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A Practical Guide for Facilities Construction Inspectors

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1.0 INTRODUCTION

This guide provides the details related to the role of the Owner Company's Facilities Construction Inspector ("Inspector"), in terms of monitoring and inspection requirements throughout the lifecycle of the field component of the facilities 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.

This document represents best practices based on the accumulated experience and consensus amongst the majority of member companies in terms of technical requirements, both in Canada and the U.S., for facilities construction inspection competencies and related tasks beyond those captured in regulation and current certification.

With the anticipated increase in upcoming facilities construction activity, the CEPA (Canadian Energy Pipeline Association) Foundation and INGAA Foundation have established a Facilities Construction Inspector Certification Working Group as part of meeting a number of key objectives that include:

- Introducing a fundamental step change in the training and qualification of Facilities Construction Inspectors as a means of improving the construction quality of projects
- Improving the overall quality of work performed by Facilities Construction Inspectors within the industry

This document, in particular, is intended to support some of these broader objectives by establishing a meaningful reference tool to enhance learning for the Facilities Construction Inspector as a complement to the existing industry knowledge base and documentation (such as recognition and alignment with the Canadian Welding Bureau (CWB), American Welding Society (AWS), and NACE International). This document also parallels and borrows heavily from the previously published "A Practical Guide for Pipeline Construction Inspectors", where applicable.

2.0 PURPOSE

The purpose of this document is to provide Facilities Construction Inspectors with background and context, beyond existing regulation, regarding best practices in the industry. As such, this document is not intended to replace formal training, regulation, or Company specific practices (which may vary based on individual circumstances); rather, it is intended as a complementary guide to information from those sources.

3.0 SCOPE

The scope of this document is limited to gas and liquid facilities construction. Specifically, content is focused on those items that are relevant to the role of a Facilities Construction Inspector as it relates to best practices within the industry. Facilities are defined as all of those systems, equipment, and pipe physically located within the confines of a compression, pumping, or meter station – usually delineated by fencing. Facilities are sites intended to move, store, measure, or otherwise transform the products moving within the site (i.e., a fenced isolation valve along a section of pipe would not be considered a facility under this scope). This document also includes inspection items for access roads to the

facility site, as well as any areas that are deemed a designated worksite for the purposes of a facility construction project (e.g., lay down areas).

This document was developed to assist the inspection of the construction of greenfield facilities (i.e., new construction); however, it may be appropriately applied to accommodate inspection of the construction of brownfield facilities (i.e., expanding an existing site or working next to an existing site). Note that additional safety requirements and specific environmental considerations may apply to the construction of brownfield facilities.

Equipment and material inspection required by the Owner Company of the Original Equipment Manufacturer (i.e., production) is not included in this scope. These inspections should be completed during the Purchasing process and should be the responsibility of Supply Chain with confirmation by Engineering. Similarly, commissioning activities are outside of the scope of this document; however, inspection activities and reporting are a key aspect of transitioning to commissioning staff.

4.0 REVISIONS TO THIS DOCUMENT

This document will be reviewed periodically (as per existing CEPA Foundation and INGAA Foundation practices) to ensure the content within remains relevant and accurate.

However, it remains the responsibility of the user to ensure that the most current revision of documents (e.g., codes and standards) are referenced, where appropriate.

5.0 HOW TO USE THIS DOCUMENT

With an eye to practicality and ease of use, this document is organized to reflect the typical construction process for facility sites and the systems contained within facility site limits for Civil, Mechanical, and Electrical (including controls and instrumentation) Inspectors, which is loosely based on a typical drawing package. Foundational information common to all aspects of construction is presented first, followed by chapters specific to each phase of construction of the facility. Within each chapter, five main headings are used consistently:

- Overview – a brief description of the specific activities in the facilities construction phase
- Inputs – detailed information regarding typical information the Inspector will require
- Execution – detailed information regarding items the Civil, Mechanical, and / or Electrical Inspector(s) should typically watch for; for ease of use, items are typically formulated as actions using verbs such as: ensure, monitor, confirm, check, etc.
- Outputs – detailed information listing typical information the Inspector will be required to produce for the Owner Company
- References – a list of key relevant reference documents for those seeking additional information for each phase of facilities construction

The “Inputs” section within each chapter is intended to clearly identify the types of documents, specifications, and other information the Inspector would likely need to reference in that phase of facility construction. The “Execution” section within each chapter provides detailed checklists, often grouped by major topic, identifying critical items that Civil, Mechanical, and / or Electrical Inspector(s) should monitor in that facility construction phase. Finally, the “Outputs” section within each chapter then articulates items that the

Inspector is expected to produce or report on as it relates to that particular phase of the facilities construction project.

