States Code* (*USC*)**		
16 *USC* Chapter 35	Regulation	Endangered Species
33 *USC* Chapter 9	Regulation	Protection of Navigable Waters and of Harbor and River Improvements Generally

[1] OPR-99 is the overarching Canadian regulation, but does not include specific instructions for the typical Pipeline Inspector; rather, it incorporates through reference of other documents that are directly relevant.

Annex A

(informative)

Pipeline Construction Inspector

Organization of This Annex

With an eye to practicality and ease of use, this annex is organized to reflect the typical construction process for transmission pipelines. Foundational information common to all aspects of construction is presented in Section 4, with sections specific to each phase of construction detailed in this annex. Within each section in this annex, five main headings are used consistently.

- Overview—A brief description of the specific activities in the construction phase.
- Inputs—Detailed information regarding typical information the Inspector requires.
- Execution—Detailed information regarding items the Inspector should typically watch for; for ease of use, items are typically formulated as actions using verbs such as monitor, confirm, check, etc.
- Outputs—Detailed information listing typical information the Inspector will be required to produce for the Operator (Operator has plan that identifies inspection requirements for the project).
- References—List of key relevant reference documents for those seeking additional information for each phase of construction.

“Inputs” within each section is intended to clearly identify the types of documents, specifications, and other information the Inspector would likely need to reference in that phase of construction. “Execution” within each section provides detailed checklists, often grouped by major topic, identifying items that Inspectors should monitor in that construction phase. Finally, “Outputs” within each section then articulates items that the Inspector is typically expected to produce or report on as it relates to that phase of the construction project.

A.1 Surveying

A.1.1 Overview

Surveying is an integral part of pipeline construction and refers to the installation of visual reference points and markers (e.g. stakes, pins, lath, and hubs) that will define the ROW limits and guide the construction of the pipeline and necessary appurtenances according to the Issued for Construction drawings. The references also mark the safe limits of ROW work areas.

If the area for the approved pipeline route is forested, Construction Surveyors are commonly the first to arrive to flag trees so Clearing Contractors can cut them down and establish the ROW for pipeline construction. The Inspector is the technical liaison for survey information between the Operator’s authorized representative, Survey Contractor, and other onsite Contractors.

Inspectors should be familiar with basic land surveying terminology and definitions, including:

- section, range, and township references;
- legal property descriptions;
- metes and bounds descriptions;
- fee property details;
- color coding of flagging;
- other basic Public Land Survey System information.

A.1.2 Inputs

As part of preparing for inspection during the surveying process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.2.

A.1.3 Execution

Typical items that the Inspector should monitor for during the surveying process are identified in a series of checklists as detailed in Table A.1.

Table A.1—Monitoring Requirements for Survey Inspection

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.3
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.4
Environmental Considerations	Identify specific items that should be monitored throughout surveying operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.5
General	Identify general items that should be monitored throughout the construction surveying process	Table A.6
Buried Facilities Location	Identify specific survey items that should be monitored at buried facilities locations	Table A.7
Right-of-Way (ROW)	Identify specific survey items that should be monitored for at ROW boundaries	Table A.8
Ditch Line	Identify specific survey items that should be monitored along the ditch line	Table A.9
Crossings	Identify specific survey items that should be monitored at crossing locations (e.g. roads, powerlines)	Table A.10
Appurtenances	Identify specific survey items that should be monitored at appurtenance locations	Table A.11
As-Builts	Identify specific information that should be monitored for collection in support of completing as-builts	Table A.12
Pilings	Identify specific survey items that should be monitored for piling locations	Table A.13
Caliper Pigging	Identify specific survey items that should be monitored in support of caliper pig runs	Table A.14

A.1.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for survey inspection appear in Table A.15.

A.1.5 Typical Input Requirements for Survey Inspection

Table A.2—Information Requirements for Survey Inspection

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to surveying, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Issued for Construction Drawings
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey — Landowner Agreements — Third-Party Crossing Agreements
	Permits related to: — Environmental — Road Use — Third-Party Crossing Permits
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing surveying requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes — Permafrost areas
	Other project-specific Plans, which may include: — Fire Prevention/Firefighting Plan — Survey Plans — Horizontal Directional Drilling (HDD) Plan

A.1.6 Items for Inspecting Typical Surveying Operations

Table A.3—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings (as required) — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Confirm Survey crew credentials/qualifications per Operator requirements
	Review all available drawings with Surveyors to verify no facilities or features (including existing facilities such as taps and abandoned pipelines) are overlooked in the current project drawings
	Confirm the Survey Contractor has contacted One Call
	Confirm that impacted landowners have been contacted prior to surveying and marking activities
	Verify that the Survey Party Chiefs possess a copy of the survey requirements, and have the proper materials and equipment to perform the work as per survey contract
	Confirm that Surveyor's equipment is calibrated
	Confirm that Surveyors have set up their equipment to use the Operator's naming convention

Table A.4—Safety Concerns for Surveying

✓	Description
	Confirm that Contractors are not encroaching with construction equipment into the survey work area
	Review and accept the Working Alone Policy for the Survey Contractor
	Confirm that all personnel are trained in hand tree-felling activities, including chainsaw usage
	Confirm that all personnel have certification and PPE for use of all-terrain vehicles (ATVs) and/or snowmobiles

Table A.5—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Advise the Environmental Inspector and/or the Operator's authorized representative before Construction Surveyors staking (marking of proposed pipelines, equipment, or features required for construction operations in a consistent manner) environmental and archaeological sites

Table A.6—Typical Monitoring Requirements—General

✓	Description
	Confirm that survey monuments are not impeding construction flow
	Confirm that survey proceeds in accordance with the contract requirements and Operator-provided Work Plans
	Observe and report any discovered or potential pipeline route selection deficiencies or obstacles (e.g. terrain features, landowner issues, road/railroad/waterway crossings, environmental features, cultural features, protected resources such as drinking water and proximity to occupied facilities)
	Confirm that Construction Surveyors are continually updating all construction drawings with red pens (redline drawings)
	Confirm compliance and operation solely within ROW and on approved access roads as outlined within the ROW line list and/or as directed by an authorized Land Agent
	Monitor that all legal survey monuments are not disturbed, defaced, altered, destroyed, or removed
	Confirm that damage or obliteration of any survey references is reported per Operator processes and treated as a safety concern
	Confirm that Contracted Surveyors are the only personnel re-establishing obliterated, missing, or damaged survey stakes, markings, and flagging
	Confirm that all stakes and flags remain visible for the duration or intended use
	Confirm that Construction Surveyors have clearly staked all underground facilities
	Confirm that Construction Surveyors collect all data [e.g. mill test reports (MTRs)] from pipe as well as valves/ fittings nameplates
	Confirm that Construction Surveyors have created the final survey drawings for the hydrostatic testing process
	Check that Construction Surveyors have signed and dated the final survey drawings

Table A.7—Typical Monitoring Requirements for Buried Facilities Location

✓	Description
	Confirm that the Construction Surveyor coordinated with the Operator and/or third parties with specific knowledge so that buried facilities along the ROW were located and appropriately marked
	Confirm that personnel locating buried facilities are trained in a recognized line locating program and are using accepted procedures and techniques and are qualified
	Confirm that all line locating equipment have current calibration certificates
	Confirm that Construction Surveyors identify and document any facility that is shown on drawings but cannot be located
	Confirm all buried facilities (e.g. pipelines or cables, drainage systems, and irrigation systems) have been located, identified by type (e.g. pipe diameter, pipe coating, year installed), have adequate depth of cover, and are staked accurately (showing all angular deflections) so that there is no chance of disturbing the facility during pipeline construction
	Confirm that all Third-Party pipeline, utility crossings, and centerlines of new and Third-Party pipelines are staked by Surveyors as specified in alignment sheets
	Confirm that the point of crossing between the proposed centerline of the new pipeline and the existing facility is marked with a cross lath of stakes with Operator-specific color codes showing the name of the Operator and the facility size
	Confirm that all offset requirements from engineering or crossing agreements are staked and clearly labeled
	Confirm that buffer stakes are placed at all Third-Party facilities and expected new facilities

Table A.8—Typical Monitoring Requirements for Right-of-Way

✓	Description
	Confirm that the Surveying Contractor will advise when stakes and marks need to be re-established
	Confirm that Surveyors are staking as per Operator-specific color codes and obtaining approval from the Operator's authorized representative if any additional color codes are required
	Monitor on an ongoing basis that all stakes/markers are collected by the Contractor after that section of work has been completed
	Confirm that Surveyors are staking the pipeline route, valves, and other appurtenances as shown on the drawings
	Confirm that Surveyors have correctly labeled all the stakes, and these are visible from the work side or within the work area of the ROW
	Confirm that the boundaries of the ROW or temporary workspace (TWS) are staked as per survey specifications
	Confirm that Surveyors are using frost pins or similar tools in hard or frozen ground when securing survey markers
	Confirm that taller stakes are installed in high crop areas or snow to maintain visibility, and hub staking (a means of staking that is resistant to being knocked down) is used in livestock pastures
	Confirm that watercourse crossings have the appropriate riparian zone (interface between land and a river or stream) buffers starting from the top of the bank, unless otherwise shown on drawings
	Confirm that progress stakes are placed along the edge of the ROW or TWS at specified intervals, so they are visible on the work side or within the work area
	Confirm that flagging is placed more frequently in heavier vegetated and treed areas to provide better visibility for clearing equipment operators

Table A.9—Typical Monitoring Requirements for Ditch Line

✓	Description
	Confirm that the centerline of the proposed pipeline ditch is staked at specified intervals, except at bends and crossings where the intervals should be more frequent
	Confirm that Surveyors are breaking down large angle bends at points of intersection (PI) into a series of smaller bends when the PI angle exceeds bending specifications (done so that the bends fit the ROW)
	Confirm that angles of deflection are recorded at all pipeline deflection points
	Confirm that Surveyors are using chainages/station numbers (an imaginary line used to measure distance that corresponds to the centerline of, for example, a pipeline or a fence), for example: — In Canada, use metric chainages with 3 digits and 1 decimal point (e.g. 2+145.1 = 2145.1 m) — In the United States, use imperial station numbers (e.g. 10,000 ft would be 100+00)
	Document and inform the Operator's authorized representative of any major deviations or necessary changes in chainage/station equations

Table A.10—Typical Monitoring Requirements for Crossings

✓	Description
	Confirm that activities are coordinated with the Operator as well as Third-Party Facility Owners through One Call/811 Call
	Confirm that Surveyors are measuring contour changes along the ditch line, accounting for the terrain (including crossings) to be bored or horizontally directionally drilled
	Confirm that the survey identifies locations of adjacent lines, including utilities, per the ROW established in the Horizontal Directional Drilling (HDD) Plan
	Confirm that all features and offsets of design crossings are staked according to the construction drawings
	Confirm that the staking of entry and exit points of any drill or bore, to verify the locations and respective workspaces, are marked and consistent with drawings
	Confirm that temporary benchmarks are placed on the work side of the ROW in a location of minimal disturbance, showing an elevation referenced to the crossing drawings (temporary benchmarks could be set on each side of the ROW in case of disturbance)
	Confirm that for typical crossings, all cadastral boundaries (i.e. legal land ownership limits) crossed are staked to show the relative disposition and are labeled with name of the Operator as well as pipeline type and size
	Confirm that all offset requirements from engineering or crossing agreements are staked and clearly labeled
	Confirm that Construction Surveyors for all crossing locations have completed Field Stakeout Reports containing: — Field sketches showing all buried facilities in relation to new and existing ROW boundaries — List of line locating equipment used — Names of Surveyors, date, local area conditions, and all correspondence — All visual inspection notes — All drawings referenced — Signature of Construction Survey Contractor and date on all reports

Table A.11—Typical Monitoring Requirements for Appurtenances

✓	Description
	Confirm that all appurtenances are staked showing the stop, start, and end locations
	Report any change in location, spacing, and quantity to the Operator’s authorized representative

Table A.12—Typical Monitoring Requirements for As-Builts

✓	Description
	Meet with the Surveyors daily to identify areas requiring as-built data
	Confirm that Construction Surveyors are collecting as-built data continually during construction and are not impeding the progress of the Contractor
	Confirm that once belowground as-built data have been collected, the Construction Surveyors have staked the location
	Note the start and end chainages/stations of as-built data collection

Table A.13—Typical Monitoring Requirements for Pilings

✓	Description
	Confirm that the Construction Surveyors, in conjunction with the Contractor, have identified all pilings

✓	Description
	Confirm that the Construction Surveyors, in conjunction with the Contractor, have marked all piles using iron spikes and wooden laths labeled with the pile numbers
	Confirm that the Construction Surveyors, in conjunction with the Contractor, are collecting elevation data at the pile cut-off, grade, and bottom of day-lighted (the act of uncovering and exposing buried utilities) holes referenced to the site data as shown on the Construction Plan

Table A.14—Typical Monitoring Requirements for Caliper Pigging

✓	Description
	Confirm that the Construction Surveyors have produced a complete data set containing all weld and bend information before any caliper runs
	Ask the Construction Surveyors to locate and stake any indications along the pipeline based on the caliper run results

A.1.7 Typical Outputs for Survey Inspection

Table A.15—Typical Reporting Requirements

✓	Description
General	
	Confirm that redline drawings are complete, checked, and forwarded to the Operator's authorized representative, and Others (as directed) in accordance with Survey Plan
	Report any discovered or potential pipeline route selection deficiencies or obstacles (e.g. terrain features, landowner issues, road/railroad/waterway crossings, environmental features, cultural features, protected resources such as drinking water, and proximity to occupied facilities)
Daily	
	Work completed, which can include, and is operator specific: — Start and end chainage/station number — A complete set of redline drawings identifying the as-built records for the pipeline (detailed requirements should be included in the Survey Contractor's scope) — Survey support sketches and data to explain as-built records (where required) — Survey support documentation to field RFIs (Requests for Information)

NOTE The reference information provided in Table A.16 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.16—List of References—Survey

Document No.	Type	Title
American Petroleum Institute (API)		
API 1102	Recommended Practice	Steel Pipelines Crossing Railroads and Highways
Common Ground Alliance (CGA)		
N/A	Recommended Practice	CGA *Best Practices*
INGAA Foundation		
N/A	Guideline	Guidance Documents for Construction—Natural Gas Pipeline Crossing Guidelines

Document No.	Type	Title
CS-S-8	Guideline	Construction Safety & Quality Consensus Guidelines—Overhead Utilities Safety

A.2 Clearing and Grading

A.2.1 Overview

Clearing and grading is the next phase of pipeline construction after surveying, where the pipeline ROW is prepared for the upcoming pipeline installation activities. Key steps of the clearing and grading process typically include:

— clearing (cutting, removal, or burning of all trees, brush, undergrowth, and debris from the pipeline ROW, including disposal);

— timber salvage (recovery and temporary storage of useful, merchantable timber from the ROW);

— unsalvageable timber disposal (removal or elimination onsite of nonmerchantable timber and brush by chipping, mulching, or burning);

— grubbing (removal and disposal of tree stumps and large roots from specific areas of the ROW);

— grading (flattening, sloping, benching, or other excavation to modify the terrain along the pipeline ROW to make it safe and accessible for construction);

— use of nonmerchantable timber (often called rip-rap, corduroy, and rollback) to build roads or pathways for vehicles and equipment or to create barriers for erosion control;

— frost packing (for cold weather activities);

— line location of buried utilities;

— fencing;

— stripping and storage of topsoil (for later redistribution after the pipe has been backfilled);

— in some cases, grade rock blasting, excavation, and removal may be required.

A.2.2 Inputs

As part of preparing for inspection during the clearing and grading process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.18.

A.2.3 Execution

Typical items that the Inspector should monitor for during the clearing and grading process are identified in a series of checklists as detailed in Table A.17.

Table A.17—Monitoring Requirements for Clearing and Grading

Item	Description	Reference
Prior to Commencing Work	— Confirm that key issues that have been identified are detailed and addressed	Table A.19
Safety	— Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.20
Environmental Considerations	— Identify specific items that should be monitored throughout Clearing and Grading Operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.21
Clearing	— Monitor the operations for adherence to relevant Operator- and project-specific requirements for Clearing (i.e. cutting of brush and trees)	Table A.22

Item	Description	Reference
Temporary Workspaces (TWS)	— Temporary workspaces, also known as push outs, allow for maneuvering of equipment as turnarounds or possibly temporary decking (i.e. storage) areas for salvaged timber	Table A.23
Access Road Preparation	— Existing roads are used to transport equipment and supplies to the ROW. Where no roads exist, temporary access roads are constructed and are removed after construction has been completed — It is imperative that all access roads can withstand the loads being transported and the frequency of intended use. When access roads need to be constructed and have been approved, the Inspector should confirm they are constructed as detailed by Operator- and project-specific requirements	Table A.24
Gates and Fences	— Existing structures should be altered to accommodate construction operations, and where possible, returned to its original state after construction is completed — New fencing and structures are immediately erected to contain livestock and, where possible, returned to its original state after construction is completed — Gates may be installed to allow access to pipeline facilities	Table A.25
Buried Facilities	— Existing buried facilities on a ROW (e.g. an existing pipeline) may require temporary aboveground mechanical support o Typically, earthen ramps or mats are installed before construction equipment can cross the surface to prevent undue stress/potential damage to underground facilities	Table A.26
Timber	— Incorporate items for removal, salvage, and disposal of timber and brush including considerations specific to watercourses — Landowner's crop removal requirements (e.g. Contractor may cut and remove crops from the ROW and store per conditions established between the Operator and the Landowner's requirements) — Discuss Crossing Plan with Environmental Inspector and/or the Operator's authorized representative to identify specific requirements when clearing occurs at or near a watercourse	Table A.27
Grubbing	— Grubbing frees the subsoil of stumps, roots, and debris to eliminate the possibility of damaging the pipe when the soil is placed back into the pipeline trench during backfilling	Table A.28

Table A.17—Monitoring Requirements for Clearing and Grading *(continued)*

Item	Description	Reference
Snow Berms	— Address specific considerations related to creating snow piles, primarily to prevent freezing of the pipeline trench	Table A.29
Grade Rock Blasting and Removal	— Grade rock blasting with explosives by a Third-Party Contractor may be required in cases where the rock is too hard to break by ripping; blasting operations require extra caution and awareness due to associated safety risks — All requirements as listed in the approved Blasting Plan should be monitored	Table A.30
Wetlands	— Specific considerations relating to land that is particularly sensitive to construction activity	Table A.31
Topsoil Stripping	— Topsoil stripping is where the topsoil is segregated to the depth and width as defined by Operator specifications, then the segregated amount is salvaged and stockpiled on the side of the ROW, to be spread back over the area after final grading is complete	Table A.32

Grading	— Grading refers to leveling the pipeline ROW so that construction can proceed smoothly and safely along the ROW — Grading includes topsoil stripping and piling as well as the installation of flumes (ditches that run next to existing pipe trench) and bridges	Table A.33

A.2.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for clearing and grading appear in Table A.34.

A.2.5 Typical Input Requirements for Clearing and Grading Inspection

Table A.18—Information Requirements for Clearing and Grading

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to clearing and grading, such as: — Access Road Drawings — Grading Drawings — Line List (e.g. special concerns for each Landowner)
	Contracts and agreements related to: — Clearing — Grading (if required) — Road Use — Crossing for Buried Facilities — Timber Salvage (Landowner, Forestry Management, Public Land Holder) — Construction Survey
	Permits related to: — Environmental — Road Use — Burning — Blasting
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Procedures for working near overhead powerlines — Emergency Medical Services (EMS) — Blasting Safety

Table A.18—Information Requirements for Clearing and Grading *(continued)*

✓	Description
	Project-specific Environmental Protection Plan (EPP) detailing clearing and grading requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Access Road Plans — Blasting Plan — Grading Plan — Burn Plan — Timber Salvage Plan — Fire Prevention/Firefighting Plan — Heritage Sites

A.2.6 Items for Inspecting Typical Clearing and Grading Operations

Table A.19—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings (as required) — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Confirm Pre-Blast Survey is conducted and documented
	Confirm well water monitoring system is installed and functional

Table A.20—Safety Concerns for Clearing and Grading

✓	Description
	Confirm that risks associated with blasting operations are identified and sufficient safety precautions are put in place
	Confirm the need for safety procedures for working near overhead powerlines
	Monitor for adherence to procedures for working near overhead powerlines
	Confirm that underground crossings are protected by earth berms or mats as appropriate

High Energy Hazards and Controls Inventory – Clearing

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Felling trees using feller bunchers	Suspended load (falling trees)	1	Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)	Exclusion zone		Specialized attachment for lifting typically attached to excavator. Ground conditions and weight/stability can cause equipment to tip.
	Electrical contact with source (>50 Volts) possible overhead powerline	6	De-energization (uncommon for transmission lines), Power line lifting	Spotter	Exclusion with barriers	
	Heavy mobile equipment tipping	14	Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)	Exclusion zone		
Felling trees with chainsaw	Suspended load (falling trees and limbs/canopy debris)	1	None	Exclusion zone		Hazards from tree being cut and other trees the falling tree impacts.
	Electrical contact with source (>50 Volts) possible overhead powerline	6	De-energization (uncommon for transmission lines), Power line lifting	Spotter	Exclusion with barriers	
	Heavy rotating equipment (chainsaw)	3	Cutting pants, chain break, kill and lock-out switches, rear handguard, chain catcher.	Exclusion zone		Chainsaw operation procedure.
Pioneering (travel lane construction)	Heavy mobile equipment roll-over / tip-over when skidding	14	Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)			
Processing/bucking/delimbing	Lateral skidder tail movement	1	None	Exclusion zone		
Skidding	Suspended load	1	Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)			Terrain conditions can introduce stability issues with suspended loads.
	Heavy equipment moving with workers nearby on foot	2	None			
	Lateral swinging load (timber)	1	None	Exclusion zone		
	Heavy mobile equipment (excavators) tipping	1	Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)			

High Energy Hazards and Controls Inventory – Clearing (continued)

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Loading	*Heavy equipment moving with workers nearby on foot*	*2*	*None*			
	Heavy mobile equipment (skid steer) with workers on foot	*2*	*None*	*Exclusion zone*		
	Log movement	*2*	*None*			*Procedure for loading logs onto trucks.*
	Heavy mobile equipment (skid steer) tipping	*1*	*Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)*			*Terrain can cause stability hazards.*
Chipping / Grinding	*Projectiles (tree/brush material, and broken chipping knives)*	*14*	*Guard body on the barrel placement (when done by hand), Cab protection (reinforced cabin, brush guards, rollover protection, seatbelt restraint)*	*Exclusion zone*		*Loading trees into chipping and grinding equipment can present line of fire hazards.*
Pre-grading Clean-up	*Heavy mobile equipment roll-over when transporting mats*	*1*	*Cab protection (Reinforced cabin, brush guards, rollover protection, seatbelt restraint)*			
	Heavy mobile equipment tip-over when lifting and seated outside cab	*1*	*Operating equipment with outriggers and within engineered limits*			

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.1--

***Pipeline Construction High Energy Hazards and Controls Inventory*, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Clearing**

High Energy Hazards and Controls Inventory – Grading and Cleanup

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Grading (includes stripping and piling of topsoil) and Return to Grade	*Swinging excavator bucket*	*2*	*None*	*Spotter*		*During rough grading the motion of the excavator bucket poses a hazard if workers are in the swing path*
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	*This occurs mainly during rough grading when the surface is extremely uneven.*
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting, Insulated boom*	*Spotter*	*Exclusion with barriers*	*This covers excavators or dumps with the beds up when transiting*
	Fall from Elevation from entering/exiting equipment cab	*8*	*Railing/Enclosure*	*3 points of contact rule*		*This is for Entering and Exiting the Equipment at heights*
	Motor vehicle incident (occupant) e.g. crew trucks	*9*	*Rollover frame, seatbelt restraint, airbag*			*While there should not be any transit on right-of-way exceeding 30mph, travel to and from the right-of-way would include this type of travel*
Surveying/Grade Checking	*Struck by excavator bucket*	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	*Eye contact with operator when moving around equipment*
Spoils Disposal (utilization of excavators/loaders to load non usable soil/rock into dump trucks for hauling away from site)	*Electrical contact with source (> 50 Volts) possible overhead powerline*	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	*This covers excavators or dumps with the beds up when transiting*
	Fall from Elevation from entering/exiting equipment cab	*8*	*Railing/Enclosure*	*3 points of contact rule*		*This is for Entering and Exiting the Equipment at heights*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.2-

***Pipeline Construction High Energy Hazards and Controls Inventory*, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Grading and Cleanup**

Table A.21—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Confirm that topsoil stripping is conducted in accordance with the environmental specifications

Table A.22—Typical Monitoring Requirements for Clearing

✓	Description
	Monitor for adherence to conditions noted in all approvals and permits issued
	Clearing is limited to vegetation within the approved ROW and approved work areas
	Monitor for proper placement of all removed trees and brush from and adjacent to the ROW
	Identify any areas where additional clearing may be required and store removed trees and brush along the ROW or on temporary workspace
	Confirm that the Contractor will strip, salvage, and store the topsoil before grading the ROW and store it along the ROW
	Confirm that topsoil and subsoil are kept in separate stockpiles
	Identify potential for delays to planned work

Table A.23—Typical Monitoring Requirements for Temporary Workspaces

✓	Description
	Confirm that Operator's authorized representative approvals for push outs are in place prior to construction
	Confirm that push outs along the outer edge of the pipeline ROW are constructed in approved areas only
	Confirm that any temporary workspace (TWS) (area usually adjacent to the permanent ROW to be used for construction purposes) for storage of excavated material, grubbing, or salvageable timber has been approved by the Operator's authorized representative, if required

Table A.24—Typical Monitoring Requirements for Access Road Preparation

✓	Description
	Monitor for adherence to all requirements identified in project road use agreement(s)
	Confirm that the Contractor uses only subsoil (no topsoil) for building road approaches
	Confirm that Clearing and Grading Contractors operate on only designated or permitted access roads and work areas
	Monitor Contractors for compliance with load limits on roads and bridges established by road use agreement(s) and respective authorities
	Confirm use of mats or clear span bridges for water crossings where culverts and fill material cannot be constructed
	During cold weather, confirm that frost is driven into the ground (frost packing) on the work side of the ROW
	During cold weather, confirm use of mats or clear span bridges for water crossings where snow fills and ice bridges cannot be constructed

Table A.25—Typical Monitoring Requirements for Gates and Fences

✓	Description
	Confirm that the Contractor builds and/or replaces fences and installs gates that cross the pipeline route per Landowner agreement(s) and Operator specifications
	Check that fences are properly braced and that gates can both open and close and be properly secured
	Confirm that a watchperson is present at open gates to control livestock, if required

Table A.26—Typical Monitoring Requirements for Buried Facilities

✓	Description
	Confirm that only subsoil (no topsoil) is used to construct earthen ramps
	Confirm that earthen ramps are constructed to the minimum height and width above natural ground surface at the point of crossing specified by crossing agreement(s)
	Confirm that line list is reviewed on an ongoing basis to address all Landowner and Third-Party Utility Owner concerns

✓	Description
	Confirm that all construction activities cease the specified distance away from any unprepared crossings

Table A.27—Typical Monitoring Requirements for Timber Processing

✓	Description
Timber Removal	
	Confirm that only approved equipment is used (e.g. cut-off type saw equipment to cut trees by hand)
	Confirm that specimen trees and shrubs identified in the Environmental Protection Plan (EPP) are marked and protected both along and marginally off the ROW or workspaces by an approved method (e.g. rubber tires or safety fences)
	Record exact species and locations of specimen trees and shrubs to assist in re-planting/replacement during clean-up and restoration phase
	Confirm that the Clearing Contractor has obtained approvals from the Operator's authorized representative before pushing any timber outside the ROW and/or cutting any trees off the ROW
	Confirm that the Contractor fells trees to minimize butt shatter and breakage towards and within the ROW
	Confirm that the Contractor brings the cut trees back within the ROW for processing for trees felled outside the ROW
	Confirm that cuts are treated per contract requirements where branches are removed from a standing tree outside the ROW, if required
	Confirm that the Contractor cuts, de-limbs, skids, and stockpiles merchantable timber to designated areas
	Monitor for adherence to specific requirements for salvage, storage, and removal associated that may be specific to the type of Landowner (e.g. Freehold, Aboriginal, Crown, National/State)
	Confirm need for, and monitor operations of timber scaler (to calculate the volume and weight of the timber stockpiles to facilitate contractual payments)
	Confirm segregation of merchantable timber according to project specifications
	Confirm that the Contractor refrains from skidding timber through partially thawed and/or muddy ground, watercourses, water bodies, or wetlands
	Confirm that on land with a significant slope (per criteria defined by Operator in contract documents) in any direction, removal of brush and trees is minimized, and root systems are left intact to prevent slope erosion
	Monitor for adherence to special conditions for disposal of trees on hillsides
	Confirm that the ROW and temporary workspace is cleared of all trees, brush, and debris to prevent mixing with excavated soils that will be returned to ditch during backfill
	Confirm that salvaged topsoil is cleared of roots and debris
Timber Removal—Watercourses	
	Confirm that timely notice is given to all agreed-to parties before starting work near a creek, river, or watercourse
	Confirm adherence to any specific requirements associated with timber removal near watercourses
	Confirm that the Contractor plans and prepares in advance for moving equipment across watercourses
	Confirm that existing water crossings are used, where possible
	Confirm that trees, shrubs, and riparian vegetation are preserved as much as practicable near all watercourses to address operational and safety concerns
	Confirm that proper approvals are in place prior to installing temporary crossings across ditches and drainages

✓	Description
	Confirm that only approved types of temporary crossings are installed over watercourses if no bridge exists. Approved temporary crossing types may include: — Clear span bridge — Ice bridge — Snow bridges (built with clean snow) — Flumes — Rock fill
	Confirm that topsoil is never used to fill stream crossings
	Confirm that all trees are felled away from watercourses
	Confirm that any felled trees are removed from watercourses immediately

Table A.27—Typical Monitoring Requirements for Timber Processing (continued)

✓	Description
	Confirm that no debris falls/deposits into watercourses
	Confirm that riparian zones on either side of watercourses are cleared by hand, unless approval from the Operator's authorized representative has been attained for machine clearing (dependent on soil condition)
	Confirm that timber stockpile sites are located on top of slopes and/or away from watercourses to provide adequate working space for piling and loading logs
Timber Salvaging	
	Confirm that the Clearing Contractor cuts, de-limbs, and stockpiles merchantable timber per Operator specifications, or conditions outlined by the Landowner, Forest Management, or Public Land Holder agreements
	Consult with the Environmental Inspector and/or Operator's authorized representative and the Timber Salvage Plan regarding any merchantable timber that appears to not meet specifications, then notify the Clearing Contractor for a decision on how to proceed
	Confirm that timber stockpile sites are cleared before pipeline construction ends
	Confirm that timber is stacked along the outer edge of the work side of the ROW or temporary workspace for easier loading onto logging trucks
	Confirm that stacked timber is not located in reforested areas, grade areas, or wetlands
	Confirm that log decks are sized adequately to accommodate loading equipment and will be located in (order of preference): — Existing cleared areas — Approved temporary workspaces — Areas with nonmerchantable timber — Areas with merchantable timber
	Confirm that decked logs are stacked with butt ends square, facing the same direction and with proper orientation for pickup
Timber and Brush Disposal	
	Confirm that proper burn permits are in place
	Confirm that burning activities comply with the Burn Plan, permit stipulations, Landowner requirements, and Environmental Protection Plan (EPP)
	Monitor continuously during any controlled burn
	Confirm that fires are completely extinguished once burn pile is consumed
	Confirm that burn locations are only on top of mineral soils and not in peat, muskeg, or wetland areas (Contractor may have to strip surface organics and replace after burning)
	Confirm that stumps, roots, and debris are broken down into smaller pieces before burning
	During cold weather, confirm that burn piles are placed on the ditch line to avoid thawing the frost-packed traffic lane on the work side of the ROW

	Confirm that the burn pile is out of sight of fire detection equipment (fire eyes)
	Confirm that every burn pile is marked using a global positioning system (GPS) and provide the Environmental Inspector and/or Operator's authorized representative with locations of all burn piles
	Confirm that all residual materials from burning are disposed as per contract documents and/or Operator or project specifications
	Confirm that no unburned timber or brush, which can mix with spoil materials, is in the disposal residue
	Confirm that burn piles are located on the ditch and away from an existing aboveground facility to allow for sufficient space for stacking and working
	Confirm that burning is never undertaken near a body of water or watercourse unless authorized by the Operator
	If burning is not permitted, confirm that chipping or mulching is conducted as per contract specifications
	Confirm that the Clearing Contractor hauls away all timber and brush from the ROW that cannot be processed by the above means

Table A.28—Typical Monitoring Requirements for Grubbing

✓	Description
	Confirm that stumps are grubbed and other debris is cleared from the ditch line but stored within the ROW
	Confirm that leftover tree stumps are chipped to a specified height in locations where grubbing is not necessary
	On the work side of the ROW, confirm that the Contractor leaves as many stumps as possible to maintain soil cohesion, compaction, and to provide a stable surface for construction equipment and vehicles
	On Crown/Public land, confirm that the Contractor removes all stumps from the spoil side of the ROW including the ditch line
	On Freehold (including unimproved Freehold) and Aboriginal land that could be agriculturally productive, confirm that the Contractor grubs and disposes of all stumps, roots, and surface rocks from the entire ROW

Table A.29—Typical Monitoring Requirements for Snow Berms

✓	Description
	Confirm that snow berms are built to Operator specifications over the ditch line immediately after clearing to prevent frost penetration into the pipeline trench
	Confirm that gaps are left in snow berms at specified intervals to allow for passage of livestock and wildlife

Table A.30—Typical Monitoring Requirements for Grade Rock Blasting and Removal

✓	Description
	Confirm that pre-blast survey has been completed
	Confirm that an approved Blasting Plan is in place
	Confirm that the Contractor has obtained permits for the use and storage of explosives
	Check that only qualified drilling and blasting personnel are employed in the blasting operations
	Confirm that the Contractor has seismic monitoring equipment for blasting in place to monitor Peak Particle Velocity limits
	Confirm that blasting notifications are in place and are being clearly communicated
	Confirm that blast calculations have been completed and agreed to for parallel pipelines and pipelines being crossed
	Confirm that any parallel pipelines or pipelines being crossed have taken necessary pressure reductions prior to blasting commencing
	Monitor for loose rock scattering onto the ROW, adjacent land, or causing damage to equipment/property
	Verify that the Contractor picks up and properly disposes of any fly-rock from blasting activities

Table A.31—Typical Monitoring Requirements for Wetlands

✓	Description
	Confirm that the Clearing Contractor clears wetlands using approved Operator procedures and per the Environmental Protection Plan (EPP)
	Confirm that trees are cut flush to the terrain surface
	Confirm that stumps are cut flush to the terrain surface and are not grubbed out of ditchto avoid unnecessary vegetation disturbance

Table A.32—Typical Monitoring Requirements for Topsoil Stripping

✓	Description
	Monitor and record start and end of stripping segments and the width (full ROW, ditch and spoil, or ditch only)
	Monitor and record stripping depths throughout stripped segments and the length of each depth
	Confirm that all stripping equipment is prepared for stripping in accordance with Operator-specific procedures

Table A.33—Typical Monitoring Requirements for Grading

✓	Description
	Confirm that all overhead power lines are marked
	Monitor grading operations for compliance to Operator or project specifications and procedures
	Confirm that resulting grading meets alignment and widths specified on drawings
	Check line list for special requirements of Landowners
	Confirm that additional temporary workspace (TWS) has been approved prior to its use
	Monitor temporary fencing requirements
	Confirm that buried facilities have been properly located and ramped to Operator or project specifications
	Confirm that grading in the vicinity of watercourses is per Operator specifications and Environmental Protection Plan (EPP) requirements
	Confirm that equipment crossings at water courses are implemented correctly and in compliance with regulatory approvals
	Confirm that survey markers are not damaged or destroyed throughout operations

A.2.7 Typical Outputs for Clearing and Grading Inspection

Table A.34—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Work completed, which can include, and is operator specific: — Record lengths and locations of temporary fencing — Record start and stop chainages/station numbers of grubbing, topsoil stripping, grading, and rock grade activities — Record stripping depths, including start-stop chainages/stations of each segment — Detailed records (per Operator forms) of blasting activity

NOTE The reference information provided in Table A.35 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.35—List of References—Clearing and Grading

Document No.	Type	Title
American Petroleum Institute (API)		
API 1172	Recommended Practice	Recommended Practice for Construction Parallel to Existing Underground Transmission Pipelines
Canadian Energy Pipeline Association (CEPA)		
N/A	Report	Pipeline Associated Watercourse Crossings
INGAA Foundation		
CS-S-8	Guideline	Construction Safety & Quality Consensus Guidelines—Overhead Utilities Safety

A.3 Stockpiling and Stringing

A.3.1 Overview

For projects of significant size, Operator-provided materials are received at a marshalling yard or stockpiling site, typically located away from the ROW, for temporary storage. The Inspector is typically responsible for:

- inspection of all received materials and log into Material Receiving Reports as required by the Operator;
- quarantine and return of any materials that are damaged or do not meet specifications according to the Operator's processes.

At the point of receipt of materials onsite, both the Inspector and a Contractor Representative should inspect, verify, and receive every shipment. The Contractor immediately takes possession and responsibility for the received materials. Depending on project size and scope, the Inspector may also be assigned to assist a designated Materials Coordinator.

The Inspector should comply with the Operator's Inspection and Materials Traceability Standards as well as quality-control (QC) processes and forms.

Stringing involves placing pipe joints end to end along the pipeline ROW, including:

- strategically placing pipe section supports (e.g. wooden skids or plastic tubs) next to the proposed pipeline ditch (in some cases trench may already be dug);
- transporting the coated pipe from stockpile sites and placing the pipe on top of the skids; this includes laying out material for specific crossings (e.g. water, road, railroad, HDD), sidebends, etc.

A.3.2 Inputs

As part of preparing for inspection during the stockpiling and stringing process, the Inspector should be familiar with relevant aspects of key Operator documents, drawings, and materials technical specifications as identified in Table A.37.

A.3.3 Execution

While the work is being executed, Inspectors are required to monitor workmanship and report on progress on a periodic basis. Typical items that Inspectors should monitor for during the stockpiling and stringing process are identified in Table A.36.

Table A.36—Typical Monitoring Requirements for Executing Stockpiling and Stringing Operations

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.38
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.39

Item	Description	Reference
Environmental Considerations	Identify specific items that should be monitored throughout Stockpiling and Stringing operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.40
Receiving/Custody Transfer	Involves confirmation that appropriate pipe and materials have been shipped and received in good condition with correct marking, labeling, or stenciling, and with required documentation [i.e. mill test reports (MTRs)] prior to the Contractor taking responsibility	Table A.41
Transport and Handling	Use of cranes, rigging and lifting, load handling, and signaling procedures for safety and preservation of material integrity	Table A.42
Storage/Stockpiling	Proper storage of pipe and materials (e.g. strategic stacking based on part number)	Table A.43
Identifying and Addressing Pipe Damage	Inspection and repair of any damaged pipe and/or coating	Table A.44
Stringing	Confirm that the correct pipe sections in the proper sequence are transported and placed on the right-of-way (ROW) with appropriate supports in place in preparation for welding	Table A.45

A.3.4 Outputs

The Inspector shall report on workmanship and progress on a periodic basis (e.g. daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator and project specific; however, best practices for reporting requirements for stockpiling and stringing appear in Table A.46.

A.3.5 Typical Inputs for Stringing and Stockpiling Inspection

Table A.37—Information Requirements for Stringing and Stockpiling

✓	Description
	All designs, drawings, and technical specifications developed by the Operator and Contractors related to stockpiling and stringing, such as: — Bill of Materials (BOM) — Alignment Sheets — Pipe Tallies — Pipe Stocking Specifications — Pipe Stringing Specifications — Specifications detailing acceptable size and nature of pipe and coating defects — Specifications detailing acceptable repair methods and practices for pipe and coating defects — Operator-specific Materials Transfer Form
	Contracts and agreements related to: — Transport and Handling of Materials — Inspection of Materials — Materials Storage
	Permits related to: — Road Transport
	Operator-specific Safety Plan, including, but not limited to: — Pipe Transport — Pipe Loading/Unloading — Pipe Storage — Handling of Materials
	Project-specific Environmental Protection Plan (EPP), detailing stockpiling and stringing requirements
	Other project-specific Plans, which may include: — Traffic Control Plan

A.3.6 Best Practices for Typical Stringing and Stockpiling Inspection

Table A.38—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings (as required) — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns — Confirm next day's stringing requirements for line pipe and heavy wall
	Equipment: — Confirm all equipment operators have appropriate certification/ticket(s) — Confirm that the Contractor possesses Manufacturer information/manual of the machinery operated — Confirm that all lifting equipment is legibly marked with safe working loads — Confirm that all lifting equipment is inspected (e.g. slings and cables) for damage with all findings documented and resolved before use
	Confirm that changes in wall thickness and bend locations are staked prior to stringing and correct pipe sections are placed incrementally along the right-of-way (ROW)

Table A.39—Safety Concerns for Stringing and Stockpiling

✓	Description
	Use caution while inspecting pipe unloading as each joint is extremely heavy
	Monitor for individuals standing between and/or under a suspended load and equipment or pipe
	Confirm that all pipes are properly chocked
	Confirm that individuals stand clear when metal banding is cut loose or other tie down means are loosened from the load
	Stand clear of lifting slings or vacuum lifters while the equipment operator is lifting and placing pipe joints
	Confirm that eye contact is made with the equipment operator to establish clear intentions when inspecting pipe and wait for operator's signal before proceeding
	Monitor and be aware of other vehicles moving in the stockpile yard or right-of-way (ROW)
	Be aware of equipment limitations related to weather, such as vac-lifts and frost
	Confirm that slings are not shortened with knots, bolts, or other makeshift devices
	Confirm that lifting configurations minimize risk of fraying or potential to damage slings

High Energy Hazards and Controls Inventory – Stockpiling & Stringing

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Loading and Unloading of Pipe on Trucks/Pipe Carriers	*Suspended Load*	*1*	*Rigging for Vertical movement, Vacuum System for both Vertical and Lateral Movement*	*Spotter*	*Taglines*	*Rigging standards. Safe Vacuum unit procedures. Safe loading and unloading procedure to protect coatings and pipe from damage.*
	Struck by pipe placed on supports (rolling, movement)	*1*	*Cribbing, Blocking*			*Placement of pipe on cribbing. Safe location for stockpiling.*
Transport of Pipe via Pipe Carriers	*Pipe movement during transport*	*2*	*Supporting, blocking and strapping*			*Strapping the pipe while being piled properly on the trailer. Safe driving procedures. Load configuration. Manufacturers requirements for strapping and safe working loads.*
	Motor vehicle incident	*9*	*Rollover frame, seatbelt restraint, airbag*			*Safe driving procedures*
	Struck by oversize loads	*2*	*None*			*Safe driving procedures. Pilot car.*
Pipe stringing by Rigging, Vacuum	*Suspended load*	*1*	*Rigging for Vertical movement, Vacuum System for both Vertical and Lateral Movement*	*Spotter*	*Taglines*	*Rigging standards. Safe Vacuum unit procedures. Safe loading and unloading procedure to protect coatings and pipe from damage. No lifting over hazards (existing pipeline crossings and powerlines).*
	Stuck by pipe placed on supports (rolling, movement)	*1*	*Cribbing, Blocking*			*Placement of pipe on cribbing. No dropping of pipe. Secured to prevent damage.*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.3-
Pipeline Construction High Energy Hazards and Controls Inventory, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Stockpiling & Stringing

Table A.40—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Confirm that diversion berms are intact and functioning after pipe stringing on slopes.

Table A.41—Monitoring Requirements for Receiving/Custody Transfer

✓	Description
	Check the pipe received at the stockpile location against the pipe tally sheet (number and length of each pipe joint the pipe mill has sent)
	Check that all the pipe joints have end caps
	Confirm that all pipe is clearly marked on the outside; if numbers are to be copied from the inside of the pipe to the outside, confirm that the numbers have been transferred correctly. Markings should include: — Size — Wall Thickness — Nominal Outside Diameter — Grade — Manufacturer — Coating Vendor — Thickness of the Coating at Mills — Heat Number — Applicable specification (e.g. API 5L) — Customer's Purchase Order (if mill purchased) — Date of Manufacture — Date of Coating — Confirm QR code or barcode is present (if required by the Operator)
	Confirm that required markings have been placed on both ends of the pipe and that these markings are consistent with the applicable mill test report (MTR)
	Check the piping components, materials, and mainline appurtenances received at the stockpile location against the BOM and Operator drawings
	Check ANSI (or equivalent) ratings, overall condition, trim, coating, operability, flange faces and/or bevels, and body condition of valves to ensure they meet specifications and are suitable for installation
	Confirm that banding from carriers and any other refuse items are hauled away to acceptable disposal sites. Burial at railway sidings or stockpile sites is not permitted

Table A.42—Monitoring Requirements for Transport and Handling

✓	Description
Transport	
	Confirm that pipe and materials are loaded, transported, and unloaded as per Operator procedures and specifications
	Monitor trucking safety and routing
	Confirm that no chains or metal straps are used to secure loads
	Confirm that pipe loads are properly secured and tarped in accordance with Operator specifications and local ordinances
	Conduct visual inspections for any damage to pipe, pipe coating, and end bevels prior to and during offloading/stacking/placement
	Conduct visual inspections for any damage to materials (e.g. flanges, fittings, bolts/nuts, gaskets, valves) prior to and during offloading and placement
	Make sure pipe joints have the correct number of nylon donuts
	Ensure correct stacking of pipe by size, wall thickness, and coating
Cranes, Rigging, and Lifting	
	Confirm that the Contractor uses equipment properly and according to what it was designed for, in particular: — Check that the center of balance of the machine and the center of weight of the load are balanced — Be aware of the rated capacity of equipment used (i.e. do not perform critical lifts of loads that exceed capacity or lift a load with undersized machinery or equipment)

✓	Description
	When operating near overhead powerlines:[10] Confirm that that a designated spotter is present Signage or goalposts are in place Sufficient distance between the powerline and personnel is maintained
	Confirm that maximum lifting angles between lifting cables and pipe are not exceeded
Loading/Unloading/Handling	
	Confirm that slings, hooks, cables, and tag lines are constantly checked before use and replaced if defective
	Check that metal end hooks are used to hook both ends of a pipe joint to lift it from transports
	Check that metal lifting hooks attached to the sideboom cables are used to hook the pipe ends for lifting
	Confirm that no brass-lined hooks are used (copper in the brass may contaminate the pipe ends causing cracking of the field-produced girth welds)
	Check that spreader bars are used for unloading double jointed pipe lengths
	Confirm that workers are not standing under a suspended load
	Confirm that lifting equipment or chockers used comply with Operator specifications and do not damage the component coatings
	Confirm that equipment controls are never left unattended for a suspended load
	Confirm that there are no vehicles in the vicinity of pipe joints during lifting/placement operations
	Confirm that boom and cable brakes are always used if a load is suspended for an extended period
	Confirm that equipment is shut down before cleaning or making adjustments/repairs
	Confirm that offloading and stockpiling operations are restricted to approved work areas
Signal Persons and Operators	
	Confirm that the Signal Person is wearing a reflective vest and has verbal communication with the Operator or is in full view using standard hand signals
	Confirm that the Operator stops immediately if there is a loss of communication or miscommunication and restarts only after communication is restored or understood

Table A.43—Monitoring Requirements for Storage and Stockpiling

✓	Description
	Inspect the individual joints of pipe for pipe bevel and coating damages during offload at the allocated stockpile site from the mill
	Check and confirm all pipe joints, fittings, manufactured bends, and other tubular materials have correct markings
	Confirm pipe stacks are properly supported (i.e. placement of timber pipe supports and chocking is in compliance with Operator specifications)
	Confirm pipe piling height is in accordance with construction specifications
	Ensure correct stacking of pipe by size, wall thickness, and coating
	Confirm that pipe is stored with end caps (as required by Operator specifications)
	Verify that any pipe with confirmed damage is marked accordingly and stored in separate piles

Table A.44—Monitoring Requirements for Identifying and Addressing Pipe Damage

[10] https://ingaa.org/cs-s-8-overhead-utilities-safety-guidelines/ (should we consolidate some of this stuff?) ; 29 CFR 1926.1408 Subpart CC – Cranes & Derricks in Construction

✓	Description
	Confirm that pipe is inspected for damage per Operator specifications prior to unloading, including, but not limited to: — Beveled ends — External pipe body for ovality, dents, gouges, and scratches — Internal pipe body for ovality, dents, gouges, scratches, and debris — Damage due to objects falling between joints
	Confirm that all damaged pipe is either: — Repaired per Operator specifications using Operator-approved techniques, or — Marked as damaged goods and stored separately in the marshalling area for disposition

Table A.45—Monitoring Requirements for Stringing

✓	Description
	Monitor for compliance to Operator's pipe stringing procedures
	Check for overhead power lines near unloading area
	Confirm that work areas are marked and identified in accordance with construction specifications
	Confirm that pipe is placed on padded skids, supported adequately off the ground, and blocked in a safe fashion to prevent movement
	Confirm that there is no damage when using padded supports to string coated pipe
	Confirm that the wall thickness, grade, and coating type of pipe is located correctly along the right-of-way (ROW) as indicated on the construction drawings
	Check that pipe bends are positioned and installed according to the marking on the bend
	Verify that required pipe transitions are at the correct locations
	Monitor site activities for compliance with rutting policies within Operator specifications
	Confirm that Landowner access and livestock crossings are maintained in accordance with Operator specifications
	Confirm that triple jointed pipes are only placed in locations where bending is not required
	Inspect the individual joints of pipe for pipe bevel and coating damages after pipe is offloaded and placed on the ROW
	Inform the Construction Manager/Chief Inspector (or designate) of all damaged pipe and reasons for damage, and confirm that the damaged pipe is quarantined

A.3.7 Typical Outputs for Stockpiling and Stringing Inspection

Table A.46—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Complete stockpiling and stringing progress reports, including: Work completed to date, including: — Start and end chainages/station numbers of strung pipe and the pipe wall thickness — Start and end chainages/station numbers of locations where pipe was not strung and reasons for skipping — Station numbers, joint numbers, wall thickness, coating types, and heat numbers when offloading on the right-of-way (ROW) — Damage occurred to the pipe during stringing and mark the damaged locations on the pipe

	— Actual hours of work utilized for labor and equipment — Number of transport loads transported — Conditions that enhanced or delayed the planned progress of the day — Completed and signed Pipe Tally Sheets — Custody Transfer Forms — Any ROW, weather, or other logistical conditions that caused either an increase or decrease in expected progress

NOTE The reference information provided in Table A.47 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.47—List of References—Stockpiling and Stringing

Document No.	Type	Title
American Petroleum Institute (API)		
API 5L1	Recommended Practice	Recommended Practice for Railroad Transportation of Line Pipe
API 5LT	Recommended Practice	Recommended Practice for Truck Transportation of Line Pipe
API 5LW	Recommended Practice	Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels
Canadian Standards Association (CSA)		
C22.3 No. 6	Standard	Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines
ENFORM		
N/A	Report	Sideboom Operator Training Standard (Entry Level)
INGAA Foundation		
CS-S-15	Guideline	Construction Safety Consensus Guidelines—Pipe Loading and Unloading Safety During Construction Activities

A.4 Field Bending

A.4.1 Overview

Field bending is an integral part of pipeline construction and refers to the set of activities associated with bending the pipe in the field so that it fits the shape of the right-of-way (ROW) and trench. Field bending is also known as “cold” bending since the pipe is not heated before the operation; because of this, there are strict limits on how much the pipe can be shaped. In cases where it is anticipated that the pipe will need a bend greater than technical specifications for field bends allow, the Operator may specify hot bends or fittings which it will purchase separately.

A.4.2 Inputs

As part of preparing for inspection during the field bending process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.49.

A.4.3 Execution

Typical items that the Inspector should monitor for during the field bending process are identified in a series of checklists as detailed in Table A.48.

Table A.48—Monitoring Requirements for Field Bending

Item	Description	Reference
Prior to Commencing Work	Daily, confirm that key issues that have been identified are detailed and addressed	Table A.50
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.51
Environmental Considerations	Identify specific items that should be monitored throughout Field Bending operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.52
Field Bending	Monitoring requirements associated with field (“cold”) bending	Table A.53

A.4.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for field bending appear in Table A.54.

A.4.5 Typical Input Requirements for Field Bending Inspection

Table A.49—Information Requirements for Field Bending

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to field bending, such as: — Bill of Materials (BOM) — Alignment Sheets — Pipe Tallies — Specifications detailing acceptable size and nature of pipe and coating defects — Specifications detailing acceptable repair methods and practices for pipe and coating defects
	Contracts and agreements related to: — Transport and Handling of Materials — Inspection of Materials — Materials Storage
	Permits related to: — Road Transport
	Operator-specific Safety Plan, including, but not limited to: — Handling of Materials
	Project-specific Environmental Protection Plan (EPP) detailing field bending requirements
	Other project-specific Plans, which may include: — Traffic Control Plan

A.4.6 Best Practice Items for Inspecting Typical Field Bending Operations

Table A.50—Prior to Commencing Work

✓	Description
	Confirm that limitations and requirements for field bending operations defined by codes/standards and Operator specifications (i.e. whichever is most restrictive) are understood and clearly communicated based on the relevant jurisdiction, pipe material, and diameter
	Identify any Operator requirements for completing test bends

✓	Description
	During winter, confirm if Operator has identified ambient temperature limits for pipe bending operations (i.e. extreme cold weather may compromise structural integrity of pipe or coating during field bending operations)
	Confirm that the appropriate instruments are available for inspecting bends (e.g. protractor, measuring tape, center finder, caliper, and straight edge)

Table A.51—Safety Concerns for Field Bending

✓	Description
	There are no incremental specific Safety Concerns beyond those identified in Section 4

High Energy Hazards and Controls Inventory – Bending

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Movement of the Pipe from Stockpile to Bending Location	*Suspended Load, Pipe*	*1*	*Proper rigging, secondary braking*	*Spotter*	*Taglines*	*Rigging procedures and safe lift procedures.*
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Reverse alarms*	
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	*This covers excavators or dumps with the beds up when transiting*
	Hydraulic Press, Piston Movement	*3*	*Caging*			*Identify limitations and requirements for field bending.*
	Mandrel - Mechanical	*3*	*None*	*Spotters*		
Placement of the pipe into the bend, and moving the bender through the machine	*High Pressure Hose Connections*	*5*	*Whip checks*			
	Bender Electrical Box	*6*	*De-energization, Lock-out-tag-out*			
	Fall from heights	*8*	*Railing on bender and ladder*	*3 points of contact rule*		
Movement of pipe out of machine and laying it on cribbing after the bending	*Suspended Load, Pipe*	*1*	*Proper rigging, secondary braking*	*Spotter*	*Taglines*	*Ensure no damage to pipe after bending (coating).*
	Suspended Load, Pipe on Cribbing	*1*	*Cribbing, Blocking*	*Rigging, Spotter*	*Taglines*	*Placement of pipe on cribbing. Safe location for stockpiling.*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.4-

Pipeline Construction High Energy Hazards and Controls Inventory, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Bending

Table A.52—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	There are no incremental specific Environmental Considerations beyond those identified in Section 4

Table A.53—Typical Monitoring Requirements for Field Bending

✓	Description
	Confirm that all field bends adhere to limitations and requirements for field bending operations based on the relevant jurisdiction, pipe material, and diameter, including compliance with: — Specified angle requirements — Pipe bend radius limitations, including coating type limitations — Specified limits of ovality and wall thinning — Smooth contour of bends (i.e. no wrinkles, ripples, etc.) — Pipe longitudinal seam location restrictions, (i.e, as near as practical to the neutral axis of the bend) — Restrictions due to pipe grade, if any — Bending equipment requirements, including use of mandrels — Pipe diameter to wall thickness ratio — Neutral axis
	Mark, record, and report any damage or out of specification bends, noting damage to coating, pipe wall, and bevels
	In cold conditions, confirm that any relevant Operator restrictions on bending operations based on ambient temperature are adhered to (i.e. extreme cold weather may compromise structural integrity of pipe or coating during field bending operations)
	Witness and confirm the success of any test bends required by Operator specifications
	Confirm that field bends are the minimum specified distance from circumferential welds or open end of the pipe as specified by the Operator
	Confirm that bending increments are distributed along the length of the bend
	Confirm that size and location of bends is established such that the pipe conforms to the centerline of the trench within limits prescribed by the Operator
	Confirm that bends and elbows are strung in the correct sequence and orientation
	Confirm that pipe and coating were not damaged during field bending operations
	Confirm that any pipe that does not meet Operator specifications (i.e. has gouges, buckles or unacceptable wrinkles, ripples, or ovality) is rejected, clearly marked, and removed from the right-of-way (ROW)

A.4.7 Typical Outputs for Field Bending Inspection

Table A.54—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Work completed, which can include, and is operator specific: — Start and end chainages/station numbers of completed bending and set-up activities — Start and end chainages/station numbers of locations where pipe was not bent and reasons for skipping — Number and types of bends made

	— For each bend: joint numbers, wall thickness, coating types, and heat numbers — Damage occurred to the pipe during bending and mark the damaged locations on the pipe — Actual hours of work utilized for labor and equipment — Conditions that enhanced or delayed the planned progress of the day — As-built information of the bends — Locations, quantities of unit price pay items, and extra work installed or utilized during bending including locations of field bends made to replace 3D (radius) and 5D (radius) fittings and vice versa

NOTE The reference information provided in Table A.55 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.55—List of References—Field Bending

Document No.	Type	Title
There are no incremental specific reference documents beyond those identified in Section 4		

A.5 Ditching and Excavation

A.5.1 Overview

Ditching and excavation is the next phase of pipeline construction, and typically involves excavation of a trench in the ROW for pipe installation. Typically, the ditching operations are after stringing, bending, welding, nondestructive examination (NDE), and coating due to the risk of having an open trench; there are exceptions, including:

- where rock is encountered, the trench may be blasted and excavated prior to stringing;
- in urban areas or other areas where numerous underground utilities and obstructions may exist.