The use of the word “ensure” throughout this document is intended to convey that Inspectors “ensure” that the contractor has performed the inspected work properly through observing, monitoring, assessing, evaluating, verifying, deciding, resolving, reporting, and documenting to ensure that the project requirements are met. Inspection items in checklists throughout the document use wording such as “Ensure {item} is properly installed” – proper installation means compliance with governing Issued for Construction (IFC) drawings, Owner Company or project specifications, Manufacturer specifications, etc.

6.0 FACILITIES CONSTRUCTION INSPECTOR – FOUNDATIONAL INFORMATION

The items covered in this chapter are those that are relevant through all phases of the facilities construction process (see Figure 1). As such, any specific content in other chapters of this publication is intended to be used in conjunction with the information provided within this section. Additional information regarding the facilities construction process can be found in the INGAA Foundation publication “Building Interstate Natural Gas Transmission Pipelines: A Primer” or the CEPA Foundation’s Pipeline Construction Overview (roll out in November 2018).

The Inspector acts as the Owner Company’s authorized representative for non-financial matters, continuously observes the Contractor’s progress and monitors all activities in their assigned areas in accordance with codes and standards; regulatory requirements; Owner Company safety and environmental requirements, drawings, plans, and specifications; as well as the terms of the construction contract or agreement. The 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 chapters, 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	Section 6.1
Code of Conduct	Section 6.2
Worker, Site, and Construction Safety	Section 6.3
Quality, Deficiencies, and Non-conformance Procedures	Section 6.4
Environmental Considerations	Section 6.5
Execution of Work	Section 6.6
Administration of Contractual Obligations	Section 6.7
Records Management	Section 6.8
Personnel Qualifications and Certifications	Section 6.9
Equipment Calibration	Section 6.10
Incident Reporting	Section 6.11