It should be noted that ditching and excavation is still required for entry and exit pits for trenchless crossings.

A mechanical wheel ditcher/trencher or backhoe with a trencher is generally used to create a trench of uniform depth and width; more specialized techniques and equipment may be required based on the type of soil and pipe. For example:

- backhoes or traditional excavators may be used for points of intersection;
- wet areas where buoyancy control of the pipe requires an extra wide trench (to accommodate placing weights over the pipe);
- road, highway, railroad, Third-Party pipelines, and river crossings;
- at all tie-in locations where extra width and depth are required for welders to work in the trench;
- areas with unsuitable/unstable soil conditions where trench sides need to be sloped (e.g. sandy soil);
- mountainous/steep slope and rocky soil/rock conditions;
- short sections of pipe and/or areas where moving equipment around is not practical.

Depending on the nature of buoyancy control requirements, trench work may be required and be undertaken within this phase of construction.

Refer to Annex B for further information on the role and responsibilities of a Blasting Inspector.

A.5.2 Inputs

As part of preparing for inspection during the ditching and excavation process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.57.

A.5.3 Execution

While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Due to the unique nature of excavation, a competent person, not typically the inspector, is responsible for monitoring and addressing any issues which may arise during times when personnel need to access the excavation. Inspectors verify that these activities are performed. Typical items that the Inspector should monitor for during the ditching and excavation process are identified in a series of checklists as detailed in Table A.56.

Table A.56—Monitoring Requirements for Ditching and Excavation

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.58
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.59
Environmental Considerations	Identify specific items that should be monitored throughout Ditching and Excavation operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.60
Excavation Equipment	Monitor the operations for adherence to relevant Operator- and project-specific requirements; confirm that equipment does not damage pipe, buried facilities, or roadways in any way	Table A.61
Trench Excavation	Confirm that the trench is excavated to project requirements, including: — Specifications for alignment of centerline and dimensions of slope of sides, width, and depth — Installation of gaps/plugs for livestock and wildlife crossings — Installation of padding and buoyancy controls in preparation for lowering-in	Table A.62
Trenching Through Rock	In rocky areas, blasting is required to break and loosen the rock to create a trench in areas where a trench cannot be excavated with backhoes, ditchers, or rippers. This is a particularly dangerous aspect of the operation due of the use of explosives; Inspectors shall confirm that the Blasting Plan is followed without exception	Table A.63
Crossing Underground Facilities (Encroachment)	A new pipeline should be constructed either under or over existing facilities (depending on their depths of cover), so the Inspector should confirm that crossing/encroachment agreements are followed and appropriate (i.e. hand trenching or hydrovac) near buried facilities	Table A.64
Ditch Plugs and Subdrains/Drain Tiles	Confirm that drainage and erosion control devices or measures, such as ditch plugs and subdrains (drainage systems that divert water away from the trench bottom)/drain tiles (perforated tubing that allows water to enter and be drained away from the pipeline) to prevent erosion of the right-of-way (ROW)/trench due to ground and surface water, are used as per Operator specifications	Table A.65
Seasonal Considerations	Itemize considerations that are specific to the construction season	Table A.66
Scope Changes	Identify items of note that can result in scope changes and therefore require monitoring and documenting for contractual reasons	Table A.67
Historic Sites	Ditching and excavating operations should be suspended upon discovery of historic sites or resources until formal notice is received from Operator to recommence construction	Table A.68

A.5.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for ditching and excavation appear in Table A.69.

A.5.5 Typical Input Requirements for Ditching and Excavation Inspection

Table A.57—Information Requirements for Ditching and Excavation

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to ditching and excavation, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Trenching Specifications and Procedures, including local jurisdictional requirements — Buoyancy Control Requirements — Topsoil Segregation Requirements — Pipeline Depth of Cover Requirements — Blasting Specification, if required
	Contracts and agreements related to: — Road Use — Crossings for Buried Facilities — Construction Survey
	Permits related to: — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Excavation Plan — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS) — Use of spotters — One Call and damage prevention for underground facilities
	Project-specific Environmental Protection Plan (EPP) detailing ditching and excavation requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Steep Slope Work Plan, including personnel qualification requirements, site-specific emergency response information, equipment type(s), number of machines and corresponding procedures, grading plan, soil types/conditions and corresponding requirements, weather-related procedures and requirements, controls or procedures to mitigate other anticipated hazards, winching diagram (if applicable), and communication devices and procedures, job safety analyses (JSAs), inspections, and emergency stop signals — Damage Prevention Practices — Blasting Plan — Fire Prevention/Firefighting Plan — Heritage Sites — Engineered Shoring and Dewatering Plans, as required

A.5.6 Items for Inspecting Typical Ditching and Excavation Operations

Table A.58—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Be aware of Operator pipeline excavation method requirements (e.g. within tolerance zone)
	Confirm that start and stop orders, signaling, and use of spotters for equipment operation are communicated
	Confirm that exclusion zones are established and site personnel are aware of the boundaries
	Confirm that a current One Call ticket has been established, where required
	Crossing underground facilities including Third-Party pipelines, power cables, communications cables, cables for cathodic protection purposes, and all public works should be identified, surveyed, and staked prior to any ground disturbance
	The Operator of a Third-Party facility may locate, expose, and excavate the facility themselves or allow the Contractor to do so (according to the Operator's procedures, specifications, and the crossing agreement)
	Confirm that appropriate agreements are in place and requirements are followed when crossing Third-Party pipelines
	Equipment: — Confirm that all equipment operators have appropriate certification(s)/ticket(s) — Confirm that Contractor possesses Manufacturer information/manual of the machinery to be operated
	Work area: — Check that Third-Party pipeline crossing ramps have been built — Check that warning signs and temporary fencing is installed on open excavations close to public accesses — Confirm that all necessary hand tool or vacuum excavations of buried facilities and Third-Party pipelines have been carried out in advance of trenching activities — Monitor that contaminated materials have been identified

Table A.59—Safety Concerns for Ditching and Excavation[11]

✓	Description
	Confirm that One Call/811 calls for underground facilities are made by the Contractor and confirm that a valid One Call/811 call ticket is in place and lines have been marked in advance of commencing work
	Be aware of changing conditions which may impact the integrity of the excavation, including weather, water hazards, increasing or decreasing soil moisture, and activity around the site
	Inspect excavations at the start of work site activities, during the work shift, and when conditions change
	Confirm that equipment operators use spotters while traversing under powerlines and overhead hazards
	Confirm that workers make eye contact with equipment operators before approaching
	Monitor, where applicable, that the Contractor follows the excavation checklist (i.e. are aware of the hazards, roles, and responsibilities associated with excavation equipment and operation)
	Confirm that equipment operators are using spotters where appropriate
	Be aware of misfired holes and their impact (undetonated dynamite which can explode) when excavating rock ditch
	Confirm that equipment operators are working only in the exclusion zone
	Shut down work immediately if any unauthorized personnel enter the exclusion zone
	Confirm that all lifting equipment (including slings and cables) is rated for the lift, inspected for damage, contamination, or wear, and all findings are resolved and documented before use
	Confirm that excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations are placed at least 2 feet (.61 m) from the edge of excavations, or protected by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both, in accordance with operator specifications. • This distance can vary by jurisdiction, for example, according to US regulation[12], two feet is the minimum distance equipment can be stored from an excavation, whereas it is set at a province-level in Canada
	Confirm that the ratio of sloping, benching, shoring, and shielding measures used are appropriate for the soil conditions
	Confirm that use of trench boxes, bracing, and other ditch shoring requirements is consistent with Operator specifications and safety conditions based on site-specific conditions
	Confirm that means of access/egress are appropriate for the situation[13]
	Monitor for adherence to Operator requirements for working on slopes
	Monitor for adherence to Operator requirements when working with contaminated materials
	Monitor for adherence to Operator Damage Prevention Practices
	Ensure that appropriate pressure reductions are implemented (where required) when working in proximity to in-service pipe
Steep Slopes[14]	
	Familiarize yourself with the operator's steep slope plan, where present
	Inspect each piece of equipment daily, giving special attention to slings, winches, cables, pins, shackles, fuel, and oil levels
	Confirm use of other personal protective equipment (PPE) as identified by the work plan (e.g. fall protection, leather gloves when handling cable)

[11] https://ingaa.org/cs-s-12-trenching-and-excavation-safety/
[12] 1926.651(j)(2)
[13] A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees
[14] INGAA CS-R-16, Steep Slope Construction

✓	Description
	Inspect all slopes prior to beginning work each day and if slope conditions change during the work shift (e.g. due to weather conditions, newly exposed rock)
	Confirm that no unnecessary ground personnel are on the slope or near the operation when equipment is moving, or winch lines/rigging are under load
	Confirm that workers are not positioned below or near active equipment operations (e.g. winching)
	Confirm that employees do not cross over or under cables when under load
	Confirm that equipment is not operated beyond the maximum slope/operating limits established by the Manufacturer (may require consideration of special lubrication requirements such as additional fluids)
	Confirm that all motions are deliberate and conducted at the proper rate of speed (i.e. to maintain center of gravity of the machine) when any equipment is operated on a hillside
	Confirm use of tracked machinery to increase stability and traction

High Energy Hazards and Controls Inventory – Ditching, Excavation, Backfill

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Excavation Operations: any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal; typically conducted by an excavator	*Working in trench*	*12*	*Benching/sloping/trench box*	*Ladder or other for egress*		
	Falls from height into trench	*8*	*None*	*Exclusion zone with caution tape*		*Direct control typically used for working in pedestrian and traffic areas*
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
	Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
Trenching Operations: a narrow excavation with a depth greater than its width but is no wider than 15 feet; work typically conducted by an excavator or trencher	*Falls from height into trench*	*8*	*None*	*Exclusion zone with caution tape*		*Direct control typically used for working in pedestrian and traffic areas*
	Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*
	Contacting existing electrical lines (below ground)	*6*	*De-energization/ schedule & verify utility outage*	*Daylighting, Locates, hydro-vac, exposing, potholing*		*Sometimes a concrete pipe/sleeve is used to protect underground electrical lines. checking existing utility plans*
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
	Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*
	Falls from height into trench	*8*	*None*	*Exclusion zone with caution tape*		*Direct control typically used for working in pedestrian and traffic areas*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.5-

***Pipeline Construction High Energy Hazards and Controls Inventory*, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Ditching, Excavation, Backfill**

Table A.59—Safety Concerns for Ditching and Excavation *(continued)*

✓	Description
	Confirm that access routes to the top and bottom of steep slopes are clearly defined and restricted to steep slope personnel
	Confirm that spotters are used at the crest of the hill and in the event of any blind spots
	Confirm that signage is placed at the crest and toe of the hill, designating presence of hazardous terrain locations and/or a blind crest or break over
	Confirm that radio checks are performed, prior to approaching the break over
	Confirm presence of safety antennas (i.e. “buggy whips”) on vehicles used during slope projects
	Confirm operator visual ground verification prior to cresting
	Confirm that a designated person with an air horn is in place to warn of immediate hazards (e.g. falling debris, dislodged rock, sliding equipment or material, broken winch line)
Blasting	
	Confirm that pre-blast survey has been completed
	Confirm that an approved Blasting Plan is in place
	Confirm that the Contractor has obtained permits for the use and storage of explosives
	Check that only qualified drilling and blasting personnel are employed in the blasting operations
	Confirm that the Contractor has seismic monitoring equipment for blasting in place to monitor Peak Particle Velocity limits
	Confirm that blasting notifications are in place and are being clearly communicated
	Confirm that blast calculations have been completed and agreed to for parallel pipelines and pipelines being crossed
	Confirm that any parallel pipelines or pipelines being crossed have taken necessary pressure reductions prior to blasting commencing
	Monitor for loose rock scattering onto the ROW, adjacent land, or causing damage to equipment/property
	Verify that the Contractor picks up and properly disposes of any fly-rock from blasting activities
	Confirm that segments being prepared for blasting have matting to protect the impact of fly-rock during the blast
	Establish and maintain adequate set-back distances for all blasting personnel and nonessential personnel

Table A.60—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Monitor and confirm topsoil/ subsoils segregation.
	Confirm that trench plugs are installed at wetland/ upland boundaries and streams as per owner’s drawings

Table A.61—Typical Monitoring Requirements for Excavation Equipment

✓	Description
	Confirm that if a machine strikes, contacts, is bogged down, slides into, or rests on top of a pipeline facility, work is stopped immediately and the Operator’s authorized representative is notified; the machine is not to be moved or extricated without Operator approval
	Confirm that the Contractor never passes the bucket over an exposed, loaded pipeline during excavation
	Inspect backfill areas for soft spots, rock, and adequate depth of cover before heavy equipment crosses a loaded line
	Confirm the use of timber mats for equipment support in areas of weak and saturated soils
	Confirm that roadways are protected from tracked equipment at road crossings

Table A.62—Typical Monitoring Requirements for Trench Excavating

✓	Description
Trench Dimensions	
	Periodically measure minimum trench dimensions to conform with specifications as defined in construction alignment sheets
	Confirm that the specified depth of cover will be measured from the top of pipe to the graded right-of-way (ROW) profile; if grading was not required, confirm that the depth will be measured to the original stripped ground NOTE Topsoil cuts are not considered in the cover depth measurement.
	Where buoyancy controls (e.g. continuous concrete coating, saddle weights, bolt-on weights, or screw anchors) are to be used, confirm that the depth of cover will be from the top of the buoyancy control measure
	Confirm that farm, lot-line and midfield, seasonal, or other drains not shown on project drawings will be installed to a minimum cover depth specified
	Confirm that depths of cover at the trench and drains will be measured from the top of the pipe to the invert of the ditch or drain
	Confirm that the trench will be deep enough to provide minimum cover in all conditions, including sand padding and sandbag or foam pillow supports where necessary
	Confirm that the trench will be graded to the specified clearance at all crossings (i.e. road, ditch, culvert, cable, water main, and sewer) or any other obstruction as directed by Operator specifications
	Monitor for locations where available workspace is insufficient to allow compliance with safety and environmental requirements; escalate to Operator's authorized representative when identified
Open Trench Considerations	
	Verify that placement of spoil does not damage adjacent structures or other assets, nor impede traffic and/or other pathways
	In cultivated fields or where livestock is present, confirm that safe, temporary bridges or backfilled sections along the trench are provided for livestock and farm machinery to cross as specified in construction drawings
	Confirm that the length of the trench left open during pipeline construction is approved by the Operator's authorized representative based on the stability of the trench and weather conditions
	Confirm that the Contractor will not leave a trench open for extended periods; in particular, monitor for: — Safety concerns for workers and wildlife (confirm that gaps are left in adjacent spoil and slash windrows at wildlife crossings, recreational trails, etc.) — Large accumulations of water — Excavated soil becoming frozen in cold weather — Snow and ice accumulation
Buoyancy Control	
	Confirm that trench keys (wider trench locations to accommodate buoyancy control weights) are excavated to specified dimensions and at appropriate locations based on the construction drawings
	If screw anchors (steel helical anchors, installed in pairs on either side of the pipe through the trench bottom into the soil after the pipe section is lowered into the trench) are to be installed, confirm that trench is adequately sloped per Operator specifications with access/egress ladders installed

Table A.63—Typical Monitoring Requirements for Trenching through Rock

✓	Description
	Check that mats or other safeguards are placed over the ditch line to prevent loose rocks from scattering onto and off the right-of-way (ROW)
	Confirm that scattered rocks are disposed of by the Contractor to an authorized site off the ROW or piled neatly in rows along the side of the ROW as per line list
	Confirm that the trench will be dug for an additional depth based on Operator specifications (i.e. greater than the minimum ditch depth shown on the drawings) to allow for trench bottom padding

Table A.64—Typical Monitoring Requirements for Crossing Underground Facilities (Encroachment)

✓	Description
	Confirm that the Contractor will excavate the trench at crossing locations with a gap between the underground facility and the proposed pipeline as specified in the contract documents and crossing agreements
	Confirm that the contractor uses hand or vacuum excavation tools when locating buried facilities
	Validate the locations of buried or exposed facilities prior to mechanical excavation
	Observe the Contractor during the exposure of an operating pipeline and monitor for compliance to project requirements
	Verify that no mechanical digging equipment is used within the tolerance zone established by the operator's damage prevention practices and specification, the construction contract, or the crossing agreement. This tolerance zone is typically between 18 in. (0.50 m) and 24 in. (0.60 m)
	Confirm that uncovered utilities are properly supported to maintain their integrity

Table A.65—Typical Monitoring Requirements for Ditch Plugs and Subdrains/Drain Tiles

✓	Description
	Ditch plugs and subdrains may be constructed based on construction drawings; in some cases the quantity and their location are determined in the field after the trench is excavated. Monitor for: — Specific terrain features/drainage patterns a) Groundwater flowing or seeping from the bottom or sides of the trench, then a subdrain (drain tile) may be required immediately downhill of the discharge point to collect the water and divert it off the right-of-way (ROW) b) Locations where water can enter the trench and flow downhill through the backfill — Ditch water encountered on slopes and hills
	Confirm that Operator specifications are met or exceeded for erosion control (e.g. a sack breaker may be installed as an alternative to ditch plugs if a ditch plug is difficult to install)
	Confirm that silt fence and straw bale sediment control measures are installed
	On slopes, confirm that Contractor has installed and keyed in trench breakers (physical dams built across the inside of a trench around the pipeline to prevent backfill migration and/or erosion) and subdrains in the trench per Operator drawings and specifications or as required
Subdrains/Drain Tiles	
	If drain tiles are cut: — Confirm that location is marked — Confirm that ends are capped to prevent clogging from dirt or debris — Confirm that temporary flumes are installed to maintain drainage
	If unmarked utilities are discovered or damaged, confirm that the Contractor contacts the Facility Owner for approval and requirements for the repair
	Confirm that the locations of all drain tiles, irrigation pipes, etc., not on drawings, but crossed by the trench line, are documented on the daily progress report and alignment sheets for the as-built drawings

Table A.66—Typical Monitoring Requirements for Cold Weather Considerations

✓	Description
	Confirm that the Contractor blades (using the blade on a grader) a berm of loose material or snow (e.g. snow roach) to Operator specification over the centerline of the trench immediately after grading the right-of-way (ROW) to prevent frost penetration into the ground along the ditch line NOTE A berm may not be required in muskeg areas or if ditching commences by end of the following day of grading.
	Confirm that frozen lumps resulting from ripping the ditch line are removed by the Contractor and stored separately from the trench subsoil pile
	Monitor for subsoil freezing into lumps in subzero temperatures (as it can damage pipe coating during lowering-in and result in nonuniform compaction over the pipe)

✓	Description
	Confirm that the Contractor lowers and backfills within a specified window following ditching so the backfill does not freeze; any exceptions are to be approved by the Operator's authorized representative
	Confirm that snow and ice in ditch are removed before lowering-in commences

Table A.67—Typical Monitoring Requirements for Additional Work Items

✓	Description
	Monitor and record the following additional work items: — Extra-depth ditch (i.e. start, end, as well as depth) — Locations where available workspace is insufficient for compliance with safety and environmental requirements — Pre-ripping attempts where subsurface rock is encountered that may require specialized mechanical excavation — Rock-ditch excavation by specialized mechanical excavation techniques — Rock-ditch excavation by blasting techniques — Quantity of rock excavation (in accordance with the method of payment in the contract documents) — Fabricated blasting mats used to contain fly-rock (where required by permit) — Use of timber mats for equipment support in areas of weak and saturated soils — Third-Party utility crossings — Subdrain (drain tile) station locations and temporary/permanent repairs, if required

Table A.68—Typical Monitoring Requirements for Historic Sites

✓	Description
	Immediately suspend ditching activity and notify the Operator's authorized representative if any historic sites or resources are discovered
	Confirm that ditching will not resume until formal notification provided by Operator's authorized representative

A.5.7 Typical Outputs for Ditching and Excavation Inspection

Table A.69—Typical Reporting Requirements

✓	Description
General	
	Record any weather or other logistical conditions that caused either an increase or decrease in expected progress
Daily	
	Work completed, which can include, and is operator specific: — Confirm that a competent person has inspected and monitored the excavation when personnel access is required — Record the quantities of any rock excavation — Record the ditch depths and widths — Start and end chainages/station numbers of dug trench — Record soil horizons — Locations of all drain tiles, irrigation pipes, etc., not on drawings, but crossed by the trench line

NOTE The reference information provided in Table A.70 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.70—List of References—Ditching and Excavation

Document No.	Type	Title
Common Ground Alliance (CGA)		
	Guideline	CGA *Best Practices*
INGAA Foundation		
CS-S-12	Guideline	Construction Safety & Quality Consensus Guidelines—Trenching and Excavation Safety
F-2008-05	Guideline	Guidelines for Parallel Construction of Pipelines

A.6 Welding

A.6.1 Overview

Welding during pipeline construction is performed to join lengths of pipe together as the Construction crew moves along the ROW. Welding is a process for joining materials together to become a manufactured or fabricated item. The welding process is used to join pipe to pipe, and pipe to components.

Whereas welding requires specialized expertise, not just for the execution of the work, but also inspection of the work, there are several items that the Inspector should be aware of as part of undertaking their role effectively (i.e. working alongside Welding Inspectors). Welding inspection should be performed only by a Welding Inspector who has been qualified and has been specifically assigned this task. The information presented within this section deviates somewhat from most sections in this annex and focuses on providing the Inspector with sufficient knowledge to determine the limitations of their role in the context of welding inspection.

Refer to Annex D for further information on the role and responsibilities of a Welding Inspector.

A.6.2 Inputs

Although the Inspector is not expected to undertake significant welding inspection activities, some indication of typical inputs is provided as orientation. This information is detailed in Table A.72.

A.6.3 Execution

Since welding inspection is a specialized role, the listing provided in this section is focused on items that would not typically require specialized welding expertise (i.e. indication of items that would prompt the Inspector to escalate identified issues).

Typical items that the Inspector should monitor for during the welding process are identified in a series of checklists as detailed in Table A.71.

Table A.71—Monitoring Requirements for Welding

Item	Description	Reference
Prior to Commencing Work	Daily confirm key issues that have been identified are detailed and addressed	Table A.73
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.74
Environmental Considerations	Identify specific items that should be monitored throughout Welding Operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.75
General Welding Operations	Typical monitoring requirements for a nonspecialized Inspector; it is important to identify those situations that require a specialized Welding Inspector	Table A.76

A.6.4 Outputs

While general Inspectors may be asked to assist a Welding Inspector, they are not to perform welding inspection activities on their own. Some indication of typical outputs is provided as background information as detailed in Table A.77.