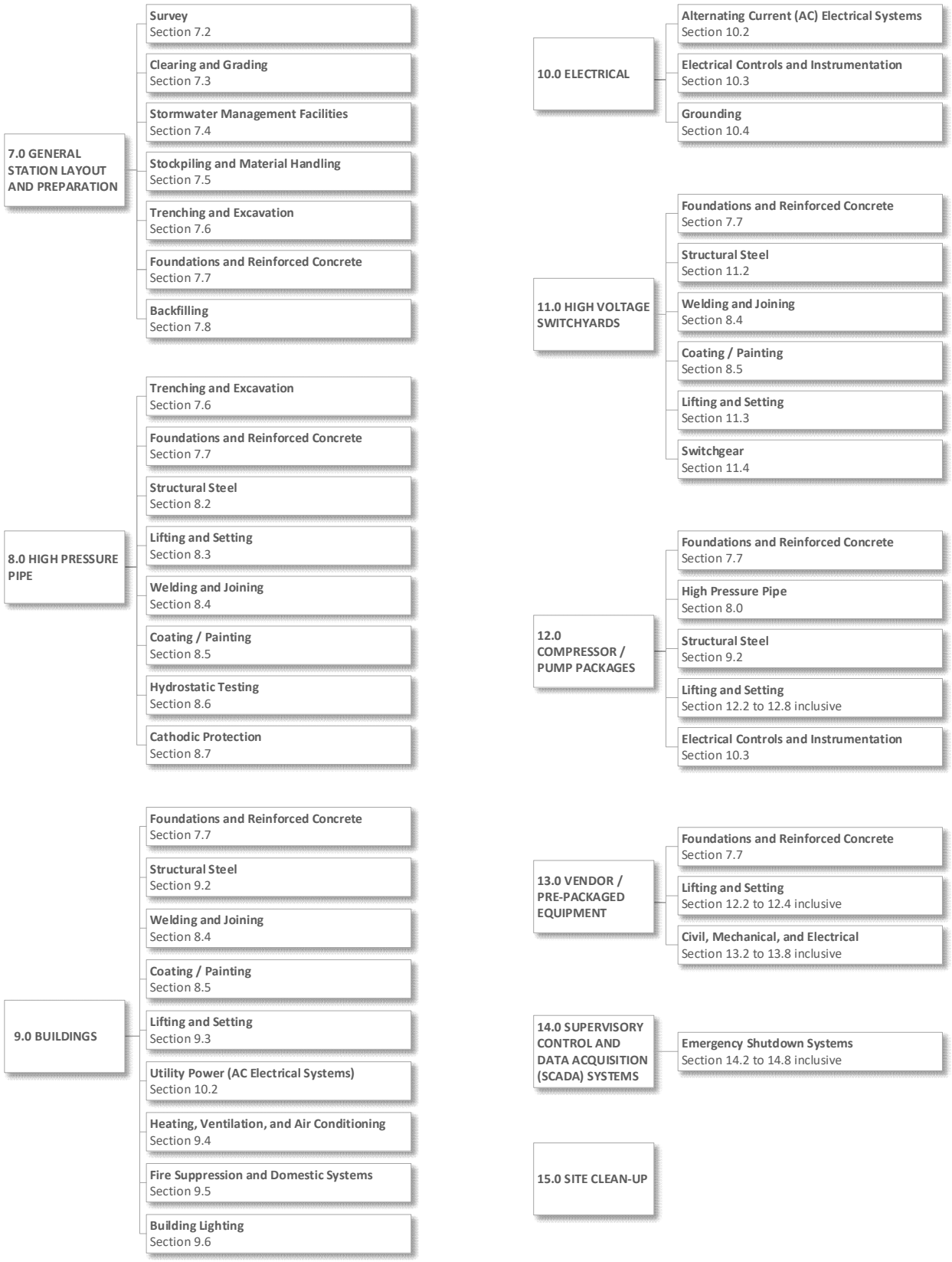


Figure 1: Typical Facilities Construction Phases

6.1 Authority

The Inspector on-site is part of a larger Project Team; as such, the Inspector should understand their role within the established chain of command and recognize situations that may need to be escalated in the best interests of the Owner Company. This is important not only for day-to-day operations, but becomes particularly important in the handling of deficiencies / non-conformances discussed later in this chapter. In particular:

- Roles of the Contractor and Inspector will be established before performing the tests or measurements to determine whether the work or an item complies with specifications and permit requirements
- If the Contractor performs tests or measurements unassisted, 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
- The Contractor should be aware of the Inspector's duties and authority (as defined in Section 6.4) outlining quality, deficiencies, and non-conformance procedures
- The Inspector has "stop work" authority when there is imminent danger to people or the environment

6.2 Code of Conduct

As the Inspector represents the Owner Company, they should always act ethically, professionally, objectively, consistently, and honestly when performing the required roles and responsibilities.

More specifically, the actual ethical conduct required from Inspectors is governed by the Owner Company's Code of Conduct, which typically includes (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
	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 Owner Company
	Endeavor to be fair, reasonable, and objective towards performing work requirements at all times
	Do not make assumptions; consult with the Construction Manager / Chief Inspector (or designate) 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
Professional Approach to Work	
	Be knowledgeable of and understand the relevant parts of the construction process

✓	Description
	Be knowledgeable of and understand Owner Company's standards and specifications
	Be knowledgeable of and understand relevant industry and government standards
	Ensure all applicable permits required to execute the work are in place and on-site prior to commencing the work
	Uphold Owner Company's industry practices to ensure safety, minimize risk, and avoid hazards in the workplace
	Be knowledgeable of Owner Company's construction timelines and understand Owner Company's construction schedule, costs, and components of the work
	Understand the role relative to other Stakeholders in the construction process and engage other expertise accordingly
	Make accurate decisions by being well informed and familiar with all contract documents and design requirements
	Arrive on site before the Contractor's crew and remain until after the crew leaves the site for the day
	Take breaks when the Contractor's crew takes breaks and remain on site during construction activities that require inspection
	Obtain all applicable documents before the start of inspection
	If questions arise that cannot be answered, seek those that have the authority to resolve
	Be proactive in problem solving and raise issues / concerns to the attention of the Construction Manager / Chief Inspector (or designate)
Positive Image in Representation of Owner Company	
	Behave in a courteous manner
	Conduct oneself in a respectable manner during off-time hours
	Show respect through good driving habits at the facility and on access or public roads
	Check the work area for good housekeeping and tidiness (e.g., equipment and consumables should be correctly handled, stored, maintained, and discarded)

6.3 Worker, Site, and Construction Safety

One of the key roles of the Inspector is to assist the Owner Company in ensuring a safe work environment both for its workers as well as the public. As such, all on-site Inspectors have "stop work" authority should a safety situation arise.

In addition to safety items detailed in the following chapters, the Inspector should keep in mind the items identified in Table 3.

Table 3: Typical Safety Considerations

✓	Description
General	
	Ensure each member of the activity crew understands their role and responsibility with respect to safety in the execution of the work
	Plan, schedule, and attend Contractor's tailgate meetings prior to commencing safety 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 along with any changes to precautions that need to be taken as a result of these changes
	Manage a proactive approach to participating in the morning Contractor safety meetings
	Promote a safe working environment of continuous improvement through communication of project issues and solutions

✓	Description
	Ensure any required emergency medical services are in place
	Continuously inspect and monitor the Contractor's workmanship and ensure conformance to Owner Company's Health and Safety specifications and Site Specific Safety Plans
	Monitor for compliance to safety regulations
	Ensure emergency / after-hours contact information is posted in site offices and provided to active Contractors
	Continuously monitor for compliance to personal protective equipment (PPE) requirements
	Ensure "safety zones" are in place and maintained at powerline locations
Safety Audits	
	Participate in weekly Project Site Specific Safety Audits and provide a constructive Corrective Action Plan to communicate safety issues to the Contractor
	Track and communicate project Safety Site Audit results to all Project Team Members

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

Table 4: List of Typical Owner Company 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
	Lock-out / Tag-out Procedure
	Vehicle and Equipment Safety Practice
	Drug and Alcohol Policy
	Job Safety Analysis (JSA)
	Other Owner Company or project specific requirements, as applicable

6.4 Quality, Deficiencies, and Non-conformance Procedures

The Facilities Construction Inspector plays a critical role in managing the quality of work performed during facilities construction. As such, the Inspector should recognize that inspection requires monitoring to regulation as well as the critical elements of the Owner Company's quality management system (QMS). Those items that are specifically relevant to the Inspector typically include the items listed in Table 5.

Table 5: List of Typical Owner Company Quality Documentation

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

As the Inspector identifies any deviations, Owner Company specific escalation processes will need to be followed.

6.4.1 Escalation Processes

Since the Inspector monitors all facilities construction activities and operations for safety, stewardship of the environment, as well as compliance to project specifications and pertinent regulations, the Owner Company will have an escalation process in place to deal with any identified deficiencies (an isolated deviation from requirements that does not impact safety, environment, structural integrity, cost, or schedule) that may require elevation to a non-conformance (a recurring deficiency or major deviation from regulation or Owner Company specification such that safety, environment, structural integrity, cost, or schedule could be impacted). Any identified non-conformance(s) need to be addressed through corrective action(s).

Specific processes vary from Company to Company and Inspectors will familiarize themselves accordingly; however, all escalation processes will typically be structured as follows:

1. Verbal discussion with Third Party Representative
2. Verbal warning with notification
3. Written warning including signed documentation
4. Stop work that can potentially impact the health, safety, and environment of people working on the worksites, the community, and the land where the work is being conducted

6.4.2 Personal Violations

The Inspector should continuously observe and report individuals for personal violations. Typical examples of personal violations are included in (but not limited to) the items identified in Table 6.