A.6.5 Typical Input Requirements for Welding Inspection

Table A.72—Information Requirements for Welding

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to welding, such as: — All applicable Welding Procedure Specifications (WPS) — All applicable Operator's Welding Standards — Alignment Sheets
	Contracts and agreements related to: — Welding o All welders are appropriately qualified to use project welding procedures — Nondestructive examination (NDE) — Construction Survey
	Permits related to: — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing welding requirements
	Other project-specific Plans, which may include: — Welding Plan

A.6.6 Items for Inspecting Typical Welding Operations

Table A.73—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Confirm that all welders have current and appropriate welding qualifications available — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns — Conduct and record tailgate meetings with welders to communicate the Operator Quality, Safety, Welding Standards, and Welding Procedure Specifications (WPS) — Communicate and monitor all hold points prior to start of welding operations — Confirm that every new welder to site is briefed on the above points during onboarding

Table A.74—Safety Concerns for Welding

✓	Description
	There are hazards unique to the welding phase that all Inspectors should be aware of, including, but not restricted to: — Hot surfaces (e.g. pre-heat or post weld) — Rotating equipment — Flying debris from wire brushing and grinding — Sharp edges (e.g. beveling) — Pinch points between pipe ends or line up clamps — Weld flash — Hazardous atmosphere (e.g. fumes) from welding processes — Pressurized containers of flammable gas requiring special transportation and storage — Working in proximity to moving equipment
	Confirm use of welding-specific personal protective equipment (e.g. ANSI-compliant safety eyewear beneath ANSI-compliant welding hoods/pancakes)
	Confirm that workers are not wearing contact lenses during welding operations
	Confirm that correct welding electrode is used and that the electrodes are in good condition (not wet, dirty, or cracked)
	Additional safety requirements require the input of a specialized Welding Inspector

High Energy Hazards and Controls Inventory – Welding

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Pipe Facing **33–35-degree bevel for weld**	*High temperatures from pipe facing equipment*	*10*	*Welding Blanket, Fire retardant clothing and Thermal Insulated Gloves*	*Caution signs with hazard label*	*Exclusion with barriers*	*Sparks from cutting and grinding*
	Heavy rotating pipe facing equipment	*3*	*Machine Guarding*	*Caution signs with hazard label*	*Exclusion with barriers*	*Pipe Facing Machine*
Pipe Positioning for Welding	*Suspended load*	*1*	*Proper rigging, secondary braking*	*Spotter*	*Taglines*	*Suspended piping and equipment*
Preheat pipe to minimize cracking	*High temperatures from preheating equipment*	*10*	*Thermal Insulated Gloves*	*Caution signs with hazard label*	*Heat shields or barriers around the preheating equipment, Flame-retardant clothing*	*Open flame*
	Explosion from pressurized propane tanks	*5,11*	*Tank cradle, straps, and valve cap*	*Tank hazard label*	*Protective Bollards*	*Propane tank*
	UV Radiation from welding flash	*7*	*Welding Curtain, Welding helmet*	*Caution tape and signs with hazard label*		
	Fire from sparks	*11*	*Remove combustibles*	*Fire Watch*	*Flame-retardant clothing*	
Passes: Root pass (Initial weld to close gap), Hot pass (Joins the root weld to both groove faces), Filler pass (Multiple passes made to the fill the weld)	*Electric Shock from Welding Power Source*	*6*	*Equipment grounding*			*Electric Shock from Welding Power Source*
	High temperatures and Spatter from Weld	*10*	*Gloves, Chaps, Welding Jacket, Welding Helmet*	*Exclusion zone with signage*		*Heat and Spatter from Weld*
	Moving Mechanical Equipment, Welder	*2*	*Proper rigging*	*Spotter*	*Taglines*	*Moving Mechanical Equipment, Welder*
Buffing & grinding to Clean Weld/slag from weld	*Heavy rotating equipment from grinder wheel*	*3*	*Machine Guarding*	*Exclusion zone with signage*		*Grinder wheel*
	High temperature from grinder and slag	*10*	*Welding Blanket*	*Exclusion zone with signage*		*Sparks for cutting and grinding*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.6-
Pipeline Construction High Energy Hazards and Controls Inventory, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Welding

Table A.75—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	There are no incremental specific Environmental Considerations beyond those identified in Section 4; additional environmental requirements require the input of a specialized Welding Inspector

Table A.76—Typical Monitoring Requirements for Welding Operations

✓	Description
	Confirm that all materials are inspected for compliance with Operator specifications
	Check joint preparation and fit up for compliance with WPS requirements and specified drawings
	Confirm that long seams are oriented and staggered per construction specification
	Confirm that the heat number of the pipe or components are visible and recorded properly
	Confirm that all required quality inspections and nondestructive examination (NDE) are performed as per Operator specifications
	General housekeeping related to clean-up of welding related debris (e.g. bevel shavings, weld rod ends)
	Confirm that specialized welding expertise is engaged for any items associated with the following: — Confirmation of appropriate welding equipment — Confirmation of appropriate handling and storage of welding materials — Confirming qualifications of welders, including tack welders, and welding operators — Identification of substandard quality of work — Examination of finished work for compliance of code, standards, specifications, and drawings — Confirmation of any issues related to weld repair

A.6.7 Typical Outputs for Welding Inspection

Table A.77—Typical Reporting Requirements

✓	Description
General	
	Safety Hazard Observation Report
	Job safety analysis (JSA)/Hazard Identification Report
Nondestructive Examination (NDE)	
	Radiographic Records
	Ultrasonic Testing
	Visual Inspection Report(s)
	NDE Results (e.g. radiographic film) and Supporting Records
	NDE Personnel Qualification Reports
Welding	
	Welding Parameter Form
	Mainline Welding Report
	List of Qualified Welders' Reports
	Welding Coupon Test Reports
	Tie-in and Poorboy (i.e. short section) Welding Report(s)

	Fabrication Welding Report(s)
	Weld Mapping
Other	
	Damaged Pipe Report
	Nonpipe Material/Equipment Damage Report
Daily	
	Work completed, which can include, and is operator specific: — Number of front end/back end welds completed, and the number of welds rejected daily — Start and end locations for the Welding Crews — Operator-specific Welding Inspection Forms — Material Traceability Report
	Other daily reports required by the Operator

NOTE The reference information provided in Table A.78 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.78—List of References—Welding

Document No.	Type	Title
American National Standards Institute (ANSI)		
ANSI Z49.1	Standard	Safety in Welding, Cutting, and Allied Processes
American Petroleum Institute (API)		
API 1104	Standard	Welding of Pipelines and Related Facilities
American Society of Mechanical Engineers (ASME)		
ASME *BPVC* Section IX	Code	Welding, Brazing, and Fusing Qualifications
American Welding Society (AWS)		
AWS QC1	Standard	Standard for AWS Certification of Welding Inspectors
Canadian Standards Association (CSA)		
CSA-W117.2	Standard	Safety in Welding, Cutting, and Allied Processes
CSA W178.2	Standard	Certification of Welding Inspectors
CSA Z662	Standard	Oil and Gas Pipeline Systems
INGAA Foundation		
N/A	Action Plan/Best Practice	Training Guidance for Welding & Coating Workers & Inspectors
N/A	Action Plan/Best Practice	Best Practices in Applying API 1104 Appendix A

A.7 Coating

A.7.1 Overview

Coating of the pipeline provides a protective barrier against damage to the pipe (e.g. corrosion, scrapes). Most of the coating operation occurs in a centralized plant; since individual pipe joints are welded together during the construction process, the (girth) weld area requires coating in the field.

While coating requires specialized expertise, not just for the execution of the work, but also Inspection of the work, there are several items that the Inspector should be aware of as part of undertaking their role effectively (i.e. working alongside Coating Inspectors). The information presented within this section deviates somewhat from most sections in this annex and focuses on providing the Inspector with sufficient knowledge to determine the limitations of their role in the context of coating inspection.

Refer to Annex E for further information on the role and responsibilities of a Corrosion Control Inspector.

A.7.2 Inputs

While the Inspector is not expected to undertake significant coating inspection activities, some indication of typical inputs is provided as orientation. This information is detailed in Table A.80.

A.7.3 Execution

Since coating inspection is a specialized role, the listing provided in this section is focused on items that would not typically require specialized coating expertise (i.e. indication of items that would prompt the Inspector to escalate identified issues).

Typical items that the Inspector should monitor for during the coating process are identified in a series of checklists as detailed in Table A.79.

Table A.79—Monitoring Requirements for Coating

Item	Description	Reference
Prior to Commencing Work	— Confirm that key issues that have been identified are detailed and addressed	Table A.81
Safety	— Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.82
Environmental Considerations	— Identify specific items that should be monitored throughout Coating Operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.83
General Pipe Surface Preparation and Coating Operations	— Typical monitoring requirements for a nonspecialized Inspector; it is important to identify those situations that require a specialized Coating Inspector — Confirm that all pipe coating damage has been identified and repaired prior to the physical lowering-in of pipe	Table A.84

A.7.4 Outputs

While general Inspectors may be asked to assist a Coating Inspector, they are not to perform coating inspection activities on their own, unless properly experienced and/or trained and qualified in the specific coating application. Some indication of typical outputs is provided as background information in Table A.85.

A.7.5 Typical Input Requirements for Coating Inspection

Table A.80—Information Requirements for Coating

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to coating, such as: — Surface Preparation — Coating Procedures — Coating Specifications — Alignment Sheets — Manufacturer-supplied information (e.g. storage and handling requirements) — Safety data sheets (SDS) for coating material

✓	Description
	Contracts and agreements related to: — Coating — Nondestructive Examination (NDE) — Construction Survey
	Permits related to: — Environmental — Road Use — Safe Work
	Operator-specific Safety Plan, including, but not limited to: — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing coating requirements for the following, but not limited to: — Disposal methods — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Coating Plan

A.7.6 Items for Inspecting Typical Coating Operations

Table A.81—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Verify that blasting medium and coating materials are approved

Table A.82—Safety Concerns for Coating

✓	Description
	Confirm that whip checks are installed on hoses
	Confirm that protection is in place to prevent blast media from entering valves, pipe, fittings, and appurtenances
	Confirm use of appropriate respiratory protection devices, as required (e.g. working with lead-based coating)
	Confirm that specialized Coating Inspector is engaged to identify additional safety requirements

High Energy Hazards and Controls Inventory – Coating

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Surface Preparation (Sandblasting of weld where two pipeline sections have been joined)	*Blasting stream (pressurized air and blast media)*	*14*	*Kill switch, supplied air, ventilation hood, leathers*	*Exclusion zone, barrier around air compressor tank safety zone*	*Signage of denoting pressurized tanks*	
	Pressure from air compressor sand blasting equipment (explosion)	*14*	*Whip checks*	*Hearing protection*		
	Chemical Inhale from sand blasting particles	*7*	*Wearing Respirator Mask/Ventilation*			
	Blasting hose connection failure	*14*	*Whip check connected with safety pins and tie wire*			*Hose and connection must be regularly inspected (approx. 120+ psi with media)*
	Open flame from tiger torch	*11*	*Supply switch (Supply switch that controls fuel flow to the torch)*			*Pre-heating is not done by a small handheld torch. It is typically a weed burner that is used with a valve.*
Preheating (by hand)	*Pressure from gas cylinder for preheat torch*	*5*	*Cylinder valve*			
	Hot joint/weld	*10*	*None*			
Preheating (by induction coil)	*Induction heating coil*	*14*	*None*	*Spotter*	*Tag lines, Danger tape with cones*	
	Suspended load of heating ring	*1*	*Automatic brake on lifting equipment, additional securing line*	*Spotter*		
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
	Electrical contact with heating ring	*6*	*Insulating guard*	*Spotter*		
	Hot joint/weld	*10*	*None*			

High Energy Hazards and Controls Inventory – Coating (continued)

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Mixing and Application (spray)	Heavy equipment moving with workers nearby on foot	2	None	Spotter	Cameras, Reverse alarms	
	Mechanical motion from spinning coating ring	3	Machine guard around spinning ring			
Machine coating ring of preheated pipeline joint	Suspended load of coating ring	1	Automated brakes on lifting equipment, additional securing line	Spotter		
	Electrical contact with coating ring	6	Insulating guard around shock hazard	Spotter		

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.7-

***Pipeline Construction High Energy Hazards and Controls Inventory*, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Coating**

Table A.83—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Review site-specific requirements for blast media
	Monitor for adherence to Operator requirements for disposal methods (e.g. silica-based blast media)
	Confirm that specialized Coating Inspector is engaged to identify additional environmental requirements
	Confirm that coating material and blast media are removed and disposed per Operator specifications

Table A.84—Typical Monitoring Requirements for General Pipe Surface Preparation and Coating Operations

✓	Description
	Confirm qualifications of coating applicators
	Confirm that all materials are handled and stored as per Manufacturer and Operator specifications
	Confirm that all materials being used match Operator specifications
	Confirm that materials are not expired per Manufacturer expiry date(s)
	Confirm that all containers for coating material are in good condition and not damaged in any way
	Confirm that all required Nondestructive Examination (NDE) is completed before applying protective coatings
	Confirm that all jeep equipment settings are appropriate for different thicknesses of coating
	Monitor holiday detection activities for compliance to Operator requirements
	Monitor Construction Contractor supplied jeeping/holiday detectors to verify that detectors are set at correct voltage output and have proper grounding
	Confirm that all jeep equipment is calibrated and within calibrated period
	Check all weld joints for holidays after being coated
	Confirm that all coating defects are marked, repaired, and pipe sections re-jeeped before lowering-in pipe
	Confirm that holidaying/jeeping is conducted immediately behind the rear lowering-in cradle (sling assemblies with rollers that a sideboom uses to lift the pipe section) for coating damage from rollers unless another location has been identified by the Operator
	Confirm that coating repairs are completed in accordance with the project coating standards for surface preparation, coating application, curing, and holiday testing
	General housekeeping of coating related debris (e.g. gloves, brushes, rollers, containers, overspray)
	Identify situations that require specialized coating expertise including: — Confirming appropriate pre-heat temperatures around circumference of pipe — Confirming that coatings are only applied within the surface, weather, and atmospheric requirements of Operator Specifications and the Manufacturer's specifications — Confirming that surface profile complies with Owner Specifications and is recorded — Identifying substandard quality of work — Examining finished work for compliance to code, standards, specifications, and drawings — Interpreting specifications and codes — Confirming any issues related to coating repair

A.7.7 Typical Outputs for Coating Inspection

Table A.85—Typical Reporting Requirements

✓	Description
General	
	Record any weather or other logistical conditions that caused either an increase or decrease in expected progress
	Record holiday detector settings and calibration results per Operator Forms
	Confirm completion of as-built redline drawings
Daily	
	Work completed, which can include, and is operator specific: — Storage and handling conditions for coating products — Number and types of coating products — Names of the Manufacturers of coating products — Color of coating products — Batch and/or lot numbers of coating products — Shelf life of coating products in use — Holiday test results — Anchor profiles — Dry film thickness of all layers in the coating system — Quality of workmanship — Operator-specific Coating Inspection Forms — Start and end points for completed coating distances — Start and end points for skipped locations and why they were not completed

NOTE The reference information provided in Table A.86 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.86—List of References—Coating

Document No.	Type	Title
Canadian Standards Association (CSA)		
CSA Z245.20	Standard	Plant-Applied External Fusion Bond Epoxy Coating for Steel Pipe
CSA Z245.21	Standard	Plant-Applied External Polyethylene Coating for Steel Pipe
CSA Z245.22	Standard	Plant-Applied External Polyurethane Foam Insulation Coating for Steel Pipe
INGAA Foundation		
N/A	Action Plan/Best Practice	Field Applied Coatings Best Practices
NACE International		
SP0185	Standard	Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
SP0188	Standard	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
SP0490	Standard	Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil)

A.8 Lowering-In

A.8.1 Overview

Lowering-in refers to preparing the trench base (if required, due to presence of rock or stones), picking the pipe up from its temporary supports off the ROW and placing it into an excavated trench after welding, NDE, coating of pipe joints, and completing any associated coating repairs. The focus is to monitor pipe and coating integrity during the lowering-in operation.

A considerable amount of planning and skill is required to lift the pipe using machinery. The size, number, and spacing of lifting machinery shall be calculated to minimize pipe stress and maintain equipment stability under the lowering-in process.

A.8.2 Inputs

As part of preparing for inspection during the lowering-in process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.88.

A.8.3 Execution

Typical items that the Inspector should monitor for during the lowering-in process are identified in a series of checklists as detailed in Table A.87.

Table A.87—Monitoring Requirements for Lowering-In

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.89
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.90
Environmental Considerations	Identify specific items that should be monitored throughout lowering-in operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.91
Trench Base Preparation	Prepare trench base such that pipe is not damaged when it is placed in the ditch due to rock, construction related debris, and other hazards on the trench bottom	Table A.92
Pipe Handling for Lowering-In	Monitor lifting operations for safety and confirm that no damage occurs to the pipe or coating	Table A.93
Crossings	Given the specialized nature of crossings within lowering-in operations, confirm that work is undertaken as per Operator requirements for the following: — Drilling of Trenchless Crossings — Boring of Trenchless Crossings — Cased Crossings	Table A.94
Buoyancy Control	Buoyancy control is any mechanism used to prevent the pipe from floating (exerting undue stresses/strain in the pipe) where ground conditions are such that there is a lot of water present	Table A.95

A.8.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for lowering-in appear in Table A.96.

A.8.5 Typical Inputs for Lowering-In Inspection

Table A.88—Information Requirements for Lowering-In

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to lowering-in, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Alignment Sheets — Buoyancy control requirements
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey
	Permits related to: — Crossings — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing lowering-in requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Fire Prevention/Firefighting Plan — Lowering-In Plan [identify the type and number of lifting/hoisting equipment (e.g. sidebooms) required and the number of and specific roles of workers to be onsite to lower and set the pipe in the trench] — Lift Plan

A.8.6 Items for Inspecting Typical Lowering-In Operations

Table A.89—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety analysis (JSA) and hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings (as required) — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Conduct planning and tailgate meetings before the start of lowering-in to make sure all personnel involved are aware of: — Lifting sequence — Critical lift circumstances — Equipment size and numbers — Individual roles and responsibilities during the lowering-in phase
	Confirm that the Contractor is using only calibrated holiday detectors with current calibration certificates
	Check training certificates of all crane operators and riggers to verify that they are competent and trained
	Confirm that Manufacturer's procedures applicable to the operation of the equipment, including rated capacities, recommended operating speeds, special hazard warnings, and instructions are readily available in the cab
	Confirm that slings, belts, and cradles have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and confirm their suitability for lifting the pipe sections
	Confirm that the Contractor has secured all belts, slings, and boom lines to the boom before moving the sideboom
	Confirm that cranes using an outrigger (hydraulically operated supports that increase the footprint of the crane, thereby offering more lateral stability) are supplied with a factory steel float (the large circular pad on the bottom of the outriggers that distribute load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes

Table A.90—Safety Concerns for Lowering-In

✓	Description
	Confirm that a job safety analysis (JSA) is conducted and strictly adhered to throughout lowering-in operations
	Confirm that the JSA is updated as required
	Confirm that appropriate safety measures are taken to prevent tipping of equipment (e.g. sidebooms)
	Confirm that side boom operators use spotters while traversing under powerlines and overhead hazards
	Confirm that no personnel are allowed between the pipe and the trench wall, which could result in a pinch point safety hazard
	Confirm that bell holes (an excavation that allows access for tie-ins, installation, inspection, maintenance, repair or replacement of a piping section or appurtenance) are excavated in a manner that will allow for safe entry; the Contractor is responsible for determining the type of soil, benching requirements, etc. for safe entry. (see applicable regulatory requirements for soil types sloping, and benching. Such as type a, b, or c soil classifications)
	Confirm that the Contractor has a rigging control in place and removes and destroys all defective rigging

High Energy Hazards and Controls Inventory – Padding and Lowering-In

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Workers pad the excavation (with heavy padding machinery) to provide a layer of soft and fine soil, to prevent pipe damage from rocks and uneven surfaces.	*Heavy equipment moving with workers nearby on foot*	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	*Terrain can represent hazards while using heavy equipment.*
	Falls from height into trench	*8*	*None*			
Workers secure assembled pipe on several side booms' roller cradles.	*Pinch point between side boom's rollers and pipe*	*3*	*None*	*Spotter*		*Pipe movement can introduce hazards.*
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
	Assembled pipe roll/fall off cribbing	*1*	*Proper rigging, secondary braking*	*Spotter*		
Side booms travel along excavation at a slow and steady pace, laying the pipe assembly into the excavation.	*Pipe assembly suspended by several side booms*	*1*	*Proper rigging, secondary braking*	*Spotter*		
	Pinch point between side boom's rollers and pipe	*3*	*None*	*Spotter*		
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	*Terrain and limited walking areas can represent hazard around moving heavy equipment.*
	Tipping of side boom	*1*	*Cab protection (Rollover protection, Seatbelt restraint)*			

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.8-

***Pipeline Construction High Energy Hazards and Controls Inventory*, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Padding and Lowering In**

Table A.91—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	There are no incremental specific Environmental Considerations beyond those identified in Section 4

Table A.92—Typical Monitoring Requirements for Trench Base Preparation

✓	Description
	Confirm removal of construction related debris (e.g. rocks, skids, welding rods, tree roots, branches, hard frozen soil, trash items) from the trench base
	Check ditch bottom for rocks, clods, or high spots which could damage coating or pipe
	Confirm proper positioning of padding material for hard bottom trenches
	Confirm that the Contractor refers to the contract documents for the appropriate drawings, specifications, and procedures for paddings (support material used to shore up the underside and sides of pipe to properly distribute loading, typically sand and/or foam pillows)
	Confirm adequate spacing between the paddings so that they do not split or overly compress and maintain the specified padding thickness
	Confirm that foam boxes are installed in accordance with design documents and rests on undisturbed soil
	Confirm that rock shield coating or sand padding has been installed if there is hard/rocky matter in the backfill material
	Confirm that drain tiles are pre-located per alignment drawings
	Check buoyancy control requirements and monitor weight placement, if required

Table A.93—Typical Monitoring Requirements for Pipe Handling for Lowering-In

✓	Description
	Confirm that sidebooms are positioned to conform to the pre-approved Lowering-in Plan/Procedure
	Check condition of lowering-in cradles, rollers, belts, and slings
	Check that end caps are installed on section ends
	Check that the pipe trench has been dewatered (drained) where warranted before lowering-in the pipe so that the pipe will not float off the trench base
	Check connection of cathodic protection test lead cables where installed
	Confirm that no pipe will be lowered that has not had all weld repairs made and girth weld protection applied and tested
	Confirm that pipe and coating are not damaged during lowering-in operations
	Confirm that the pipe is not overstressed during lowering-in operations by limiting sideboom spacings to less than or equal to that specified in the Lowering-In Plan
	Confirm that no workers are in the trench, on the pipe, between pipe and trench or pipe and equipment during lowering-in operations
	Monitor for trench wall failure while pipe is suspended over or in the trench
	Confirm that the coated pipe is never dragged or pulled on the trench base
	Confirm that lowered pipe never swings or rubs against trench walls or sidebooms
	Confirm that the pipe is in the center of the trench and conforms to all side, over, and sag bends without adding any external stress to the pipe
	Confirm that drain tiles are not damaged during lowering-in operations
	Confirm that pipe bends are fitted in the trench properly, per the following: — Sag bends—the legs should be firmly supported — Over bends—the crutch should be firmly supported (this is important to avoid back fill load to open the bend) — Side bends—the side bends should be kept away from the trench wall
	Confirm that the ditching, lowering, and backfilling activities occur in close proximity to one another
	Confirm that specified gaps between lowered pipe and buried Third-Party utilities (e.g. pipelines and cables) are maintained

✓	Description
	Review and amend the job safety analysis (JSA), tailgate documents, and Lowering-in Plan if there has been any deviation

Table A.94—Typical Monitoring Requirements for Trenchless or Cased Crossings

✓	Description
General	
	Confirm that crossing is consistent with design shown on alignment sheet
Drilling of Trenchless Crossings	
	Confirm that the design is satisfied by both the drilling company and the Operator
	Verify that the directional profile has been confirmed by an Engineer or other trained and competent person
	Verify that the directional drills are installed as outlined by the directional drill profile
Boring of Trenchless Crossings	
	Confirm that the carrier pipe is of the correct wall thickness and is coated with the specified abrasion-resistant coating
	Confirm that bore holes are placed in a safe location in order to perform the work
	Since exact bell hole locations are determined by the Contractor onsite, confirm that selected locations are safe and meet any constraints within crossing agreements and Operator specifications
	Confirm that entry and exit trenches are located and excavated in a manner that will not disturb the road or railroad
	Confirm that trench faces are sloped or timbered/shored as necessary to prevent soil collapse
	Confirm that the bore diameter is larger than the diameter of the pipe by the specified value
	Confirm that all soil is removed from inside of the pilot pipe before attaching it to the carrier pipe
	Confirm that the bored hole is never left unlined
	Confirm that punching and/or reaming is not used to advance the carrier pipe
	Confirm that carrier pipe joints are properly positioned in the trench and the trench is safe for welding, coating, and inspection
	For voids detected before pipe installation, confirm that the Contractor is filling the voids as per the methods pre-identified and approved by the Operator
	Confirm that depths of cover are validated with the Contractor before crossing activities start
	Confirm that all pilot pipe has been removed from the section and the carrier pipe is properly aligned on the entry and exit sides of the crossing
	Confirm that the direction or angle of the bore has not deviated from the limits of the borehole by looking through one end and seeing at least part of the borehole at the other end
Cased Crossings	
	Verify that casing installation methods, equipment used, operator performance, and completeness/ acceptability, including the correct pipe, wall thickness, and coating, if any, are in accordance with Operator specifications
	Confirm that mainline welding is acceptable along with the pipe coating and/or pipe jacketing
	Verify that mainline pipe insertion procedures are followed so that no damage occurs to the pipe and its coating
	Inspect spacers/insulators visually, during and after installation
	Confirm installation of seals and vents
	Verify that the completed cased crossing is not electrically shorted and testing methods are correct
	Verify that depth profile specifications are met
	Verify that the required documentation is completed

Table A.95—Typical Monitoring Requirements for Buoyancy Control

✓	Description
	Monitor and record the start and stop locations as well as type of all buoyancy control (e.g. set-on weights, bolt-on weights, continuous concrete)
	Monitor and record the spacing between set-on or bolt-on weights
	Confirm that trench depth provides the specified cover to the top of the weight
	Confirm that lowering-in of a continuous concrete coating section has sideboom support at the specified intervals defined in the stress analysis
	Confirm that bolt-on weights have wood lagging between weights to avoid movement during installation

A.8.7 Typical Outputs for Lowering-In Inspection

Table A.96—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Work completed, which can include, and is operator specific: — Coating repairs — Bedding and padding lengths and depths — Starting and completed footage lowered-in — Field applied rock shield length, and start and end locations — General trench materials/conditions — Buoyancy control types, locations, and start and stop locations — Lowering-in operations carried out per lowering-in specifications, procedures, and drawings

NOTE The reference information provided in Table A.97 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.97—List of References—Lowering-In

Document No.	Type	Title
American Society of Mechanical Engineers (ASME)		
ASME B30.5	Standard	Mobile and Locomotive Cranes
ASME B30.14	Standard	Side Boom Tractors

A.9 Horizontal Directional Drilling Installation

A.9.1 Overview

If required by the project due to logistical or environmental constraints (e.g. where pipe crosses rivers, wetlands, roads, or other obstacles), pipe can be installed without a trench using HDD. HDD is a construction method that involves creating a hole underneath these obstacles, along a specially designed drill path (based on existing underground infrastructure and subsurface conditions), in order to pull the pipe back through the hole. HDD consists of the following three basic steps:

— drilling the pilot hole to establish the drill path for the crossing;

— reaming (or enlarging) the pilot hole;

— pulling the carrier pipe back through the reamed hole.

Refer to Annex C for further information on the role and responsibilities of an HDD Inspector.

A.9.2 Inputs

As part of preparing for inspection during the HDD installation process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.99.

A.9.3 Execution

Typical items that the Inspector should monitor for during the HDD installation process are identified in a series of checklists as detailed in Table A.98.

Table A.98—Monitoring Requirements for Horizontal Directional Drilling Installation

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.100
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.101
Environmental Considerations	Identify specific items that should be monitored throughout horizontal directional drilling (HDD) installation operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.102
General HDD Operations	Identify general items that should be monitored throughout the HDD process, including specific monitoring items for drilling fluids	Table A.103
Prior to HDD (Onsite)	Identify general items that should be monitored onsite prior to HDD	Table A.104
Pilot Hole Operations	Identify specific items that should be monitored during pilot hole operations	Table A.105
Reaming Operations	Identify specific items that should be monitored during reaming operations	Table A.106
Pull Back Operations	Identify specific items that should be monitored during pull back operations	Table A.107
Post-Installation	Identify specific items that should be monitored during post-installation activities	Table A.108
Clean-up Operations	Identify specific items that should be monitored during clean-up operations	Table A.109

A.9.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for HDD installation appear in Table A.110.

A.9.5 Typical Inputs for Horizontal Directional Drilling Installation Inspection

Table A.99—Information Requirements for Horizontal Directional Drilling Installation

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to horizontal directional drilling (HDD) installation, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Buoyancy control requirements — Rig anchoring plan and drawings for HDD equipment set-up — Specified directional drill profile

✓	Description
	— Geotechnical information related to construction plan
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey
	Permits related to: — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing HDD installation requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Fire Prevention/Firefighting Plan — HDD Plan, including Operator-approved design drawings and specifications, tolerances, equipment and manpower requirements, noise limits, drilling fluids, coating type, anticipated risks and their mitigation, as well as specialized operations such as bundle drills (i.e. where a single directional drilling rig is used to pull multiple pipes through a single hole), intersect drills (i.e. where two directional drilling rigs are used at opposite ends of a site to bore a single hole), etc. — Site-specific Security Plan during HDD (including fencing, lighting, security guards) — Relevant Contingency Plans (e.g. inadvertent return during HDD operations)

A.9.6 Items for Inspecting Typical Horizontal Directional Drilling Installation Operations

Table A.100—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety analysis (JSA) and hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Conduct planning and tailgate meetings before the start of horizontal directional drilling (HDD) installation to make sure all personnel involved are aware of: — Lifting sequence — Critical lift circumstances — Equipment size and numbers — Individual roles and responsibilities during the HDD installation phase — Bore method to be used
	Confirm that the Contractor is using only calibrated holiday detectors with current calibration certificates
	Check training certificates of all crane operators and riggers to verify that they are competent and trained
	Confirm that slings, belts, and cradles have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and confirm their suitability for lifting the pipe sections
	Confirm that the Contractor has secured all belts, slings, and boom lines to the boom before moving the sideboom
	Confirm that cranes using an outrigger (hydraulically operated supports that increase the footprint of the crane, thereby offering more lateral stability) are supplied with a factory steel float (the large circular pad on the bottom of the outriggers that distribute load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes
	Confirm that all materials required for work (e.g. drill pipe, bits, reamers, casing, downhole tools) are of suitable size and grade for the work to be performed and are free of defects or damage that may result in failure
	Verify that type of coating used on pipe sections is consistent with HDD Plan
	Establish the pilot tracking method to be used for the project (e.g. 3D wire charting, above grade scanner traceability, gyro feature within pilot itself)
	Confirm that drilling equipment, including drill rig anchoring system and pump intakes, is in safe condition and good working order (e.g. clean and free of fuel and/or lubrication leaks), and of suitable type and size to install the crossing in accordance with Operator-approved drawings and specifications
	Confirm that a surface survey of the steering system is completed within acceptable tolerances in accordance with Operator-approved specifications
	Confirm that survey requirements for HDD are met in accordance with A.1
	Confirm that service/fuel vehicles are equipped with Operator-approved hydrocarbon spill kits suitable for small spill clean-up on both ground and water surfaces
	Confirm proper installation of necessary coils (i.e. locating devices placed on the ground surface that provide directional information for steering the bore)

Table A.101—Safety Concerns for Horizontal Directional Drilling Installation

✓	Description
	Confirm that a job safety analysis (JSA) is conducted and strictly adhered to throughout horizontal directional drilling (HDD) installation operations
	Confirm that the JSA is updated as required
	Confirm that side boom operators use spotters while traversing under powerlines and overhead hazards
	Confirm that no personnel are allowed between the pipe and the trench wall, which could result in a pinch point safety hazard
	Confirm that bell holes (an excavation that allows access for tie-ins, installation, inspection, maintenance, repair or replacement of a piping section or appurtenance) are excavated in a manner that will allow for safe entry; the Contractor is responsible for determining the type of soil, benching requirements, etc. for safe entry
	Confirm that the Contractor has a rigging control in place and removes and destroys all defective rigging
	Confirm that drilling equipment, including drill rig anchoring system and pump intakes, is in safe condition and good working order (e.g. clean and free of fuel and/or lubrication leaks), and of suitable type and size to install the crossing in accordance with Operator-approved drawings and specifications

High Energy Hazards and Controls Inventory – HDD

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Mobilization of Equipment on both entrance and receiving end, Staging and material mobilization	*Heavy equipment moving with workers nearby on foot*	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	*Traffic control devices: Dependent on the project location*
	Suspended load	*1*	*Proper rigging*	*Spotter*	*Taglines*	
	Electrical contact with source (> 50 Volts) possible overhead powerline	*6*	*De-energization (uncommon for transmission lines), Power line lifting*	*Spotter*	*Exclusion with barriers*	
Reamer runs through length of future pipeline and bentonite is pumped in to keep the hole open	*Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)*	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*
	Reamer rotating above ground	*3*	*Torque limiter device, Emergency stop function*	*Alarm sensors*	*Spotter*	
Side Boom lifts pipe and loads into rig	*Suspended load*	*1*	*Proper rigging, secondary braking*	*Spotter*	*Taglines*	
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
	Drill rig threading pipe	*3*	*Emergency stop function reamer*	*Spotter*		
Pipe elevated by Side boom using Cradles (with rollers)	*Suspended load*	*1*	*Proper rigging, secondary braking*	*Spotter*	*Taglines*	
	Heavy equipment moving with workers nearby on foot	*2*	*None*	*Spotter*	*Cameras, Reverse alarms*	
Pipe continuously fed until the entire pipeline has been laid in the hole (continuous process)	*Threading of pipes in drill rig*	*3*	*Drilling guards/emergency stopper*	*Signage*		
	Damaging existing pipelines - Ground Disturbance (contain toxic/flammable gas/other)	*5,7,11*	*Schedule and verify implementation of utility outage/ De-pressurize pipes*	*Daylighting, Locates, hydro-vac, exposing, potholing*	*Flame-retardant clothing*	*Also make sure to check utility plans and As-Builts*

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.8-
Pipeline Construction High Energy Hazards and Controls Inventory, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-HDD

Table A.102—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Monitor for inadvertent surface returns
	Confirm that appropriate testing is conducted for disposal of drilling fluid.

Table A.103—Typical Monitoring Requirements for General Horizontal Directional Drilling Operations

✓	Description
	Monitor for compliance to the Operator-approved horizontal directional drilling (HDD) Plan, including adherence to temporary workspace (TWS) boundaries and verified ROW limits
	Monitor for compliance to the site-specific Security Plan
	Monitor for compliance to noise limits placed on the operation (i.e. total noise limit through entire operation or at specific times of day)
	Confirm that visual and voice contact are always maintained between all drill personnel so that any operational changes are communicated immediately and effectively
	Monitor for compliance to Manufacturer's specifications for equipment (e.g. operating limits, operational requirements, maintenance and service requirements)
	Monitor refuelling of any equipment near watercourses and wetlands for compliance with Operator-approved specifications
	Monitor the drill path for surface migration (e.g. surface seepage, sinkholes, settlement) during drilling, reaming, and pipe installation procedures in accordance with Operator-approved specifications
	Confirm monitoring and recording of tank pit volume, drilling fluid flow and pressure, rate of penetration, rotary torque, rotational speed, fluid discharge rate, bit location, and drill string (continuous section of drill pipe) axial and torsional loads
	Confirm that entry and exit pits are immediately and continually pumped out to contain drilling fluid and cuttings (solid material removed from the drilled hole as a result of HDD operations), if liner or tank cannot be used
	Monitor for compliance to Operator-approved specifications for any specific seasonal considerations (e.g. equipment and procedures to maintain drilling fluid flow and water supply during cold weather conditions, fluid release monitoring of frozen watercourses during drilling)
	Confirm that construction is conducted in such a manner as to minimize damage to shorelines, recreational areas, and fish and wildlife habitats
	Confirm use of borehole casing centralizers during drilling of pilot hole, reaming passes, and pipe pull back, if applicable
Drilling Fluids	
	Confirm that drilling fluid and cuttings handling and storage equipment is available during all aspects of work
	Verify use of Operator-approved drilling fluids and additives only
	Confirm that drilling fluid properties are tested and reported in accordance with Operator-approved specifications
	Monitor drilling fluids to maintain full annular circulation
	Confirm that drilling fluid losses (i.e. at locations other than the entry and exit points) are minimized
	Confirm that steps are taken to restore circulation if annular circulation is lost
	Confirm that annular drilling fluid pressures (pressure within the annulus, the region bounded by two concentric circles, of the drilled hole and the downhole string of drill pipe) are monitored and recorded to identify potential inadvertent surface returns (the loss of drilling fluid from the slurry or lubrication system)
	Confirm that recirculation of drilling fluid surface returns is maximized
	Confirm proper handling (i.e. containment and collection) of inadvertent surface returns of drilling fluids in accordance with relevant Contingency Plan and Operator-approved specifications
	Confirm that the relevant Contingency Plan is followed in the event of an inadvertent surface return, including abandonment of the existing hole and re-drilling at a second location, if required
	Confirm that operations are halted immediately if a loss of drilling fluid occurs in the immediate vicinity of a watercourse/wetland or on land and that appropriate action is taken in accordance with Operator-approved specifications
	Confirm that drilling fluid and soil testing are performed and properly documented prior to reuse
	Confirm that drilling fluid, cuttings, and soil testing are performed and properly documented prior to disposal
	Confirm that handling, cleaning, and disposal of drilling fluid and cuttings are in accordance with Operator-approved specifications
	Verify that drilling spoils are kept as dry as possible for local mixing and burial or spreading, if appropriate
	Confirm that any pit containing drilling fluid that is unattended at any time is fenced to prevent entry of animals or unauthorized personnel

Table A.104—Typical Monitoring Requirements Prior to Horizontal Directional Drilling (Onsite)

✓	Description
	Monitor erection and removal of the horizontal directional drilling (HDD) equipment in accordance with Operator-approved drawings
	Confirm that the expected drill path is clearly flagged on both sides of the watercourse channel and structure being crossed for quick reference in the event of a potential fracture, prior to commencing any drilling operations
	Confirm that the entry and exit points are staked on the ground in accordance with Operator-approved drawings and specifications
	Confirm that all utilities in proximity of the drill path are located in accordance with Operator-approved specifications
	Verify that there are no gaps in steering system coverage over accessible ground surfaces for the entire length of the drill path
	Monitor hydrostatic testing of all pipe sections prior to installation in accordance with A.12, including adequate support and restraint of pipe during the test
	Verify proper installation of impervious synthetic liner or metal tank at entry and exit pits, if applicable
	Verify location and methods of installation of borehole casing through the entry and exit points, if required to reinforce borehole
	Monitor testing of borehole casing for proper seal, if applicable

Table A.105—Typical Monitoring Requirements for Pilot Hole Operations

✓	Description
	Confirm that correct pilot tracking method is used
	Confirm that flowing streams are monitored both upstream and downstream of the drill path in accordance with Operator-approved specifications, if applicable
	Verify that a small diameter pilot hole is drilled along the alignment in accordance with Operator-approved drawings and specifications, including directional tolerances and curve radius
	Confirm that deviations between the recorded position of the drill string and the plan and profile tolerances are documented and immediately reported
	Confirm that final survey at ground elevation is completed upon exit of the pilot hole bit and tied into the existing project survey

Table A.106—Typical Monitoring Requirements for Reaming Operations

✓	Description
	Confirm that a swivel device is used to connect the pipe pull section to the reaming assembly to minimize torsional stress imposed on the section
	Verify that the pilot hole is reamed to a diameter suitable for installation of the prefabricated pipe section in accordance with Operator-approved specifications, including number of reaming passes and maximum reaming rates
	Monitor completion of swab passes to clear borehole obstacles prior to pull back operations in accordance with Operator-approved specifications, if required, including number of swabbing passes
	Confirm that lost or lodged tools/equipment are removed from the reamed hole prior to attempting pipe pull back

Table A.107—Typical Monitoring Requirements for Pull Back Operations

✓	Description
	Verify that the directional drills are installed as outlined by the directional drill profile
	Confirm that all welding and coating inspections (including visual inspection for defects) and nondestructive testing (NDT) examinations have been completed prior to horizontal directional drilling (HDD) installation
	Confirm that pull back operation starts immediately after the final swab pass is completed
	Confirm that pull section is safely supported as it proceeds during pull back in accordance with Operator-approved specifications, including suitable number and condition of roller supports and proper support spacing
	Monitor the lift operation during pull back for compliance with Operator-approved specifications, including use of appropriate lifting equipment, proper entry/exit angles, free movement of pipe between rollers, undamaged coating, proper radius of curvature of pipe, and support of the pipe end as it leaves the rollers
	Confirm that pull forces during pull back are monitored and recorded, and that pull forces are in accordance with Operator-approved specifications
	Confirm that situations encountered during pull back that could cause coating damage are corrected immediately
	Confirm that pipe lodged in the drill hole during pull back is recovered, if possible, or abandoned in accordance with Operator-approved specifications and Contingency Plans
	Confirm that pull section coating is inspected for holidays at point of entry and any coating damage found is repaired in accordance with A.7
	Confirm that pull section is installed in one continuous length with no field joined welds between pull sections if space allows; if space is not available, confirm that field joined welds between pull sections are minimized and fully inspected by radiographic inspection prior to installation in accordance with A.6
	Confirm that coating of field joints is given sufficient time for curing, if field joined welds between pull sections are necessary during the pull
	Confirm that ballast control (to aid in pull back of large diameter pipe) is performed in accordance with Operator-approved specifications, including acquisition and disposal of water and monitoring of water fill rate
	Confirm that any damage to the pipe resulting from external pressure or buoyancy modification during installation is properly repaired
	Confirm that installation of the pipe section within the reamed hole is in accordance with Operator-approved drawings and specifications, including minimum length, alignment, profile, and grade to which the pipe is laid
	Confirm that a minimum of one full joint of pipe is exposed at the front of the pull section after installation to allow for cleaning and inspection of pipe and coating
	Monitor for proper separation of drill pipe and tooling using Operator-approved method and equipment
	Verify methods of removal of borehole casing through the entry and exit points after pipe pull back

Table A.108—Typical Monitoring Requirements for Post-installation

✓	Description
	Confirm that each end of the section is clean, dry, and not in contact with the ground to allow for visual inspection and coating continuity measurement
	Inspect pipe visually after installation
	Confirm that a gauge/sizing plate is run to check for any deformation from the installation in accordance with Operator-approved specifications
	Verify that an internal inspection tool (i.e, caliper, UT, XYZ) run through the installed pipe is performed in accordance with Operator-approved specifications
	Confirm that weld caps are installed on crossing pipe ends if tie-ins to the pipeline are delayed
	Confirm that over bend for tie-in is properly supported and performed in accordance with Operator-approved specifications
	Confirm that connections to existing pipe are completed and tested in accordance with Operator-approved drawings and specifications and A.6

✓	Description
	Confirm that buried pipe ends are marked for ease of future locating

Table A.109—Typical Monitoring Requirements for Clean-up Operations

✓	Description
	Monitor that water from washing down drilling equipment is managed and/or contained to prevent contamination of the drilling fluids or mud; stop this process if equipment or surfaces being washed are contaminated with oils or greases, resulting in contamination of the drilling fluid or mud
	Confirm that any liquids contained are tested prior to disposal
	Confirm that all attempted drill paths and the final drill path are checked for voids and subsidence
	Confirm that all void spaces (e.g. abandoned drill holes) are filled and compacted with Operator-approved material, sealed, and restored back to original contours in accordance with Operator-approved specifications
	Confirm that entry and exit pits that contained drilling fluids or cuttings are remediated in accordance with Operator-approved specifications
	Confirm that work areas are cleaned up, including removal of waste, remaining materials, and equipment used from the site

A.9.7 Typical Outputs for Horizontal Directional Drilling Installation Inspection

Table A.110—Typical Reporting Requirements

✓	Description
General	
	Confirm that Contractor reporting is completed for specialized items such as horizontal directional drilling (HDD) (e.g. Coating Conductance Test)
	Confirm completion of as-built redline drawings, including plan and profile views of HDD, if applicable
	Complete HDD reports, if applicable, including: — Drilling Fluid Properties Report — Drilling Fluids and Cuttings Disposal Report — Drilling Fluid Loss and Release Report — Reaming Report, including soil conditions impacting production rates, e.g. amount of rock — Pipe Pull Back Report, including equipment and force used during pull back — Gauge/Sizing Plate Tool Run Report
Daily	
	Work completed, which can include, and is operator specific: — Coating repairs — Ballast control types, locations, and start and stop locations — HDD operations carried out per HDD specifications, procedures, and drawings

NOTE The reference information provided in Table A.111 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.111—List of References—Horizontal Directional Drilling Installation

Document No.	Type	Title
Canadian Association of Petroleum Producers (CAPP)		
CAPP 2004-0022	Guideline	Planning Horizontal Directional Drilling for Pipeline Construction
Federal Energy Regulatory Commission (FERC)		
N/A	Guideline	Guidance for Horizontal Directional Drill Monitoring, Inadvertent Return Response, and Contingency Plans (HDD Plan Guidance)
Pipeline Research Council International (PRCI)		
PRCI PR-444-133602	Report	Assessing the Integrity of Coating Systems on Pipelines in Trenchless Crossings

A.10 Backfilling

A.10.1 Overview

Backfilling refers to refilling the trench with the excavated or new fill subsoil once the pipe section has been lowered into the trench. As backfilling operations begin, the soil is returned to the trench in reverse order, with the subsoil put back first followed by the topsoil, returning the topsoil to its original position. The Inspector should monitor for the following:

- backfill material is suitable and placed in the trench in such a way that the pipe and coating are not damaged;
- coating damage is repaired per Operator specifications prior to backfilling;
- all buoyancy controls are in place, if required.

A.10.2 Inputs

As part of preparing for inspection during the backfilling process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.113.

A.10.3 Execution

Typical items that the Inspector should monitor during the backfilling process are identified in a series of checklists as detailed in Table A.112.

Table A.112—Monitoring Requirements for Backfilling

Item	Description	Reference
Prior to Commencing Work	— Confirm that key issues that have been identified are detailed and addressed	Table A.114
Safety	— Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.115
Environmental Considerations	— Identify specific items that should be monitored throughout Backfilling operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.116
General Operations	— Identify overall items that Inspectors should monitor during backfilling operations	Table A.117
Materials	— Padding (e.g. sand) refers to the material placed around the pipe for uniform support and protection against pipe and coating damage; this operation should be monitored for adherence to Operator specifications in order to prevent damage to the pipe	Table A.118
Pre-heating Operations (when required)	— When the ambient temperature is lower than the installation temperature in specifications and drawings, pre-heating operations will be required before backfilling and monitored for compliance to Operator specifications	Table A.119
Special Locations	— Inspectors should monitor for additional items when backfilling at special locations including, but not limited to, open-cut streams, high water table, wetlands, bends, facilities sites, fenced locations, and slopes	Table A.120
Primary and Secondary Roads—Bored	— Primary roads refer to highways and major roads, which are paved main roads with large traffic volumes, well-marked traffic lanes, shoulders, and ditches — Secondary roads refer to roads with moderate traffic volumes, well-marked traffic lanes and with/without shoulders or ditches; these roads are surfaced with granular materials, soil, or both; these roads also include private driveways, roadways, access roads, etc. — Inspectors should monitor for additional requirements for bored road crossings	Table A.121
Open-cut Roads	— In special cases where approval has been obtained for a pipeline to be installed by cutting the road open, inspect and confirm that the Contractor is abiding additional requirements by the Operator	Table A.122
Horizontal Directional Drilling (HDD)	— For horizontal directionally bored crossings, Inspectors should monitor Contractor activities for additional items	Table A.123

A.10.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for backfilling appear in Table A.124.

A.10.5 Typical Inputs for Backfilling Inspection

Table A.113—Information Requirements for Backfilling

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to backfilling, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Backfill Specifications
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey
	Permits related to: — Water Crossing (e.g. minimum depth of cover, buoyancy control) — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Procedures for working around overhead powerlines — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing backfilling requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Project documentation for incremental specific requirements

A.10.6 Items for Inspecting Typical Backfilling Operations

Table A.114—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor’s tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Confirm that the Operator witnesses and acquires approval before commencing the backfilling operation
	Prior to backfilling, re-inspect the trench to make sure it is free of debris
	Prior to backfilling, confirm that cover, sandbags, rock shield, and Third-Party lines have been inspected and documented per Operator specifications
	Confirm that Contractor repairs all coating damage per Operator specifications and repair procedures

Table A.115—Safety Concerns for Backfilling

✓	Description
	There are no incremental specific Safety Concerns beyond those identified in Section 4

Table A.116—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Confirm prior authorization before frozen topsoil is backfilled.

Table A.117—Typical Monitoring Requirements for Backfilling Operations

✓	Description
	Confirm that the Construction Survey crew collects as-built data before backfilling commences
	Confirm that backfilling commences as soon as practical after lowering-in the pipe; otherwise, contact the Operator's authorized representative
	On slopes, confirm that the Contractor has installed and keyed in trench breakers (physical dams built across the inside of a trench around the pipeline to prevent backfill migration and/or erosion) and subdrains in the trench per Operator drawings and specifications or as required
	Confirm that cathodic protection test leads are installed as per construction drawings and Operator cathodic protection construction specifications
	Check that the open ends of pipe are protected by appropriate plugs
	Confirm that bedding materials do not act as an electrical barrier between pipe and cathodic protection equipment
	Confirm that the Contractor uses only Operator-approved select/imported backfill
	Monitor the backfill equipment to ensure that the tolerance zone is not compromised
	Confirm that Proctor density tests are conducted as required per the Operator specifications
	Confirm that trench is filled with approved padding, packing it around the pipe where warranted
	Confirm that trench is filled with excavated material to provide firm support for the pipe
	Confirm that padding or select backfill is used to provide a minimum cushion between the top of the pipe and the start of rocky backfill, as specifications and drawings stipulate, and the Contractor does not place rocky backfill directly on the lowered pipe
	Confirm that rock shield or wood lagging is used through areas of coarse gravel and small cobble stone, instead of support bags or pillows and padding if warranted
	Confirm that larger rocks with sizes too large for backfill are hauled away or stacked neatly along the right-of-way (ROW) as specified in Operator specifications and drawings
	Check that marker tape is installed in the ditch above the pipe, where required by the Operator
	Monitor that pipes sharing a common ditch maintain the minimum distance as specified in the design documents
	Monitor that soil is backfilled in the same sequence, or in the same geotechnical layers, as when it was removed during trenching operations
	Confirm that the spoil will be placed directly on top of the pipeline with an auger type (a tool with a horizontal helical bit that physically moves backfill off the ROW surface directly into the trench) backfill technique wherever possible; otherwise, confirm that an excavator (back hoe or track hoe) will initially place spoil before a bulldozer is used for backfill

Table A.117—Typical Monitoring Requirements for Backfilling Operations *(continued)*

✓	Description
	Confirm that there is minimum cover over the installed pipe (or top of concrete weights) as specified in Operator or project specifications
	Confirm that final backfilled surface is level across the trench
	Confirm that soil compacting of agricultural (cultivated, pasture, and native range) land is carried out if specified in Operator or project specifications, drawings, and line lists
	Confirm that overall drainage control measures are undertaken as advised by the line list
	Check that watercourses or land drain reinstatement are correct and are functioning properly
	Check that ditch plugs and sack breakers are installed at the locations defined by the terrain and project specifications
	Continually observe for sinkholes along the ditch line and stop work for consultation with the Operator's authorized representative when identified or suspected
	Confirm that the Contractor compacts the spoil in the trench so that the trench crown (berm) is no higher than specified by the Operator
	Confirm that the top-most specified depth of the backfilled trench and crown for cultivated land are rock-free
	Confirm that the Contractor leaves openings in the trench crown (berm) as required to allow for natural drainage of surface water
	Confirm that the ROW is left in as close to original condition as possible
	Confirm that the Contractor will conduct final clean-up when soils are dry and unfrozen; final clean-up should be delayed until spring when spoil can be adequately compacted in the trench and spoil and topsoil can be removed from the sod surface more accurately
	Confirm that the Contractor removes spoil and stored topsoil to eliminate scalping of native sod, in a manner approved by the Operator
	Confirm that the Contractor replaces soils with adverse chemical properties within the area from which they were removed, to eliminate spread outside of the excavated site
	Confirm that the Contractor re-contours graded portions of the ROW to match the surrounding landforms and drainage patterns
	Confirm that the Contractor provides adequate erosion protection (installing suitable geotextiles) where surface drainage crosses the trench line and to prevent surface drainage from flowing down trench line
	Confirm that the Contractor re-distributes salvaged topsoil carefully over the stripped area (e.g. the size and type of equipment used and the number of passes that are needed to replace topsoil is key to reclamation success as overworking some soils can result in increased pulverization, loss of organic matter, and increased erosion potential)
	Confirm that the Contractor picks surface rock to match the stoniness level of the surrounding landscape
	If required, confirm that the Contractor uses track hoes equipped with clean-up buckets to shade the pipe berm (per initial backfill procedure) and replaces the bulk of the spoil
Cold Weather Construction	
	Confirm that during cold weather construction trench excavation, pipe lowering-in and backfilling are completed by the Contractor within 24 hours or as agreed with the Operator
	Confirm solidified or frozen backfill is broken up with a screw auger, power dozer, or other approved equipment
	Confirm that any snow or ice is removed from the compacted layer prior to placement of subsequent layers
	Confirm that during cold weather construction, the Contractor leaves a trench crown (berm) over the trench to compensate for settlement upon thawing of frozen soils as indicated in Operator specifications, construction drawings, and agreements

Table A.118—Typical Monitoring Requirements for Materials

✓	Description
	Confirm that topsoil is never used as padding material or fill
	Confirm that the backfill material is soft, free from large rocks, stumps, frozen material, or any other foreign material that can dent the pipe or scratch the external coating as per Operator specifications
	Confirm that when excavated material is not suitable for backfill, Operator-approved imported material is used for padding above and below the pipe
	Confirm that when gravel or gravel/sand mixture is used as backfilling material for buoyancy control purposes where trench walls provide firm support, the material is free-draining and exhibits sufficient shear strength when thawed and mixed with water
	Confirm that earth-filled sacks or rock riprap (rock or other support material used to armor drainage ditches and trench walls) is used for erosion control
Sand Padding	
	Confirm that if the excavated material is not suitable for padding, either a mechanical separator will be brought in or approved padding material will be hauled in and placed around the pipeline
	Confirm that where sand is used for padding, it is dry, unfrozen, and free from any rocks larger than specification or having sharp edges
	Confirm that the Contractor applies sand padding after sandbags and foam support pillows are placed in the trench
	Confirm that the Contractor uses only sandbags or foam pillows to support the pipe
	Confirm that the Contractor places the minimum thickness specified of sand padding on top of the lowered pipe as indicated in Operator or project specifications, construction drawings, and agreements
	Confirm that the Contractor is using auger equipment for backfill where coarse fragments are encountered in trench materials

Table A.119—Typical Monitoring Requirements for Pre-heating Operations (if Required)

✓	Description
	Confirm that pipeline is preheated by blowing hot air through the pipeline
	Confirm that temperatures at the inlet and outlet of the pipeline are being constantly monitored
	Confirm that inlet temperature does not exceed the pipe coating design temperature
	Confirm that outlet temperature is never less than the specified installation temperature
	Confirm that backfilling and compaction are completed while pipeline temperature is maintained above specified installation temperature
	Confirm that the length of pre-heated section is as per Operator specifications
	Confirm that all wet areas on the right-of-way (ROW) are red lined for future reference

Table A.120—Typical Monitoring Requirements for Special Locations

✓	Description
	Confirm that gravel and/or sand-filled bags are used on solidly compacted backfill at open-cut water crossings that may be subject to erosion
	Confirm that concrete weights or backfilling is used as specified in Operator or project specifications to overcome the upward buoyancy force on the pipe due to a high-water table or use sandbags in wetlands
	Confirm that for bends where no foam boxes are specified by engineering design, a minimum of sand padding will be provided based on specifications; the padding should extend beyond the tangent on both sides of the bend
	Confirm that the Contractor is backfilling and finishing the grade at compressor and pump stations, mainline valves, temporary tie-overs, meter stations, and other sites with fenced enclosures, as per Operator specifications
	Confirm that cathodic protection test leads remain intact and accessible above ground

Table A.121—Typical Monitoring Requirements for Primary and Secondary Roads—Bored

✓	Description
	Confirm that the Contractor supports both ends of the bored crossing according to project specifications, construction drawings, and agreements
	Confirm that the Contractor backfills excavated trench outside the road edges with granular materials according to Operator specifications, construction drawings, and agreements
	Confirm that the Contractor backfills and compacts outside the bore edges, below the pipe, and/or places sandbags below the pipe to minimize the risk of pipe settlement and potential buckling

Table A.122—Typical Monitoring Requirements for Open-cut Roads

✓	Description
	Confirm that for secondary roads, the Contractor uses excavated trench materials up to a specified distance below the road surface if material is free of moisture and rocks; remaining backfill will be with select, imported, granular materials according to project specifications, construction drawings, and agreements
	Confirm that backfilling is accomplished in layers, with each layer thoroughly compacted to the specified requirements with Operator-approved vibration type tamping machines to produce a smooth and even surface
	Confirm that for repaving road surfaces, the Contractor cleans the adjacent roadway outside the open-cut trench and shoulders of all mud and debris, then paves the road to leave a smooth and even surface
	Confirm that the final topping is of granular material to match with existing road surface

Table A.123—Typical Monitoring Requirements for Horizontal Directional Drilling

✓	Description
	Confirm that the Construction Team consults with the Horizontal Directional Drilling (HDD) Contractor to determine backfill and compaction requirements for both ends of any HDD crossing
	Check that both ends of the bored crossings will be adequately supported before backfilling
	Check that supports are not placed in disturbed or uncompacted soil
	Confirm that once the crossing pipe is in place, both ends of the bored crossings are immediately backfilled as per Operator specifications

A.10.7 Typical Outputs for Backfilling Inspection

Table A.124—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Work completed, which can include, and is operator specific: — Cover dimensions — Ditch crown height above grade — Land drain locations and depths — Start and end points for completed backfilling distances — Start and end points for skipped locations and why they were skipped — Number of rock hits on pipe — Number repairs due to rock hits — Schedule changes including any delay or acceleration and reasons — As-built alignment and profile of installed pipe — Holiday detector settings and calibration — Locations of damaged drain tiles for repair — Start, stop, and types of buoyancy control installed — Start, stop, and type of pipe protection materials installed — Any right-of-way (ROW), weather, or other logistical conditions that caused either an increase or decrease in expected progress

NOTE The reference information provided in Table A.125 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.125—List of References—Backfilling

Document No.	Type	Title
There are no incremental specific reference documents beyond those identified in Section 4		

A.11 Cathodic Protection

A.11.1 Overview

Cathodic protection is a technique used to control corrosion of a pipeline's metal surface by making the pipeline the cathode of an electrochemical cell. Cathodic protection is a simple method of protection where the pipeline is connected to a more easily corroded (sacrificial) metal (e.g. magnesium) that acts as the anode. The sacrificial metal then corrodes instead of the pipeline. For long pipelines, this passive galvanic cathodic protection is not adequate, and an external direct current (DC) electrical power source (rectifier) can be used to provide additional electrical current to protect the pipe.

As part of the cathodic protection system, test stations are required to take readings on a periodic basis. Typically, these test stations are installed at intervals of 2 to 3 kilometers (1.2–1.9 miles), not to exceed 5 kilometers (3.1 miles). Cathodic test leads, sacrificial anodes, negative drain leads, and ground bed cables are some of the major components that are installed at these stations to complete a cathodic protection system.

The Inspector's concern should be directed not only toward new installations but to existing Third-Party buried facilities and their cathodic protection systems where there is potential for damage during excavation.

Refer to Annex E for further information on the role and responsibilities of a Corrosion Control Inspector.

A.11.2 Inputs

As part of preparing for inspection during the cathodic protection process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.127.

A.11.3 Execution

Typical items that the Inspector should monitor for during the cathodic protection process are identified in a series of checklists as detailed in Table A.126.

Table A.126—Monitoring Requirements for Cathodic Protection

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.128
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.129
Environmental Considerations	Identify specific items that should be monitored throughout Cathodic Protection operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.130
Cathodic protection Installation	Monitor the installation of cathodic protection systems for safety as well as adherence to Operator specifications. Incorporate considerations for locating cathodic protection test stations such as: — Ease of accessibility of proposed installation location (e.g. on existing fence lines) — Use of existing facilities (e.g. valve or scraper trap locations) — Landowner restrictions	Table A.131
Cathodic protection at Third-Party Pipeline Crossings	Confirm sufficient communication with Third-Party Pipeline Owners to facilitate that requirements of the crossing agreement are met in a safe and efficient manner	Table A.132

A.11.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for cathodic protection appear in Table A.133.

A.11.5 Typical Input Requirements for Cathodic Protection Inspection

Table A.127—Information Requirements for Cathodic Protection

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to cathodic protection, such as: — Access Road Drawings — Line List (e.g. special concerns for each Landowner) — Cathodic Protection Installation Specifications — Cathodic Protection Testing Specifications — Third-Party utility locations where cathodic protection connections are required — Locations and Types of Ground Beds and Anodes
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Crossing Agreements — Cathodic Protection Installation — Construction Survey
	Permits related to: — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing cathodic protection requirements
	Other project-specific Plans, which may include: — Cathodic Protection and Installation — Fire Prevention/Firefighting Plan

A.11.6 Items for Inspecting Typical Cathodic Protection Operations

Table A.128—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Cathodic protection requirements as per Operator specifications — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor’s tailgate meetings (as required) — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns

Table A.129—Safety Concerns for Cathodic Protection

✓	Description
	Confirm that Manufacturer’s instructions are followed in the use of thermite devices

Table A.130—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	There are no incremental specific Environmental Considerations beyond those identified in Section 4

Table A.131—Typical Monitoring Requirements for Cathodic Protection Installation

✓	Description
	If possible, confirm installation of cathodic test stations near existing roads for ease of accessibility during subsequent periodic testing in locations specified on project drawings
	Confirm if existing rectifiers are to be shut down in areas where existing pipe maintenance programs are under way
	Confirm that minimum required wall thickness exists prior to cad welding
	Confirm that test leads are backfilled carefully to avoid breaking wire-to-pipe connections and to avoid burying the lead wires before connections to the junction boxes are completed
	Confirm that both ends of the conduit leading up to the junction box are reamed out to remove any burrs that may cause a short in test lead wires
	Confirm that test leads are tested electrically after backfilling to confirm that wire-to-pipe connections have not been broken
	Confirm that test lead conduits are installed at locations and in a manner per the Operator specification

Table A.132—Typical Monitoring Requirements for Cathodic Protection at Third-Party Pipeline Crossings

✓	Description
	Confirm that the Third-Party pipeline company is notified prior to any work on or near their pipeline; typically, a representative from the Third-Party pipeline company is present to observe or they themselves conduct the work
	Confirm that work undertaken in the vicinity of a Third-Party Pipeline Company's cathodic protection system adheres to requirements identified for crossings in Third-Party Operator and Operator specifications
	Confirm that existing ground cables connected to Third-Party buried facilities are disconnected and moved out of harm's way during construction; confirm that any alternating current (A/C) interference mitigation concerns are addressed
	After daylighting the Third-Party pipeline, examine coating to determine type, condition, and possible damage; notify the Third-Party Pipeline Owner if damage is found
	At the Third-Party pipeline crossing, confirm that cathodic protection readings are taken by: — Using existing test leads on the Third-Party pipeline — Taking a pipe-to-soil reading if the coating has been damaged — Taking a reading at the nearest Third-Party pipeline's test station
	Confirm that the Third-Party pipeline coating is never punctured to take a pipe-to-soil reading
	Confirm that if a test lead is to be attached to the Third-Party pipeline, a Third-Party Pipeline Company Representative will be present to perform the work themselves, unless otherwise agreed upon
	Confirm that at Third-Party pipeline crossings, test leads are installed at all line crossings
	Confirm that test stations are installed as close to pipeline crossings as possible

A.11.7 Typical Outputs for Cathodic Protection Inspection

Table A.133—Typical Reporting Requirements

✓	Description
General	
	Complete cathodic protection installation/test station report, including: — Number of Test Station Installations — Test Station Survey Numbers — Continuity Test Results (i.e. upon backfilling to confirm that test leads have not broken)
	Complete Third-Party pipeline crossing report, including: — Survey Station Numbers at Crossings — Name of Third-Party Pipeline Companies — Pipeline Size and Use — Type and Condition of Coating — Clearance Above or Below Pipeline — Distance from Nearest Third-Party Rectifier — Output from Third-Party Rectifier — Pipe-to-Soil Readings at Crossing — If test leads are installed, Size and Color of Wire — Description of Location; Township, Range, Section, and Landowner (tract number from alignment sheet) — Sketch of the Pipeline Crossing Showing Available Landmarks
Daily	
	There are no incremental specific reporting requirements beyond those identified in Section 4

NOTE The reference information provided in Table A.134 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.134—List of References—Cathodic Protection

Document No.	Type	Title
Canadian Gas Association (CGA)		
OCC-1	Standard	Recommended Practice for Control of External Corrosion on Buried or Submerged Metallic Piping Systems
NACE International		
SP0169	Standard	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
SP0177	Standard	Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
SP0188	Standard	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

A.12 Hydrostatic Testing

A.12.1 Overview

A hydrostatic test is a form of pressure testing used to confirm that the pipeline has acceptable strength and will not leak under operating conditions. Hydrostatic testing uses water to perform the test. Operatorspressure test a new pipeline after it is installed but before it is put into service for the following reasons:

- prove the integrity of the fabricated assemblies, including all welds, in support of the safety of the public, environment, and surrounding property;
- confirm the quality of fabricated assemblies, line pipe materials, and field welds performed on the ROW so that the pipeline system can safely operate;
- prove the workmanship of fabricators;
- comply with industry and governing body regulations.

Water is a preferred medium for pressure testing because it is not compressible, meaning it does not store energy under pressure. While pressure testing with air or other fluids is possible, it can result in rapid releases of this stored energy, resulting in damage or injury. Care should be applied when using natural water sources for pressure testing because of possible contamination, as well as withdrawal and disposal restrictions.

A.12.2 Inputs

As part of preparing for inspection during the hydrostatic testing process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.136.

A.12.3 Execution

Typical items that the Inspector should monitor for during the hydrostatic testing process are identified in a series of checklists, organized around the typical sequence of events during hydrostatic testing, as detailed in Table A.135.

Table A.135—Monitoring Requirements for Hydrostatic Testing

Item		Description	Reference
Prior to Commencing Work		— Confirm that key issues that have been identified are detailed and addressed — Review and confirm that all testing equipment has been calibrated or certified as fully functional in advance of the testing operations	Table A.137
Safety		— Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.138
Environmental Considerations		— Identify specific items that should be monitored throughout Hydrostatic Testing operations that relate specifically to the Operator- or project-specific Environmental Protection Plan (EPP)	Table A.139
Preparing Test Sections		— Monitor Contractor work to confirm that the test section is prepared (e.g. installation of test heads, cleaning, test water removal, and equipment use) to Operator specifications	Table A.140
Preparing for Pressure Test		— Confirm that all required permits, plans, and calculations are approved and in place prior to commencing hydrostatic test operations	Table A.141
Filling the Pipe		— Confirm that pipe is filled as per the Hydrostatic Test Plan	Table A.142
Preparing for Pressurization		— Confirm that all instrumentation and equipment is in place prior to pressurization, including setting up a “Test Bus”	Table A.143
Pressurization	Establishing Pressure-Volume Curve	— Determine slope of pressure-volume curve (the relationship between the volume of water injected into the test section and the corresponding pressure rise)	Table A.144
	Leak Check (if required)	— If there is need for a yield plot, then while the fill pump is shut off, the test heads should be checked for leaks and pressures compared at two test head pressure gauges and validated against elevation differences	Table A.145
	Strength Test	— Proof of strength of installed pipe as per Hydrostatic Test Plan	Table A.146
	Leak Test	— Follow controlled depressurization process from strength test to leak test	Table A.147
Leak or Failure Investigation (if required)		— In the case of a pipe leak or failure during hydrostatic testing, the Contractor will visually inspect the test section route for water ponding or wet soils, locate the leak or determine the cause of the failure, and advise the Inspector; if visual inspection does not reveal the leak location, advise the Operator of further action — The Inspector should notify the Operator’s authorized representative and work with the Contractor to develop a Leak Detection Plan and have it approved; when a leak is discovered, the Contractor will repair the pipe section and the hydrostatic test will be conducted again	Table A.148
Depressurizing		— Confirm that depressurizing happens safely in preparation for dewatering and drying	Table A.149
Dewatering		— Confirm that dewatering happens in a manner consistent with environmental permits and approvals	Table A.150
Test Head Removal/Replacement		— The Contractor will supply all materials, equipment, and personnel to remove test heads and replace with a pig launcher and receiver or tie into other facilities as specified by the Operator	Table A.151

Item	Description	Reference
Drying and Cleaning	— In order to prevent internal corrosion, line drying should be undertaken to the Operator's specifications (e.g. forced air or nitrogen, MEG or methanol, drying pigs, or some combination)	Table A.152

A.12.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for hydrostatic testing appear in Table A.153.

A.12.5 Typical Input Requirements for Hydrostatic Testing Inspection

Table A.136—Information Requirements for Hydrostatic Testing

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to hydrostatic testing, such as: — Alignment Sheets — Pipeline Facility Drawings — Line List — Drawings specific to hydrostatic test, including but not limited to: a) Temporary Launchers and Receivers b) Elevation Profiles
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey
	Permits related to: — Road Use — Water withdrawal, disposal, and discharge
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Emergency Medical Services (EMS) — Emergency Contact List
	Project-specific Environmental Protection Plan (EPP) detailing hydrostatic testing requirements
	Other project-specific Plans, which may include: — Hydrostatic Test Plan addressing, but not limited to, the following items: a) Site-specific safety/hazards and appropriate analysis b) Emergency Response Plan in the event of a rupture during the test c) Testing personnel emergency contact list d) Test section design process e) Determination of class locations f) Elevation profiles g) Test section lengths h) Test water sourcing, filling, pressurizing, depressurizing, and dewatering i) Accessibility to test sections j) Road crossings and signage k) Possible reduction of the number of sections with heavy wall pipe l) The sequencing of hydrostatic tests m) Test pressure calculations n) Minimum test head rating o) Testing crew credentials

✓	Description
	p) Test equipment list and capacities q) Test schedule and sequence of tests r) Instrumentation and its certification s) Provision of protective berms around fuel storage used to supply fuel-driven line fill pumps, as required t) Leak Detection Mechanism/Plan, if required u) Personnel responsibilities, including visual inspection

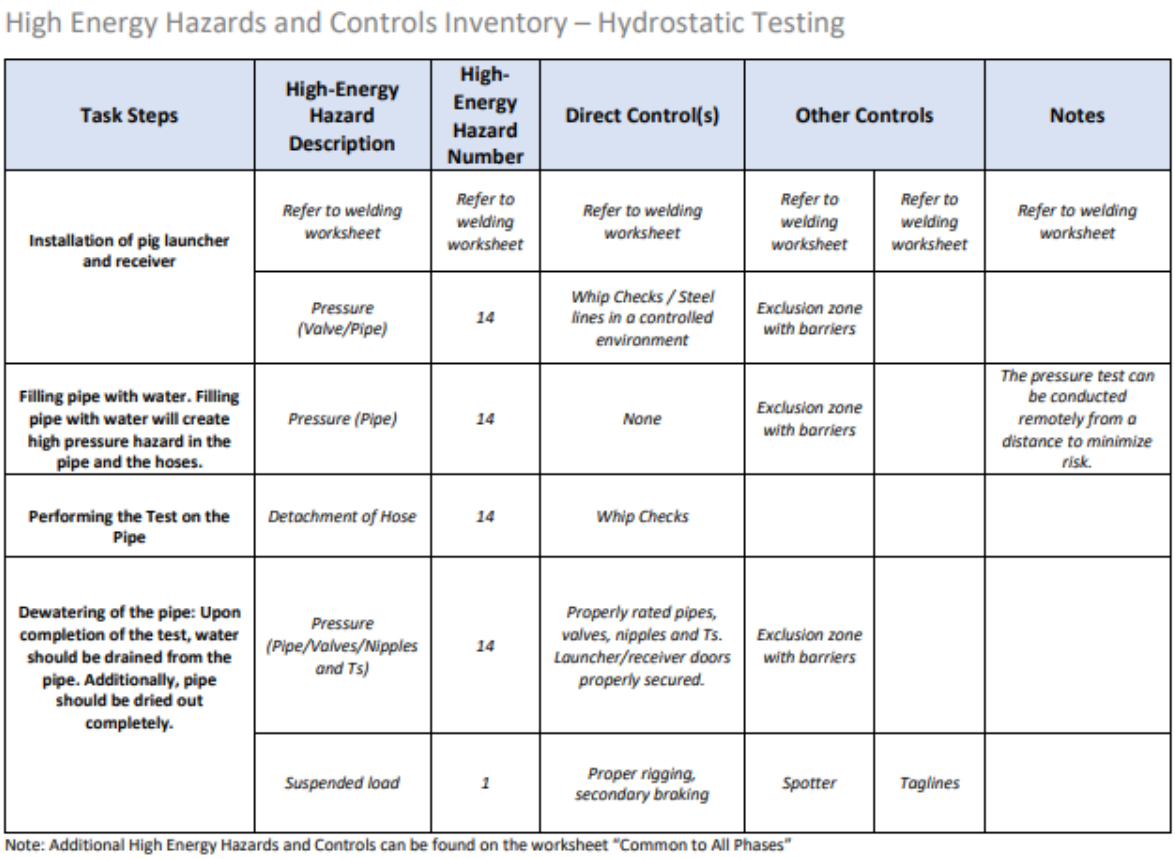
A.12.6 Items for Inspecting Typical Hydrostatic Testing Operations

Table A.137—Prior to Commencing Work

✓	Description
	Participate in meetings to address: — Job safety — Hazard identification — Environmental concerns — Duties of Inspector(s) — Contractor questions or concerns
	Confirm that the Hydrostatic Test Plan is approved
	Check signage and contact information at public access points to the right-of-way (ROW), and if required, temporarily restrict access points
	Check for signage and contact information at all exposed pipe locations
	Communicate with the rest of the Construction Management/Inspection resources regarding test schedules and locations
	Check that test water withdrawal and disposal notifications, registrations, and permits are in place
	Confirm that the schedule allows for the full length of strength and leak tests from start to completion
	Confirm that water source volumes and flow rates are sufficient for the test sections and meet permit conditions
	Prior to and upon completion of a hydrostatic test, confirm that the local authorities are alerted
	Confirm that testing components (e.g. test heads, etc.) meet expected pressure requirements
	Check all testing equipment certification (e.g. pressure recorders, test weights) and confirm that a copy of the calibration/certification documents is onsite
	Confirm that identified defects have been remediated

Table A.138—Safety Concerns for Hydrostatic Testing

✓	Description
	Confirm that comprehensive safety requirements are covered in detail within the Hydrostatic Test Plan, including, but not limited to: — Identification of the exclusion zone, which includes the minimum distance between personnel and the hydrostatic test — Notification of appropriate individuals prior to a hydrostatic or pneumatic test — Pneumatic test presents significant hazards, verify all control measures have been implemented — Verification that all material and equipment is rated to withstand test pressure including affected supply and discharge line — Visual inspection of all equipment for proper installation and valve positioning (e.g. supply hose connections are secured with retaining devices, discharge end is supported or restrained) — See INGAA CS-S-9 — See API04049 See 1110 5.4 — Implementation of appropriate signs, barricades, and barriers — Verification of the process for depressurizing lines before sealing or breaking joint components



High Energy Hazards and Controls Inventory – Hydrostatic Testing

Task Steps	High-Energy Hazard Description	High-Energy Hazard Number	Direct Control(s)	Other Controls		Notes
Installation of pig launcher and receiver	Refer to welding worksheet	Refer to welding worksheet	Refer to welding worksheet	Refer to welding worksheet	Refer to welding worksheet	Refer to welding worksheet
	Pressure (Valve/Pipe)	14	Whip Checks / Steel lines in a controlled environment	Exclusion zone with barriers		
Filling pipe with water. Filling pipe with water will create high pressure hazard in the pipe and the hoses.	Pressure (Pipe)	14	None	Exclusion zone with barriers		The pressure test can be conducted remotely from a distance to minimize risk.
Performing the Test on the Pipe	Detachment of Hose	14	Whip Checks			
Dewatering of the pipe: Upon completion of the test, water should be drained from the pipe. Additionally, pipe should be dried out completely.	Pressure (Pipe/Valves/Nipples and Ts)	14	Properly rated pipes, valves, nipples and Ts. Launcher/receiver doors properly secured.	Exclusion zone with barriers		
	Suspended load	1	Proper rigging, secondary braking	Spotter	Taglines	

Note: Additional High Energy Hazards and Controls can be found on the worksheet "Common to All Phases"

Figure A.9-

Pipeline Construction High Energy Hazards and Controls Inventory, The INGAA Foundation, Inc., July 2024 Appendix B: High Energy Hazards and Controls Inventory-Hydrostatic Testing

Table A.139—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Confirm that all stationary equipment (e.g. pumps, generators, fuel containers) within specified distances from a watercourse or water body is in secondary containment
	Confirm that all equipment to be used within specified distances from a watercourse or water body is clean and free of leaks and is equipped with approved spill kits
	Confirm that appropriate testing is conducted for disposal of test water
	Confirm that appropriate testing is conducted for disposal of debris from cleaning operations (i.e. if cleaning runs are completed)
	Confirm that appropriate containment is installed for receipt of any cleaning/drying pigs

Table A.140—Typical Monitoring Requirements for Preparing Test Sections

✓	Description
	Check that the lengths of exposed pipe (at the ends where test heads are connected) are kept to a minimum
	Confirm that any required bell holes (small excavated areas) are monitored for air quality

✓	Description
	Confirm that during cold weather construction, hoarding (plastic insulation over a wood frame used to maintain temperature around an exposed section of pipe) and heating are installed for exposed test section ends where test heads are to be welded
	Inspect the test heads and isolation values and confirm that they are refurbished as required
	Confirm that the test heads are welded per Operator specifications; confirm that specialized welding inspection expertise is engaged for welding process (as per A.6)
	Confirm good access to isolation valves (either through orientation of installation and/or scaffolding)
	Confirm that “safety zones” (i.e. fenced or otherwise marked areas based on the specifics of the project) around test heads/pigging launchers and receivers are established and maintained throughout the operation
	Confirm that fill water is collected and sent for laboratory testing so that results are available before filling

Table A.141—Typical Monitoring Requirements for Preparing for Pressure Test

✓	Description
Test Section	
	Confirm that the final test pressure calculation sheet is signed and dated by the Operator designate and available
	Check that water tanks have sufficient capacity to complete the test section before running out of water
	Check that pumps have the correct capacities (pressure delivery and volumetric flow rate)
	Check that water hoses for fill and squeeze activities have the correct ratings
	Check that water heating boilers (for hydrostatic testing in cold weather season) are in working order
	Check that the temperature recording device meets project requirements
	Confirm that recorders for pipe skin and ground temperature measurements are installed at the correct locations as specified per Hydrostatic Test Plan
	Check that the temperature recorders to measure the fill water temperature are installed and working properly
	Check that there are pressure gauges installed on test heads
	Check that a flow turbine meter is installed on the fill water line connected to a test head
	Check that all hoses connecting to the instruments in the test bus are installed
	Confirm that supply and discharge lines are adequately anchored, supported, and installed per Hydrostatic Test Plan
	Confirm that all other hoses are correctly installed and secure; monitor on an ongoing basis
	Check that lights/generators are in working order
	Confirm that a test bus for testing the water quality is available, if required
Test Bus	
	Confirm that the test bus is supplied with the following: — Pressure charts and temperature charts — Pressure recorder (either hydraulic dead weights and/or electronic recorders) — Flow totalizer (shows the total volume of water injected into the test section) — Thermometers (ambient and/or alternate) — Test instrument certificates — Test system spare parts
	Confirm that the Contractor will install a thermometer outside the test bus in the shade to measure the ambient temperatures during pressure testing

Table A.142—Typical Monitoring Requirements for Filling the Pipe

✓	Description
	Confirm that accuracy of the flow turbine and flow totalizer is confirmed and any discrepancies are resolved prior to proceeding
	For cold weather testing of buried pipe, confirm that any preheating requirements as identified in the Hydrostatic Test Plan are executed
	Confirm that the test section is filled using pigs based on the specified procedure, in particular: — To avoid trapping of air from the water source — To maintain control of the pig — Confirm that the starting position of all valves and equipment is as specified in the filling procedure per the Hydrostatic Test Plan — Additional specific seasonal considerations may also apply
	Check and record continually the total injected volume on the flow totalizer
	Confirm that filling is continuous until the lead filling pig is seated in the downstream test head
	Monitor for compliance to the filling procedure, as specified in the Hydrostatic Test Plan

Table A.143—Typical Monitoring Requirements for Preparing for Pressurization

✓	Description
	Come prepared with the following items to the test site/test bus for pressurizing the test section and yield plotting: — Final validated calculation sheets that are stamped, signed, and dated by Operator Designate — Mechanical pencil, pen, eraser, ruler, and calculator — Writing pad, graph paper, and envelopes — Operator hydrostatic test forms and logs — Unit conversion table — Watch, cell phone, cell phone charger, and water/food

Table A.144—Typical Monitoring Requirements for Establishing Pressure-Volume Curve

✓	Description
	Examine the test calculations to determine ahead of time whether a yield plot is required; prepare accordingly
	Establish pressure increase rate as per Operator Hydrostatic Test Plan using the pressure recorder
	Clearly note and establish the start and stop pressures for this portion of the hydrostatic test per the calculation sheet
	Confirm that all instrument and equipment settings are as per Operator Hydrostatic Test Plan
	Confirm that the Contractor has unhooked the fill pump and hooked up and started the squeeze pump as specified by the Operator to pressurize the test section
	Log the time, test section pressure (using dead-weight pressure recorder), and water volume (using flow totalizer) on log sheet
	Minimize changes to pump settings before completing yield plot (results in pressure waves and unreliable yield plots)

Table A.145—Typical Monitoring Requirements for Leak Check

✓	Description
Yield Plot (if required)	

✓	Description
	Check the test heads for leaks and pressures (while the fill pump is shut off), compared at two test head pressure gauges and validate against elevation differences
	Confirm that a pressure versus volume plot is produced and the values verified against the hydrostatic test calculation sheet; any discrepancies should be resolved before proceeding further
	Confirm that established yield plot start and stop pressures are used
	Confirm that limits for identifying yielding of pipe are established and monitored per Hydrostatic Test Plan; pressurization should be stopped if limits are exceeded
	Record results on the yield plot log sheet

Table A.146—Typical Monitoring Requirements for Strength Test

✓	Description
	Confirm that all instrument and equipment are installed, located, and set as per Operator Hydrostatic Test Plan
	Confirm that established yield plot start and stop pressures are used
	Confirm that the pre-established pressure increase rate is maintained
	Confirm that limits for identifying yielding of pipe are established and monitored per Hydrostatic Test Plan; pressurization should be stopped if limits are exceeded
	Record results on the yield plot log sheet
	At the appropriate time, confirm that the Contractor is advised to lock the test section, install a bull plug at the inlet point, and the test section is declared to be on strength test
	Fill out the strength test data log as required by the Operator
	Accept the strength test by signing and dating the log if the pressure remains above the minimum value as specified by the Hydrostatic Test Plan
	If the pressure drops below the minimum test pressure, proceed to investigate and resolve as per the Hydrostatic Test Plan

Table A.147—Typical Monitoring Requirements for Leak Test

✓	Description
	Confirm that pressure reduction from strength test value to leak test value is completed in a manner consistent with Hydrostatic Test Plan
	All other monitoring requirements are similar to Strength Test per Table A.146

Table A.148—Typical Monitoring Requirements for Leak or Failure Investigation

✓	Description
	Advise the Operator of further action if the Contractor cannot locate a pipe leak or determine the cause of failure during hydrostatic testing through visual inspection
	Notify the Operator's authorized representative and work with the Contractor to develop a Leak Detection Plan and have it approved
	When a leak is discovered, confirm that the Contractor repairs the leak per Operator specifications and that other portions of this document are referenced prior to conducting the hydrostatic test again

Table A.149—Typical Monitoring Requirements for Depressurizing

✓	Description
	Confirm that the Contractor does not start depressurizing until all required personnel are onsite
	Confirm that the Contractor has taken all safety precautions before starting to depressurize the test section

	Check that the Contractor has secured the depressurizing hose to prevent vibration during pressure release
	Confirm that the Contractor opens the test head slowly to protect it from shock-loading the pipeline
	Confirm that the Contractor or other personnel do not, under any circumstance, open the bleed-off assembly fully

Table A.150—Typical Monitoring Requirements for Dewatering

✓	Description
	Confirm that the Contractor does not start dewatering until all required personnel are onsite
	Confirm that the Contractor dewaters to locations approved in the water permit or the Environmental Protection Plan (EPP)
	Confirm that the Contractor does not dewater until proper fill-water sampling is completed and filtration unit is in place, if required
	Check that the Contractor securely supports and ties down the dewatering line at the discharge end to prevent whipping/uncontrolled erosion
	Confirm that the Contractor installs an energy absorbing device at the discharge end of the dewatering line to prevent erosion, bottom scour, or damage to vegetation
	Check that the Contractor uses a bidirectional pig propelled by compressed air to push water out of the test section
	Check that the Contractor probes the dewatering pigs to verify their proper position before and after dewatering runs
	Confirm that the test section is dewatered based on the specified procedure, in particular: — Appropriate pressure set points and pig speed are maintained — A test section with a downhill slope is dewatered with the appropriate precautions as identified per the Hydrostatic Test Plan (e.g. the discharge end valve should not be opened before receiving the pig) — Additional specific seasonal considerations may also apply

Table A.151—Typical Monitoring Requirements for Test Head Removal/Replacement

✓	Description
	Inspect for damage and unfit fittings once test head is removed
	Check that the sacrificial pup is removed, and nuts, studs, and valves are properly secured for transport
	Confirm that heavy wall pipe end is prepared for welding during final tie-ins

Table A.152—Typical Monitoring Requirements for Drying and Cleaning

✓	Description
General	
	Confirm that drying method/procedure used by the Contractor is consistent with Hydrostatic Test Plan requirements
	Confirm that all liquid from valve bodies has been removed
	Confirm that Operator criteria for a “dry line” are met
	If the pipeline will not be commissioned soon after drying, confirm that the pipeline is purged with dry nitrogen to meet Operator specifications
	Check launching and receiving facilities for proper configuration and suitability for the operation, including pressure relief provisions and mainline block valve positioning
	Monitor tool run activities; if the inspection device becomes lodged in the pipeline, coordinate activities with Contractors in order to locate the tool, perform extraction work, and make pipeline repairs
	Confirm that pipeline cleaning devices are constructed per Operator specifications to properly gauge the internal condition of the new pipeline
	Monitor pipeline cleaning device location, speed, and quantity during the cleaning operation
	Confirm that defects or obstructions (e.g. damage to gauging plate, stuck swabs, anomalies indicated by other devices) are located and repaired in accordance with Operator specifications
	Confirm that any connections that have been reworked after hydrostatic testing are flagged for additional inspection
Drying Pig Runs	
	Confirm that pigs used for drying runs are as specified by the Operator
	Confirm that number of pig runs is per Operator requirements (each pig should be numbered)
	Confirm that all drying pigs are counted upon receipt (i.e. confirm that no pigs remain in the line)
Air Drying	
	Confirm that injected dried air relative humidity readings meet specifications
Methanol Wash	
	If the Operator has specified methanol wash as the acceptable drying method, confirm that specifications for injection and recovery are followed

A.12.7 Typical Outputs for Hydrostatic Testing Inspection

Table A.153—Typical Reporting Requirements

✓	Description
General	
	Record all hydrostatic test calculations and results
	Submit Calibration Certificates for test equipment
	Complete Safety Hazard Observation Report
	Complete test head inspection documentation
	Establishing Pressure-Volume Curve—Log the time, test section pressure (using dead-weight pressure recorder), and water volume (using flow totalizer) on log sheet
	Leak Check—Record results on the yield plot log sheet
	Strength Test—Fill out the strength test data log as required by the Operator
Daily	
	Complete hydrostatic testing progress reports, including: — The monitoring and inspection items as defined in previous tables within Annex A

NOTE The reference information provided in Table A.154 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.154—List of References—Hydrostatic Testing

Document No.	Type	Title
American Gas Association (AGA)		
	Guideline	Pipeline Purging Principles and Practice
American Petroleum Institute (API)		
API 1110	Recommended Practice	Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide
INGAA Foundation		
CS-S-9	Guideline	Construction Safety & Quality Consensus Guidelines—Pressure Testing (Hydrostatic & Pneumatic) Safety Guidelines

A.13 Clean-up and Restoration

A.13.1 Overview

Construction site clean-up is the final cleaning and removal of construction materials left over from the pipeline ROW and surrounding area. All materials not native to the site are removed. Restoration is the act of returning the construction site to its former (i.e. prior to construction) condition. Construction site clean-up and restoration is important as it:

- provides tangible examples of Operator's attention to detail during construction;
- helps to satisfy regulatory agencies and Landowners;
- sets the stage for Landowner acquiescence, agreement, and support when approached for future projects.

Clean-up work can be performed in phases depending on the location and season of construction. For example, during extreme cold weather construction, the Contractor will perform the machine or initial clean-up immediately after the end of construction and before the spring breakup, then return to the site the following winter to do the final clean-up.

During warm weather construction, the Contractor should do both machine and final clean-up immediately after the end of construction and return to the site later for additional restoration work (e.g. repairing a sunken ditch).

A.13.2 Inputs

As part of preparing for inspection during the clean-up and restoration process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.156.

A.13.3 Execution

Typical items that the Inspector should monitor for during the clean-up and restoration process are identified in a series of checklists as detailed in Table A.155.

Table A.155—Monitoring Requirements for Clean-up and Restoration

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.157
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.158
Environmental Considerations	Identify specific items that should be monitored throughout Clean-up and Restoration operations that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.159
General Clean-up and Restoration	Monitor to confirm that condition of the right-of-way (ROW) and construction area is returned as close to the original state as possible, also taking into consideration Landowner concerns	Table A.160
Topsoil Replacement	Confirm that topsoil quality is per Operator specification and Landowner agreements as part of ROW rehabilitation	Table A.161
Terraces, Drainage, and Slope Protection	Confirm that appropriate drainage and slope protection mechanisms have been installed as required by Operator specifications	Table A.162
Diversion Berms	Confirm that Diversion Berms (shallow earthen dykes that collect and redirect surface water on ROW) are constructed as required following Operator specifications	Table A.163
Watercourses and Crossings	Confirm that watercourses and crossings are treated as per requirements of any permits as well as required by Operator specifications	Table A.164
Roads	Confirm that roads have been returned to a state as per Operator specifications, road crossing, and Landowner agreements	Table A.165
Replanting and Reseeding	Confirm that replanting and reseeding are completed as per requirements of any permits as well as required by Operator specifications	Table A.166
Fencing	Confirm that fencing has been installed as per Operator specifications and Landowner agreements	Table A.167

A.13.4 Outputs

Report requirements and reporting processes are Operator and project specific; recommended practices for reporting requirements for clean-up and restoration appear in Table A.168.

A.13.5 Typical Input Requirements for Clean-up and Restoration Inspection

Table A.156—Information Requirements for Clean-up and Restoration

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to clean-up and restoration, such as: — Access Road Drawings — Grading Drawings — Line List (e.g. special concerns for each Landowner)
	Contracts and agreements related to: — Road Use — Crossing for Buried Facilities — Construction Survey
	Permits related to: — Environmental — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Traffic Control Plan — Requirements for Personal Protective Equipment (PPE) — Procedures for working around overhead powerlines — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing clean-up and restoration requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Approved Grading Plan — Clean-up and right-of-way (ROW) Restoration Plan — Heritage Sites

A.13.6 Items for Inspecting Typical Clean-up and Restoration Operations

Table A.157—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor’s tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns

Table A.158—Safety Concerns for Clean-up and Restoration

✓	Description
	There are no incremental specific Safety Concerns beyond those identified in Section 4

Table A.159—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	There are no incremental specific Environmental Considerations beyond those identified in Section 4

Table A.160—Typical Monitoring Requirements for General Clean-up and Restoration

✓	Description
	Liaise with Land Agent on any special restoration requirements of Landowners
	Confirm complete removal of debris (e.g. general construction debris, rocks, boulders)
	Confirm that previously existing contours in landscape are recreated
	Check placement of erosion control measures for compliance with Operator specifications
	Confirm that right-of-way (ROW) preparation is suitable for the application of fertilizers and seeds per Operator specifications as well as Landowner agreements
	Confirm that appropriate equipment is used to remove compaction
	Confirm no surplus construction or pipeline materials are left on the ROW (refer to contract documents to determine which materials should be stored and which should be scrapped)
	Confirm that reusable materials (e.g. pipe sections, valves, coating material) were returned to the Operator after being prepared for return
	Confirm that the ditch crown is not blocking any drainage, access roads, recreational trails, or wildlife/livestock trails across the ROW and that sufficient gaps have been included to allow cross-drainage
	For cold weather construction, confirm that the ROW is stabilized after construction and during machine clean-up to prevent erosion during the spring thaw; final clean-up may be completed during the following construction season, depending on ground conditions
	Confirm that the Contractor conducts final clean-up when soils are dry and unfrozen
	Check that all required diversion berms have been built
	Confirm that cathodic protection test leads at all test stations are installed at specified heights on supporting poles
	Confirm that final continuity check of cathodic protection test leads is completed
	Confirm that rock material from construction or excavation that was not reused is removed from the ROW and hauled to an Operator-approved dump site or distributed within a specific portion of the ROW
	Confirm that all damages to properties such as buildings, fences, hedges, survey monuments, roads, railways, bridges, culverts, drainage ditches, and terraces occupied or crossed during construction are restored to the original condition
	Confirm that all required pipeline warning signs are installed at fence lines and on each side of all road, railway, utility, and water crossings

Table A.161—Typical Monitoring Requirements for Topsoil Replacement

✓	Description
	Confirm that stones are removed and the subsoil surface is lump-free and leveled for topsoil replacement
	Confirm that topsoil is only handled when weather conditions permit (e.g. heavy rain may disrupt operations) and in accordance with Operator specifications/procedures and Landowner agreements
	Confirm that clean-up equipment heavier than allowed in the construction specifications does not operate over top the pipeline
	Confirm that all pipelines on the right-of-way (ROW) are only crossed in accordance with the construction specifications
	Confirm that all holes, ruts, and depressions are filled with soil
	Confirm that soil tests on the ROW are completed to determine the level of compaction caused by construction
	Confirm that ROW locations occupied during construction are de-compacted to loosen subsoil before replacing topsoil
	Confirm that topsoil has been replaced evenly throughout work area to a depth comparable to pre-construction and off-ROW conditions
	Confirm that restored topsoil has been prepared, groomed, and stones removed
	Check ROW locations where topsoil was not stripped but was compacted; it may require de-compaction, soil preparation, and/or grooming

Table A.162—Typical Monitoring Requirements for Terraces, Drainage, and Slope Protection

✓	Description
	Check that the construction of terraces, berms, or cross ditches on the right-of-way (ROW) divert surface runoff to adjacent vegetated areas or existing drainage systems has been completed
	Check cross-drainage or watercourses for depth and operability
	Confirm that all erosion prone slopes are re-vegetated by seeding with approved mixes, erosion control matting, hydro-seeding, and/or hydro-mulching as per Operator specifications and Landowner agreements
	Confirm that all seepages are provided with drainage
	Confirm that drainage ditches are constructed to convey overland flows off the ROW and prevents flooding, if required
	Verify that land drains are operational and that no wet spots or pooling is evident

Table A.163—Typical Monitoring Requirements for Diversion Berms

✓	Description
	Confirm that the construction of terraces, berms, or cross ditches on the right-of-way (ROW) to divert surface runoff to adjacent vegetated areas or existing drainage systems has been completed
	Confirm that all seepages are provided with drainage
	If required, confirm that drainage ditches are constructed to convey overland water flows off the ROW to prevent flooding
	Confirm that berms are prepared for seeding

Table A.164—Typical Monitoring Requirements for Watercourses and Crossings

✓	Description
	Confirm that water crossings are restored to pre-construction conditions and erosion and sediment control measures are installed per Operator specifications, Landowner agreements, or as required
	Confirm that riparian zones at major creek and river crossings are stabilized by supplying and installing site-specific reclamation

✓	Description
	Confirm that water quality is maintained while applying erosion/sediment control at a watercourse

Table A.165—Typical Monitoring Requirements for Roads

✓	Description
	Confirm that all temporary access roads built during construction are removed and reclaimed per contract requirements
	Confirm that road surfaces, fences and gates, signs, etc. are replaced or restored per contract requirements
	Confirm that road system drainage tile systems are repaired, modified, and/or replaced per contract requirements
	Confirm that side-cuts are sloped and filled to stable angles to prevent incidents to persons, livestock, wildlife, or the environment

Table A.166—Typical Monitoring Requirements for Replanting and Reseeding

✓	Description
	Confirm that the final soil surface is prepared adequately for seeding, taking soil conditions, weather conditions, right-of-way (ROW) requirements, and surrounding land use into consideration
	Confirm that all seed mixes, fertilizers, and rates of application have been approved by Operator and Landowner agreements
	Confirm that all seed and fertilizer application equipment and techniques have been approved by the Operator using an approved technique such as seed drills or mechanical/hand broadcasters
	Confirm that areas where soil stabilization is required (e.g. slopes, stream banks) have been seeded, fertilized, hydro-seeded, or sprayed with a tackifier (a soil adhesive)/mulch mixture
	Confirm that trees and shrubs have been replanted or transplanted to meet Operator specifications and Landowner agreements
	Confirm that all original vegetation, including seeds, sod, grass, shrubs, and trees, is restored or replaced, including fertilizing per Operator specifications and Landowner agreements

Table A.167—Typical Monitoring Requirements for Fencing

✓	Description
	Confirm that all temporary fences and barricades that were erected to stop unauthorized access by people or livestock (e.g. at the worksite, road crossings, access roads, or to identify sensitive locations such as water crossing approaches and heritage resource sites) have been removed per Operator specifications
	Confirm that all fencing at compressor, sales/receipt meter stations, and valve locations that has been dismantled for convenience of work has been restored or replaced
	Confirm that sections of existing fence and gates that were removed have been supplied and replaced with new fence materials and new gates

A.13.7 Typical Outputs for Clean-up and Restoration Inspection Reporting

Table A.168—Typical Reporting Requirements

✓	Description
General	
	There are no incremental specific reporting requirements beyond those identified in Section 4
Daily	
	Complete clean-up and restoration progress reports, including: — Progress of the Contractor's clean-up activities with starts and end chainages/station numbers of daily progress — Updates on start and end chainages/station numbers of locations where the Contractor did no clean-up with a detailed explanation for omission — Any right-of-way (ROW), weather, or other logistical conditions that caused either an increase or decrease in expected progress — Depth of replaced topsoil — Compaction depths — Start/stops on tackifier applications — Start/stops on any specialized compaction removal — Drain tile station locations — Temporary/permanent repairs performed (e.g. fence damage) — Location and type of sediment control measures installed — Installation of additional warning signs

NOTE The reference information provided in Table A.169 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.169—List of References—Clean-up and Restoration

Document No.	Type	Title
There are no incremental specific reference documents beyond those identified in Section 4		

A.14 Post-construction Inspection

A.14.1 Overview

Post-construction inspection is typically the last component of pipeline inspection, in which the Contractor prepares the site for commissioning and start-up of the pipeline. This is a complex time for the project, as key stakeholders become involved (i.e. Operator Operations and Maintenance personnel), and often requires the Inspector to be aware of a separate, project-specific plan. This aspect of the work varies significantly between projects and requires attention to detail.

The Inspector's role is to confirm that any remaining installation items are completed as per the plan, including removal of temporary devices and verification of valve positions. Based on input from the Operator, the Inspector's scope for critical items typically ends when commissioning begins; noncritical items (e.g. clean-up and restoration) may be completed after commissioning.

A.14.2 Inputs

As part of preparing for inspection during the post-construction inspection process, the Inspector should continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table A.171.

A.14.3 Execution

Typical items that the Inspector should monitor for during the post-construction inspection process are identified in a series of checklists as detailed in Table A.170.

Table A.170—Monitoring Requirements for Post-construction Inspection

Item	Description	Reference
Prior to Commencing Work	Confirm that key issues that have been identified are detailed and addressed	Table A.172
Safety	Monitor the operations for adherence to relevant Operator- and project-specific safety requirements	Table A.173
Environmental Considerations	Identify specific items that should be monitored throughout Post-construction Inspection that relate specifically to the Operator- and/or project-specific Environmental Protection Plan (EPP)	Table A.174
General Post-construction Inspection	Monitor to confirm that any remaining installation items are completed, including removal of temporary devices and verification of valve positions	Table A.175

A.14.4 Outputs

Reporting requirements and processes are Operator and project specific; recommended practices for reporting requirements for post-construction inspection appear in Table A.176.

A.14.5 Typical Input Requirements for Post-construction Inspection

Table A.171—Information Requirements for Post-construction Inspection

✓	Description
	All designs, drawings, and specifications developed by the Operator and Contractors related to post-construction inspection, such as: — Issued for Construction Drawings — As-built Redline Drawings — Operator pre-start-up review procedures and checklists
	Contracts and agreements related to: — Road Use — As-built Survey — Landowner Agreements
	Permits related to: — Road Use
	Operator-specific Safety Plan, including, but not limited to: — Hydrostatic Test Plan — Requirements for Personal Protective Equipment (PPE) — Procedures for working around overhead powerlines — Emergency Medical Services (EMS)
	Project-specific Environmental Protection Plan (EPP) detailing post-construction inspection requirements for the following, but not limited to: — Watercourses — Wetlands — Wildlife habitats — Migratory routes
	Other project-specific Plans, which may include: — Commissioning Plan, including leak monitoring and detection — Operator Qualification (OQ) requirements — Project documentation for incremental specific requirements

A.14.6 Items for Typical Post-construction Inspection

Table A.172—Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: — Job safety and/or hazard identification issues — Environmental concerns — Duties of Inspector(s) — Pipeline Contractor's tailgate meetings, as required — Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Participate in pre-commissioning meetings, including, but not limited to: — Clarification and/or confirmation of roles and responsibilities of the Contractor during purging, packing, and calibration — Processes for addressing as-built drawings — Processes for addressing critical pre-start-up punch (deficiency) list items

Table A.173—Safety Concerns for Post-construction Inspection

✓	Description
	Be familiar with lockout/tagout (LOTO) procedures
	Identify all the energy sources that are introduced into the system
	Confirm that safety perimeters for venting are established
	Confirm use of flame-retardant clothing, if required
	Verify that notifications to agencies and landowners are complete
	Verify that notifications to first responders are complete

Table A.174—Typical Monitoring Requirements for Environmental Considerations

✓	Description
	Monitor and record erosion/sediment control maintenance issues prior to restoration success criteria (e.g., 70% native vegetative cover)

Table A.175—Typical Monitoring Requirements for General Post-construction Inspection

✓	Description
General	
	Confirm that all equipment (e.g. valves, instrumentation, pressure gauges) is verified to be operable
	Confirm that piping insulation is installed according to specification, where needed
	Verify that all energy isolation points can accept a lock and/or tag
	Inspect any connections that have been flagged for additional inspection (i.e. reworked after hydrostatic testing)
	Monitor purging/cleaning practices (including identification of any health hazards such as biocides or other additives introduced into pipeline)
	Confirm that safe disconnection procedures are followed
	Confirm that dew point (i.e. moisture in the line) is checked, as necessary, following dewatering/dehydration activities
	Confirm that all temporary isolation devices are removed, if present (e.g. blinds used during construction)
	Confirm that mechanical installation is complete [i.e. the Contractor has completed all required activities and critical pre-start-up punch (deficiency) list items]
	Confirm that the relevant components of the pre-start-up safety review (PSSR) have been completed
Valves and Piping	
	Confirm that all flange bolts meet tightness requirements
	Confirm that all flanges are leak tested to meet Operator specifications
	Confirm that all threaded connections are properly installed after hydrostatic testing and pig runs
	Confirm that all fail safe positions of valves are verified by functional testing
	Confirm that all check valves and regulators are installed in the correct orientation and flow direction verified following pressure testing
	Check that all valves identified on the Issued for Construction Drawings as locked open/locked closed are in the proper orientation and locked/sealed
	Verify that valve stems, wheels, handles, and vents are oriented properly to prevent obstruction and provide safe, adequate access for operations (e.g. vents that are not installed vertically pose a safety hazard for Operations personnel and orientation should be identified for safety review by the Operator)
	Verify that lines are labeled (e.g. color coded, flow direction), where required
	Confirm that pipeline markers are installed
	Ensure proper installation of all connections (pipe to the flange and vessel) associated with fabrication, including location, alignment, leveling, plumbness, gasket type, gasket class, and bolt torqueing or tensioning.
	Ensure that flange fit-ups and screwed connections are properly installed, including verification of the following: □ torque/tension requirements; □ proper support and torqueing/tensioning per operator specifications; □ flange is clean and free of any debris; □ connection to the proper piece of equipment; □ location; □ equipment/device needed to be used (e.g., standard gasket, CGI gasket, insulation kit); □ correct vessel; □ screwed connections are properly installed without cross-threading.
	Ensure that special bolting requirements, if any, including specific fasteners, installation order and location, and coating or protective cover, are met.
Over Pressure Protection Devices and Instrumentation	

✓	Description
	Confirm that all over pressure protection (OPP) devices are set at or below maximum allowable operating pressure (MAOP)/maximum allowable working pressure (MAWP) for the piping being protected; if not, confirm set point complies with Operator specifications
	Confirm that isolation valves under relief valves are locked or sealed open as required by applicable regulations (including instrument relief valves)
	Confirm that flare system is equipped with the appropriate type of in-line vent valve
	Confirm that alarms and detectors are functional and have appropriate set points
	Confirm that all OPP devices are vented in a safe direction
	Confirm that all relief valve vents are equipped with rain covers or weep holes
	Confirm that all OPP devices are properly identified on as-built redline drawings

A.14.7 Typical Outputs for Post-construction Inspection Reporting

Table A.176—Typical Reporting Requirements

✓	Description
General	
	Confirm that redline drawings are complete, checked, and forwarded to the Operator's authorized representative, and Others (as directed) in accordance with Operator requirements
	Update punch list
	Complete documents required for regulatory compliance (e.g. welding packages, hydrostatic test records, Operator-required records)
	Complete hard copies of items listed within the reporting requirements tables within this annex (except for daily reports) such as: — Nondestructive examination (NDE) — Welding and welding inspection — Operator qualification (OQ) — Pressure testing — Pipe inspection — Maximum allowable operating pressure (MAOP)/design/engineering calculations/equipment data sheets — Pipe surveys/geographic information system (GIS) — Corrosion — Facilities/drafting
Daily	
	Complete post-construction inspection progress reports, including: — Work completed to date, including: o Any health hazards (e.g. use of biocides or additives during purging/cleaning/drying process) — Any right-of-way (ROW), weather, or other logistical conditions that caused either an increase or decrease in expected progress

NOTE The reference information provided in Table A.177 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

Table A.177—List of References—Post-construction Inspection

Document No.	Type	Title
There are no incremental specific reference documents beyond those identified in Section 4		

Annex B
(normative)

Blasting Inspector

B.1 Scope

Individuals assigned as blasting inspectors are recognized as specialists in this activity and typically have additional schooling from explosive suppliers and other sources or have gained experience while actively involved in the use of explosives. Inspectors assigned to blasting operations report to the chief inspector and may handle other inspection duties depending on their training and experience.

B.2 Qualifications

B.2.1 General

Blasting inspectors should be knowledgeable of the basic requirements included in this recommended practice and be knowledgeable in the following areas related to use of explosives and pipeline construction blasting operations.

B.2.2 Transportation, Handling, and Storage of Explosives

Blasting inspectors should be familiar with applicable regulations and Operator practices regarding the safe movement, storage, and handling of explosives.

B.2.3 Blasting Plan

Blasting inspectors should be familiar with the contractor’s blasting plan and confirm that all safety precautions are implemented per the plan.

B.2.4 Permit

Blasting inspectors should be knowledgeable of pertinent permits and their issuing agencies and confirm that the provisions of the permits are properly addressed by the contractor.

B.2.5 Safety Precautions

Blasting inspectors should be knowledgeable of safety precautions to be taken during blasting operations, including, but not limited to, notifications, warning signage, use of two-way radios, barriers, and safe distance parameters from the blast zone.

B.2.6 Blasting Preparation

Blasting inspectors should be familiar with charge placement drilling operations, including configurations and depth of charge holes, charge placement procedures, charge padding activities using earth or blast mats, proper fusing techniques, use of correct wiring, and blasting machines, and confirm that each of these activities follow accepted practices and Operator procedures.

B.2.7 Blasting

Blasting inspectors should monitor the results of the blasting to confirm its effectiveness and measure and record, if required, the area blasted in the event of extra work authorization or special bid pricing.

B.2.8 Clean-up

Blasting inspectors should monitor clean-up activities so that there is minimal collateral damage due to excess heaving or debris scatter.

Annex C
(normative)

Horizontal Directional Drilling Inspector

D.1 Scope

Individuals assigned to carry out the inspection duties related to horizontal directional drilling (HDD) are recognized as specialists due to the nature and complexity of these operations. Thorough monitoring and documentation by qualified inspection personnel is crucial since a drilled installation is typically buried with deep cover under inaccessible terrain or infrastructure features and its installed condition cannot be verified by visual examination. HDD inspectors should have specialized knowledge and have experience in this crossing methodology. HDD inspectors report to the chief inspector and may handle other inspection duties as directed by the chief inspector.

D.2 Qualifications

D.2.1 General

HDD inspectors should be knowledgeable of the basic inspection requirements included herein and be knowledgeable about the characteristics, features, and work performance activities of HDD operations, including, but not limited to, the following:

- drill path;
- pilot hole;
- downhole survey systems/surface tracking systems;
- course length;
- inclination;
- azimuth;
- stationing;
- elevation;
- entry/exit angles;
- radius of curvature;
- pull section;
- reaming;
- buoyancy control;
- coating integrity;
- drilling fluid;
- documentation requirements.

D.2.2 Construction Staking and Marking

HDD inspectors should be familiar with staking and marking of the drilled segment, particularly the entry and exit points, including the distance between the points, their elevations, and how each of these is determined. HDD inspectors should understand the importance of these accurately located points that provide a benchmark for the downhole survey and the orientation of the survey measuring instruments.

D.2.3 Horizontal Directional Drilling Equipment

HDD inspectors should be familiar with HDD equipment of various sizes and types suitable for different jobs, machinery condition, and suitability for the intended work.

D.2.4 Horizontal Directional Drilling Personnel

HDD inspectors should observe the functioning of the HDD equipment operating personnel and their supervision as to their competence and proficiency and how they handle the HDD equipment and its associated gear, including the surface monitoring system used to determine the downhole probe location.

D.2.5 Drilled Path

HDD inspectors should monitor the drilled path during pilot hole drilling and assess if the drilling is on the proper inclination and azimuth to verify the vertical and horizontal positioning, including the drilled length, depth of cover, and entry/exit angles required by the Operator specifications. HDD inspectors should also assess if the exit location is within limits set forth by the specifications.

D.2.6 Pipe Installation

D.2.6.1 General

HDD inspectors should review the pipe installation operation to verify Operator specifications are met, including the following.

D.2.6.2 Pull Section

HDD inspectors should confirm that the welds, pipe, and joint coating of the carrier pipe string to be pulled into the drilled crossing have been properly inspected and the pull section is ready for placement.

D.2.6.3 Reaming

HDD inspectors should be knowledgeable of the equipment and its appurtenances used to enlarge the drill hole to accommodate the pull back operation and be able to assess the effectiveness of this operation.

D.2.6.4 Pull Section Handling

HDD inspectors should monitor and assess the adequacy of support of the pull section during pull back. Roller stands or other support mechanisms as well as the lifting equipment should be checked to confirm satisfactory movement of the pipe string into its drilled crossing.

D.2.6.5 Buoyancy Control

HDD inspectors should be knowledgeable of buoyancy control processes that may be used to lessen pulling loads.

D.2.6.6 Pipe Coating

HDD inspectors should inspect the pipe coating with a properly calibrated holiday detector just prior to the pipe entering the reamed drill hole and confirm that any coating repairs meet Operator specifications.

D.2.7 Drilling Fluid

HDD inspectors should be familiar with types of drilling mud and its proper use, monitor the ROW for potential drilling mud migration or intrusion, and confirm the containment and disposal of the drilling fluids follow accepted procedures. Site-specific or regulatory requirements for drilling fluid disposal should be clearly communicated by the Operator to the inspector.

D.2.8 Documentation

HDD inspectors should understand requirements established by the Operator and any permitting agencies and complete needed documentation in a timely and complete manner. Requirements from permitting agencies should be clearly communicated by the Operator to the inspector.

Annex D
(normative)

Welding Inspector

E.1 Scope

Individuals assigned as welding inspectors shall be qualified as welding inspectors so that the inspection of this critical activity is carried out in strict accordance with codes, regulations, and Operator specifications. Qualification and certification in this function require additional schooling and usually a significant amount of on-the-job experience. Welding inspectors report to the chief inspector and may function as backup for the chief.

E.2 Qualifications

E.2.1 General

Welding inspectors should be knowledgeable of the basic requirements included in this recommended practice; have completed training in API 1104, CSA Z662, ASME *BPVC* Section IX, or industry welding schooling; and be skilled in the following areas related to pipeline welding.

E.2.2 Certification and Qualification Verification

Welding inspectors should be familiar with both welder and nondestructive testing (NDT) technician qualification and certification documentation provided by the contractor or individual and be capable of verifying the documents' authenticity.

E.2.3 Testing Welders

All mainline pipeline welding strictly follows Operator-approved and qualified welding procedures, which consistently produces sound welds with correct mechanical properties and meets Operator requirements. Every welder, welding on the pipeline, should be tested and qualified by making an acceptable weld using the approved/qualified procedure to be used in the construction. Welding inspectors should be capable of monitoring and assessing these tests and determining acceptability of the welds by visual examination, NDT, and destructive testing. Welding inspectors confirm that each welder passing the qualification test is issued and uses an identification number to identify his/her welds during construction.

E.2.4 Welding Equipment

Welding inspectors check the following for compliance with welding procedures and specifications:

- suitability of welding machines, electrode holders, grounding clamps, and cables and their proper use;
- welding rod, including AWS classification and size;
- storage/handling procedures for welding rod and other welding supplies;
- other equipment, such as cutting/beveling machines, any preheat equipment, brushes, and grinders.

E.2.5 Alignment of Pipe for Welding

Welding inspectors monitor the following pipe gang and line up activities:

- no foreign debris and/or wildlife in the pipe;
- pipe gang proficiency to confirm proper handling, fit up, and bevel alignment;
- clamping procedures and proper support of pipe during and after welding, including padded skids for coated pipe;

- seam alignment, if any, to confirm pipe seams are rolled off top center per specifications;
- potential magnetism [near high-voltage alternating current (HVAC) lines or where there is evidence of residual magnetism] that could adversely affect welding (arc blow) and take steps to degauss the pipe. (If the pipe is being laid under HVAC lines, verify that the pipe section is grounded.)

E.2.6 Welding Inspection

Welding inspectors should carry out their responsibilities in the areas below to confirm compliance with the appropriate specifications and standards. Welding inspectors should:

- have a copy of the qualified welding procedure readily available and the qualification papers of qualified welders and verify that proper welding procedures are being consistently followed;
- visually inspect each weld and observe welder technique/performance including smoothness of metal application, rod travel speed, starts/stops, and welder identification;
- verify that the NDT contractor has provided written NDT procedures for all processes and performs in accordance with those procedures, and verify NDT of welds is in accordance with industry standards and regulations;
- evaluate weld quality by reviewing NDT results; noting defective welds, rejection rates, and repairable/nonrepairable (cut-outs) welds versus standards of acceptability contained in Operator specifications; marking any unacceptable welds for repair or cut-out, and noting which welder or welders made the unacceptable welds.

E.2.7 Weld Repairs/Replacement

Welding inspectors inspect any repairs in the same manner and intensity as production welds and conduct the following:

- confirm that the cylinder of pipe cut-out and the replacement pipe piece meet length restrictions for the diameter of pipe involved and confirm any weld repairs follow the appropriate code specification;
- confirm that appropriate weld repair procedure is utilized;
- check proper beveling, fit up, weld quality, and NDT results versus standards.

E.2.8 Tie-ins

Welding inspectors should inspect tie-in operations for proper alignment, beveling, welding, coating repair, and pipe placement and confirm that pipe is properly supported when placed in the ditch. Welding inspectors should confirm that welders have adequate space in the welding area to see the weld and access the area fully.

E.2.9 In-service Welding

Special welding procedures and welder qualifications are required for in-service welding.

Refer to API 1104 and CSA Z662 for further information on in-service welding.

E.2.10 Documentation

Welding inspectors complete in a timely manner all required records of welding operations, including, but not limited to, number of welds, NDT records, rejection rates, repairs, and other documentation as specified by the Operator.

Annex E
(normative)

Corrosion Control Inspector

F.1 Scope

Individuals assigned as corrosion control inspectors (or coating inspectors) should be qualified and certified in corrosion control. Qualification and certification require specialized schooling, usually under the auspices of NACE International.

F.2 Qualifications

F.2.1 General

Corrosion control inspectors should be knowledgeable in the basic requirements included herein [e.g. have completed the NACE Coating Inspector Program (CIP) Level 1 or equivalent] and be capable of carrying out the inspection duties below.

F.2.2 Pipe Coating Requirements

Corrosion control inspectors should be knowledgeable about proper aboveground/belowground coating application techniques, including surface preparation, priming, type and method of application, curing time, application limitations, atmospheric condition restrictions, and integrity testing.

F.2.3 Mill Applied Coating

Corrosion control inspectors should be capable of inspecting, marking, and following repairs in accordance with specifications and manufacturer's recommended repair criteria for any observed coating damage beginning with when the pipe arrives on the job to lowering-in.

F.2.4 Over the Ditch Coating

Corrosion control inspectors should inspect, assess, and note corrective action needed in the following areas:

- coating machine condition, suitability for the work, correct operation, and operator performance of his/her duties;
- confirm that surface preparation meets specifications;
- confirm that environmental conditions are suitable for coating activities;
- check that correct primer is used, it is correctly applied at the specified thickness, and drying time is within specification;
- verify that correct coating is being applied at the proper rate, travel speed, tension, and overlap;
- verify that proper lifting/placement techniques are used and coating protection is provided on lower in.

F.2.5 Field Joint Coating

Field joint coating and application methods are typically used on mill-applied coating and all tie-ins. Corrosion control inspectors should check the following to confirm coated field joints meet specifications:

- monitor contract personnel doing this work to confirm specified procedures are followed;
- confirm that surface preparation meets specifications and manufacturer's requirements/recommendations are followed;
- verify that the correct primer is used, properly applied at the right thickness, and drying time is within specified limits;

- confirm that coating is the correct type, applied per specifications and manufacturer's recommendations, and proper curing time is observed before movement of the pipe;
- check that coated pipe is properly handled and protected awaiting lower in.

F.2.6 Coating Repairs

Corrosion control inspectors should confirm that removal of damaged coating follows manufacturer's recommendations and/or Operator specifications and damage to the pipe surface is avoided. Corrosion control inspectors should check that repair of damaged coating on either mill-applied or over the ditch coating follows the project coating standards for surface preparation, coating application, curing, and holiday testing.

F.2.7 Cathodic Protection Requirements

New pipelines require installation of corrosion control testing facilities, rectifier units, and ground beds. Corrosion control inspectors should be knowledgeable about the proper installation and testing of these devices.

- Test leads for corrosion control monitoring should be checked by the corrosion control inspectors to confirm they were installed properly.
- Rectifier units and ground beds should be checked by the corrosion control inspectors to confirm proper installation per specifications and that they operate properly. Corrosion control inspectors should complete Operator required documentation for these installations.

F.2.8 Foreign Pipeline Bonding Requirements

Corrosion control inspectors should be knowledgeable on these installations, including the wiring, test station, and wire terminations, and confirm that they are tested and operate properly.

F.2.9 Cathodic Protection Testing and Measurement Requirements

Corrosion control inspectors should confirm that all rectifiers are read, calibrated where needed, and pipe-to-soil potentials are taken at test stations and measure any cased crossings for electrical shorts to confirm that all installations meet specifications.

Annex F
(normative)

Chief Inspector

G.1 Scope

Individuals assigned as chief inspectors are typically highly skilled and experienced in pipeline construction and have served in several different inspection classifications. Chief inspectors should be capable of managing, directing, and overseeing pipeline construction inspection personnel involved in each construction activity, including welding inspectors, corrosion control inspectors, utility inspectors, and specialized inspectors, such as blasting and horizontal directional drilling (HDD). Chief inspectors usually report to an Operator project manager or management personnel charged with completing a pipeline project.

G.2 Qualifications

F.2.1 General

Chief inspectors should be knowledgeable in each of the major requirement areas of pipeline construction. The basic requirements are detailed herein and include:

- pipeline construction inspector responsibilities;
- personnel and general pipeline safety;
- environmental and pollution control;
- general construction inspection.

F.2.2 Special Inspection Requirements

Chief inspectors should have in-depth knowledge of welding inspection, corrosion control inspection, and specialty inspection, such as blasting, HDD, and other specialty inspection that may be required by the project.

F.2.3 Other Knowledge and Skill Requirements

F.2.3.1 Principles

Chief inspectors should be knowledgeable and capable of supervising inspection activities, which includes, but is not limited to, understanding project objectives, contract implementation, planning and scheduling tasks, identifying scope changes, measuring and controlling job progress, managing quality assurance (QA), and completing documentation requirements, all within the requirements of the Operator.

F.2.3.2 Fundamentals of Project Controls

Chief inspectors should understand project control requirements, including, but not limited to, receipt of materials and supplies, verification of material conformance to specifications, and timely communication of project progress. Project controls can vary greatly between projects, and chief inspectors should be capable of monitoring requirements set by the operator.

F.2.3.3 Contract Implementation

Chief inspectors should be knowledgeable about the contract requirements. This can include, but is not limited to:

- Project scope of work,
- Schedule,
- design, quality, safety and environmental requirements,

- line lists,
- approved materials lists,
- project execution plans which can include management of change,
- technical requirement exhibits, including work procedures, plans, and specifications. .

F.2.3.4 Project Materials Tracking and Traceability

Chief inspectors should be familiar with the processes and procedures used in supply management systems, including, but not limited to, tracking and tracing materials and supplies using identifiers, such as serial numbers, mill numbers, and heat numbers, verifying adherence to specifications, conformance to purchase orders, and resolving delivery timing issues and their influence on job progress.

F.2.3.5 Elements of Public Relations

Chief inspectors shall know Operator requirements as to what is pertinent and appropriate in providing information, answering questions, and resolving issues with the general public, including landowners, regulatory and law enforcement officials, mass media representatives, and other individuals who may interface with the project construction. Chief inspectors shall inform the inspection team of the operator's public relations requirements.

Annex G
(informative)

Regulation in North America

G.1 Scope

The United States and Canada both have extensive federal level regulations and regulatory guidelines that directly concern or impact pipeline construction. This annex is designed to assist the pipeline industry in identifying these pieces of legislation in the two countries. It does not cover local regulation and is not intended to be entirely comprehensive of all federal-level regulation in the United States and Canada that may impact pipeline construction.

G.2 Pipeline Regulation in the United States and Canada

Table G.1 describes regulations applicable for pipeline construction inspection in the United States and Canada.

Table G.1—Applicable Regulations for the United States and Canada

Topic	Applicable U.S. Regulation	Applicable Canadian Regulation
Atmospheric Testing	OSHA 1910.146 Appendices B and D	CSA Z1006 – Management of Work in Confined Spaces
Backfill	49 *CFR* 192.319	CSA Z662 Section 6.2.7 and 6.2.9
Backfill and Clean-up Operations	49 *CFR* 192.327, 49 *CFR* 195.248, and 49 *CFR* 195.252	CSA Z662 Section 6.2.7 and 6.2.9 OPR Section 21
Cased Crossings	49 *CFR* 192.323 and 49 *CFR* 195	CSA Z662-15 Section 4.12.3.3
Clean Water	Federal Water Pollution Control Act (FWPCA) of 1972 (especially, Subpart A); Clean Water Act (40 *CFR* 110)	Canada Water Act, 1985
Compressed Air	OSHA 1926.803	SOR-86-304 Section 10.21, 10.22, 10.26.3
Confined Space Entry	OSHA 1910.146	SOR-86-304 Section 11.4
Cultural and Heritage Concerns	National Historic Preservation Act	Heritage Conservation Act Section 13 National Energy Board Act Section 44 National Energy Board Onshore Pipeline Regulations Section 04-1 NEB Filing Manual Section 2.1 The Heritage Resources Act Section 12(1) Heritage Act Section 48 Cultural Heritage Act Section 48 Natural Heritage Conservation Act Section 34 Heritage Property Act Section 23
Depth Requirements and Terrain	49 *CFR* 195.248 and 49 *CFR* 192.327	CSA Z662-15 Section 4.11, 6.2.6
Ditching Operations	OSHA 1926.651	CSA Z662-15 Section 6.2.6
Ditching Requirements	49 *CFR* 195.248	CSA Z662-15 Section 6.2.6 and 12.6.3
Documentation	49 *CFR* 195.266 or 49 *CFR* 192	CSA Z662-15 Section 3.1.2 g and 3.3.3

Topic	Applicable U.S. Regulation	Applicable Canadian Regulation
		OPR Section 6.3, 6.4, 6.5 (1) (o), 6.5 (1) (n), 6.5 (1) (v), 6.5 (3), 10 (1), 41, 56 (g) (7)

Table G.1—Applicable Regulations for the United States and Canada *(continued)*

Topic	Applicable U.S. Regulation	Applicable Canadian Regulation
Drilling and Blasting	OSHA 1926.900 to 1926.914	Drilling: CSA Z662-15 Section 6.2.11 Blasting: CSA Z662-15 Table 4.9
Earth Moving and Erosion and Runoff	OSHA 1910.180, 1910.181, and 1926 Subpart P	Canadian Environmental Protection Act, 1999 – Schedule 6
Emergency Conditions	OSHA 1910.151, 1910.157, 1926.23, and 1926.24	CSA Z662-15 Section 10.4.3 OPR Section 32
Environmental Contamination	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	National Energy Board Act and Canadian Oil and Gas Operations Act
Excavation	OSHA 1926 Subpart P	CSA Z662-15 Table 4.9, Section 10.10.1.3 SOR-86-304 Section 3
	OSHA 1926.650 and 1926.651	SOR-86-304 Section 3.12
Explosive Blasting	OSHA 1910.109 and OSHA 1926.900 to 1926.914	SOR-86-304 Section 10.25
Eye Protection	OSHA 1910.133 and 1926.102	SOR-86-304 Section 12.6
Fall Prevention	OSHA 1926.25, 1926.26, and 1926.500 to 1926.503	SOR-86-304 Section 12.10
Fittings	49 *CFR* 195.206	CSA Z662-15 Section 5.2.9, 5.3.2, 11.20.3, 14.3.3, 15.5.3
Flammable and Combustible Liquids	OSHA 1910.106 and 1926.152, 49 *CFR* 177, and OSHA 1910.106	Part X of the Canada Occupational Health and Safety Regulations
Flora and Fauna Concerns	Endangered Species Act	Canadian Environmental Protection Act
Foot Protection	OSHA 1910.136 and 1926.96	SOR-86-304 Section 12.5
Foreign Line Crossings	49 *CFR* 192.325 and 195.250	CSA Z662-15 Section 4.12.2 OPR Sections 22 and 51
Hand Protection	OSHA 1910.138	SOR-86-304 Section 12.9
Handling and Transportation of Explosives	OSHA 1910.109, OSHA 1926.900 to 1926.914, and 49 *CFR* 177	Explosives Act and the Explosives Regulations, 2013
Handling Contaminants	OSHA 1910.1200 and 1926.65	Canadian Environmental Protection Act, 1999
Hazardous Waste	40 *CFR* 261.3, OSHA 1910.1200, and OSHA 1926.65 40 *CFR* 171, 40 *CFR* 171.8, and OSHA 1910.1200	SOR-86-304 Section 10.43
Hazardous Waste Response	40 *CFR* 172, OSHA 1910.120, and OSHA 1910.1200	Canadian Environmental Protection Act, 1999, Division 8

HAZMAT	OSHA 1910.100 to 1910.119, 1910.1000 to 1910.1028, 1910.1200, and 1926 Subpart Z 40 *CFR* 116	SOR-86-304 Section 10.3

Table G.1—Applicable Regulations for the United States and Canada *(continued)*

Topic	Applicable U.S. Regulation	Applicable Canadian Regulation
Head Protection	OSHA 1910.135 and 1926.100	SOR-86-304 Section 12.4
Hearing Protection	OSHA 1910.95, 1926.52, and 1926.101	SOR-86-304 Section 7.7
Hot Work	OSHA 1910.119(k)	SOR-86-304 Section 11.9
Hydrostatic Testing	49 *CFR* 192 Subpart J and 49 *CFR* 195 Subpart E	Section 8 CSA Z662 -15 OPR Sections 23-26
In-line Inspection	49 *CFR* 195.450 to 195.452 49 *CFR* 192.150 to 192.917	CSA Z662-15 Section 10.3, Annex D OPR Sections 40 and 41
Incident Response for Contamination	OSHA 1926.65	National Energy Board Act and NEB Remediation Process Guide
Isolation of Hazardous Energy Sources	OSHA 1910.147	Z460-13, Control of Hazardous Energy—Lockout and Other Methods
Ladders	OSHA 1910.28 and OSHA 1926.450 to 1926.454	SOR-86-304 Section 2.9
Lowering-in Requirements	49 *CFR* 192.319 and 49 *CFR* 195.246	CSA Z662-15 Section 6.2.6
Motorized Work Equipment Safety	OSHA 1926.550 and OSHA 1926.600 to 1926.604; OSHA 1926.600 and 1926.602	Canada Occupational Health and Safety Regulations (SOR/86-304) Section 14.4
Operator Qualification	49 *CFR* 192.801 to 192.807 and 49 *CFR* 195.501 to 195.509	
Other Atmospheric Conditions or Concentrations of Toxic Contaminants that May Be IDLH	OSHA 1926 Subpart Z	Part X of the Canada Occupational Health and Safety Regulations
PELs	OSHA 1910.1000	
Personnel Verification	49 *CFR* 192.303, 192.305, and 192.307; 49 *CFR* 195.200, 195.202, 195.204, and 195.206	CSA Z662-15 Section 13.1.6
Pipe Bending	49 *CFR* 192.313 and 49 *CFR* 195.212	CSA Z662-15 Sections 6.2.3 and 6.5.5
Pipe Handling	49 *CFR* 192.309	CSA Z662-15 Sections 6.2 and 11.21.2, 11.21.6.4
Pressurized Gases	OSHA 1910.101, 1926.153, and 1926.803	Canada Occupational Health and Safety Regulations (SOR/86-304) Section 10
Radiation Exposure	10 *CFR* 20.1301 and 20.1302 and NORM conditions	SOR-86-304 Section 10.26

Respiratory Protection	OSHA 1910.134 and 1926.103	SOR-86-304 Section 12.7
Rigging and Lifting	OSHA 1910.180 and 1910.184 OSHA 1926.250 and 1926.251	SOR-86-304 Sections 14.1 and 14.48
Safety Apparel	OSHA 1910.132 and 1926.95	SOR-86-304 Section 12.1

Table G.1—Applicable Regulations for the United States and Canada *(continued)*

Topic	Applicable U.S. Regulation	Applicable Canadian Regulation
Safety Equipment for Compressed Gas Cylinders and Tanks	OSHA 1910.101, 1910.102 (acetylene), 1910.104 (oxygen), and 1910.110 (LPG); 49 *CFR* 177.400; and 49 *CFR* 177.844	Canada Occupational Health and Safety Regulations (SOR/86-304) Section 11
Shoring Requirements	OSHA 1926.652	SOR-86-304 Section 3.12
Signage	49 *CFR* 195.410	CSA Z662-15 Section 10.5.3 OPR Section 36 f
Solid and Hazardous Waste Concerns	Resource Conservation and Recovery Act (RCRA)	Canadian Environmental Protection Act, 1999
Stormwater	National Pollutant Discharge Elimination System (NPDES) requirements	Canada Water Act, 1986
Tool Hazards	OSHA 1910.180, 1910.184, 1910.215, 1910.241 to 1910.244, 1910.254, and 1926.300 to 1926.303	SOR-86-304 Section 14.35
Traffic Control Barrier and Marking Procedures	Manual on Uniform Traffic Control Devices (MUTCD)	Manual of Uniform Traffic Control Devices for Canada (2014) (MUTCDC)
Underground Utility Verification	49 *CFR* 195.442 and 49 *CFR* 102.325	CSA Z662-15 Section 10.16.2
Valve Materials	49 *CFR* 195.258 and 49 *CFR* 195.260	CSA Z662-15 Table 5.3
Vehicle Operation	OSHA 1926.601	Canada Occupational Health and Safety Regulations (SOR/86-304) Section 14
Waste Generation	OSHA 1910.120	Canadian Environmental Protection Act, 1999
Work Site Waste Removal	OSHA 1926.25	CSA Z662-15 Section 12.6.13.6 OPR Section 11 (c)

Bibliography

[1] API Recommended Practice 5L1, *Recommended Practice for Railroad Transportation of Line Pipe*

[2] API Recommended Practice 5LT, *Recommended Practice for Truck Transportation of Line Pipe*

[3] API Recommended Practice 5LW, *Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels*

[4] API Recommended Practice 1102, *Steel Pipelines Crossing Railroads and Highways*

[5] API Recommended Practice 1109, *Line Markers and Signage for Hazardous Liquid Pipelines and Facilities*

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

[7] API Recommended Practice 1161, *Recommended Practice for Pipeline Operator Qualification (OQ)*

[8] API Recommended Practice 1162, *Public Awareness Programs for Pipeline Operators*

[9] API Recommended Practice 1172, *Recommended Practice for Construction Parallel to Existing Underground Transmission Pipelines*

[10] API Recommended Practice 1173, *Pipeline Safety Management Systems*

[11] API Recommended Practice 1177, *Recommended Practice for Steel Pipeline Construction Quality Management Systems*

[12] API Specification 5L, *Line Pipe*

[13] API Specification 6D, *Specification for Pipeline and Piping Valves*

[14] API Standard 1104, *Welding of Pipelines and Related Facilities*

[15] API Technical Report 1166, *Excavation Monitoring and Observation for Damage Prevention*

[16] API, *Security Guidelines for the Petroleum Industry*

[17] ANSI/ASME B16.5 [15,16], *Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard*

[18] ANSI/ASME B16.9, *Factory-Made Wrought Buttwelding Fittings*

[19] ANSI/ASME B16.20, *Metallic Gaskets for Pipe Flanges*

[20] ANSI/ASME B16.21, *Nonmetallic Flat Gaskets for Pipe Flanges*

[21] ANSI/ASME B16.47, *Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard*

[22] ANSI/ASNT SNT-TC-1A [17], *Personnel Qualification and Certification in Nondestructive Testing*

[23] ASME B31.4, *Pipeline Transportation Systems for Liquids and Slurries, Chapter V: Construction, Welding, and Assembly*

[15] American National Standards Institute, 1899 L Street, NW, 11th Floor, Washington, DC 20036, https://www.ansi.org.

[16] American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016, https://www.asme.org.

[17] American Society for Nondestructive Testing, 1711 Arlingate Lane, Columbus, OH 43228, https://www.asnt.org.

[24] ASME B31.4, *Pipeline Transportation Systems for Liquids and Slurries, Chapter VI: Inspection and Testing*

[25] ASME B31.4, *Pipeline Transportation Systems for Liquids and Slurries, Chapter VIII: Corrosion Control*

[26] ASME B31.8, *Gas Transmission and Distribution Piping Systems*

[27] ASME B31Q, *Pipeline Personnel Qualification*

[28] ASME *Boiler and Pressure Vessel Code*, *Section IX, Welding and Brazing Qualifications*

[29] AWS [18], *Certification Manual for Welding Inspectors*

[30] CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*

[31] CGA Pamphlet S-1.1, *Pressure Relief Device Standards—Part 1: Cylinders for Compressed Gases*

[32] CSA Z662 [19], *Oil and Gas Pipeline Systems*

[33] FHWA [20], *Manual on Uniform Traffic Control Devices (MUTCD)*

[34] Homeland Security Regulations Public Law 107-296 and 107-71

[35] NACE SP0169 (formerly RP0169) [21], *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*

[36] NFPA 30 [22], *Flammable and Combustible Liquids Code*

[37] NOAA/NMFS Title 50 [23], *CFR* Part 402, Interagency *Cooperation—Endangered Species Act of 1973, as Amended*

[38] OSHA Title 29 [24], *CFR* Part 1910, *Occupational Safety and Health Standards*—Sections 1910.25, 1910.26, 1910.28, 1910.95, 1910.100 to 1910.120, 1910.132 to 1910.136, and 1910.138; Appendices A and B to Subpart I; Sections 1910.141, 1910.146, 1910.147, 1910.151, and 1910.157; Appendix A to Subpart L; and 1910.180, 1910.181, 1910.184, 1910.215, 1910.241 to 1910.244, 1910.254, 1910.1000 to 1910.1028, and 1910.1200

[39] OSHA Title 29, *CFR* Part 1926, *Safety and Health Regulations for Construction*—Sections 1926.21, 1926.23 to 1926.26, 1926.36, 1926.52, 1926.57, 1926.59, 1926.65, 1926.95, 1926.96, 1926.100, 1926.103, 1926.150, 1926.153, 1926.250, 1926.251, 1926.300, and 1926.303; Subpart J (Welding and Cutting); Sections 1926.450, 1926.451, 1926.452, 1926.454, 1926.500, 1926.503, 1926.550, 1926.600, 1926.601, 1926.602, and 1926.604, Subpart P (Excavations); Section 1926.803; Subpart U (Blasting and the Use of Explosives); Sections 1926.1053 and 1926.1060; and Subpart Z (Toxic and Hazardous Substances)

[40] Peabody, A. W., *Control of Pipeline Corrosion*, NACE International, Second Edition, January 2001

---

[18] American Welding Society, 8669 NW 36 Street, Miami, FL 33166, https://www.aws.org.

[19] CSA Group, 178 Rexdale Blvd., Toronto, Canada M9W 1R3, https://www.csagroup.org.

[20] U.S. Department of Transportation, Federal Highway Administration, 1200 New Jersey Avenue, SE, Washington, DC 20590, https://highways.dot.gov.

[21] NACE International, 15835 Park Ten Place, Houston, TX 77084, https://www.nace.org.

[22] National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169, https://www.nfpa.org.

[23] United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, 1849 C Street, NW, Washington, DC 20240.

[24] Occupational Safety and Health Administration, 200 Constitution Ave NW, Washington, DC 20210, https://www.osha.gov.

[41] PHMSA Form 7 [25], *Evaluation Report of Liquid Pipeline Construction*

[42] SSPC [26], *Good Painting Practice, Volume 1*

[43] U.S. DOT Title 49 [27], *CFR* Part 177, *Carriage by Public Highway*

[44] U.S. DOT Title 49, *CFR* Part 177, Section 835, *Class 1 Materials*

[45] U.S. DOT Title 49, *CFR* Part 177, Section 844, *Class 9 (Miscellaneous Hazardous) Materials*

[46] U.S. DOT Title 49, *CFR* Part 192, *Transportation of Natural and Other Gas by Pipeline*—Sections 192.301, 192.303, 192.305, 192.307, 1902.309, 192.313, 192.319, 192.323, 192.325, and 192.327; Subpart E (Welding of Steel in Pipelines); Subpart I (Requirements for Corrosion Control); and Subpart J (Test Requirements)

[47] U.S. DOT Title 49, *CFR* Part 195, *Transportation of Hazardous Liquids by Pipeline*—Sections 195.200, 195.202, 195.204, 195.206, 195.210, 195.212, 195.214 to 195.234, 195.236, 195.238, 195.242, 195.244, 195.246, 195.248, 195.250, 195.252, 195.254, 195.266, 195.300, 195.302, 195.304, 195.305, 195.306, 195.308, 195.310, 195.404, 195.410, 195.442, 195.501, and 195.505 and Subpart H (Corrosion Control)

[48] U.S. DOT Title 49, *CFR* Part 199, *Drug and Alcohol Testing*

[49] U.S. EPA Title 36 [28], *CFR* Part 800, *Protection of Historic Properties*

[50] U.S. EPA Title 40, *CFR* Part 110, *Discharge of Oil*

[51] U.S. EPA Title 40, *CFR* Part 112, *Oil Pollution Prevention*

[52] U.S. EPA Title 40, *CFR* Part 116, *Designation of Hazardous Substances*

[53] U.S. EPA Title 40, *CFR* Part 122, *EPA Administered Permit Programs: The National Pollutant Discharge Elimination System*

[54] U.S. EPA Title 40, *CFR* Part 171, *Certification of Pesticide Applicators*—Section 171.8

[55] U.S. EPA Title 40, *CFR* Part 172, *Experimental Use Permits*

[56] U.S. EPA Title 40, *CFR* Part 261, *Identification and Listing of Hazardous Waste*—Section 261.3

[57] U.S. EPA Title 40, *CFR* Part 300, *National Oil and Hazardous Substances Pollution Contingency Plan*

[58] U.S. EPA, *National Menu of Best Management Practices (BMPs) for Stormwater*

[59] U.S. FWS/NMFS Title 50, *CFR* Part 402, *Interagency Cooperation—Endangered Species Act of 1973, as Amended*—(7 *USC* 136 and 16 *USC* 1531)

[60] U.S. NRC Title 10 [29], *CFR* Part 20, *Standards for Protection Against Radiation*—Sections 20.1301 and 20.1302

---

[25] Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, 1200 New Jersey Avenue, SE, Washington, DC 20590, https://www.phmsa.dot.gov.

[26] The Society for Protective Coatings, 800 Trumbull Dr., Pittsburgh, PA 15205, https://www.sspc.org.

[27] U.S. Department of Transportation, 1200 New Jersey Avenue, SE, Washington, DC 20590, https://www.transportation.gov.

[28] Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, https://www.epa.gov.

[29] U.S. Nuclear Regulatory Commission, Washington, DC 20555, https://www.nrc.gov.