Table 6: Examples of Personal Site Violations

Type	Description	Potential Consequence / Outcome
Conduct	Not wearing proper personal protective equipment (PPE)	Removal of worker from worksite
	Wearing incorrect attire (e.g., muscle shirts, shorts, or clothes made of synthetic fibres)	
	Using headphones for radio / MP3 devices while on duty	
	Roughhousing on the worksite	
	Not wearing seatbelts	
	Not respecting environmental 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	Stopping use of or removing the vehicle or equipment from the worksite
	Not maintaining “safety zones” at powerline or overhead hazard locations	
	Non-functional backup alarms on tracked equipment and rubber-tired vehicles	
	Not having canopies for clear Operator vision on machinery or using a spotter	
	Not having fire extinguishers or, if required, absorbent on welding units, vehicles, and heavy equipment	
	Using defective tools	
	Equipment leaking fluids	
	Any unsafe condition or practice, as determined by Owner Company Construction Manager / Chief Inspector (or designate) or Inspection Resources	Construction shutdown
	Construction activities not compliant with applicable safety, contract, and regulatory requirements	

6.5 Environmental Considerations

The Owner Company views compliance with applicable environmental regulations as a priority, and is committed to constructing project facilities in compliance with environmental permit requirements. Environmental compliance is a shared responsibility, and all members of the Project Team are responsible for ensuring that construction activities are conducted in compliance with environmental permits and requirements at all times. In general, environmental considerations are included in this document for the facility site and potential access roads; however, additional environmental considerations may be required based on the specific situation.

Typically, at least one individual will be assigned the role of Environmental Inspector (EI). A project specific Environmental Protection Plan (EPP) will detail requirements, where applicable, for the following (but not limited to):

- Wetlands, Muskeg, and Swamp Areas
- Wildlife Habitats
- Migratory Routes
- Stormwater Management
- Trench Dewatering
- Fuel Containment
- Hydrostatic Test Water Withdrawal and Disposal
- Disposal of Surplus Construction Materials and Debris

Environmental stewardship is a shared responsibility between all Inspectors as detailed in Table 7.

Table 7: List of Typical Environmental Activities

✓	Description
	Inform and instruct all Employees / Contractors of environmental concerns, special conditions, regulations, and specific permit conditions applicable to the construction area and the work itself
	Maintain contact with the Environmental Inspector
	Ensure that disturbance or damage to the environment is minimized, especially the following: • Uncontrolled fires • Soil and water erosion • Habitat damage or loss • Air, noise, and water pollution
	Ensure construction entrances are maintained to prevent tracking mud and debris onto public roadways
	In case of unanticipated disturbance or damage caused by construction activities, contact the Environmental Inspector and mitigate as soon as possible to restore affected areas to their original condition (to the extent possible) in a manner satisfactory to the Owner Company, Land Owners, Land Holder, and regulatory authorities
	Ensure equipment is not fueled, serviced, or staged within specified distances of water bodies
	Ensure that hazardous materials are stored away from specified distances of water bodies
	Ensure that all construction debris (e.g., rags, oil cans) and garbage is collected and disposed of to an approved facility
	Observe for persons feeding or harassing livestock or wildlife; if observed, report incident immediately to the Construction Manager / Chief Inspector (or designate)
	Report all wildlife deaths and nuisance animals to the Environmental Inspector
	Observe for firearm possession while on or off the facility site (e.g., at camp); if observed, report incident immediately to the Construction Manager / Chief Inspector (or designate)
	Observe for possession of pets while on or off the facility site (e.g., at camp); if observed, report incident immediately to the Construction Manager / Chief Inspector (or designate)
	Ensure all specified vehicles have a minimum specified amount of commercial sorbent material to address spills on both water and land
	Ensure Contractor's personnel have read and understand the environmental specifications and commitments
	Ensure all environmentally sensitive material is properly disposed of

✓	Description
	Ensure Fire Prevention and Firefighting Plans are updated, including details of monitoring, prevention, and response concerning: • Facility site preparation • Manpower and equipment • Training of personnel • Emergency procedures
Survey	
	Advise the Environmental Inspector and Construction Manager / Chief Inspector (or designate) before Construction Surveyors stake (marking of proposed site, pipe, equipment, or features required for construction operations in a consistent manner) environmental and archaeological sites
Clearing and Grading	
	Ensure topsoil stripping is conducted in accordance with the environmental specifications
	Ensure Owner Company surface run-off, containment, and / or sedimentary control plans are implemented
Trenching and Excavation	
	Monitor and record trenching and spoil pile segregation for subsoils with variable horizons
Coating / Painting	
	Review site specific requirements for blast media. Silica based media may require specialized disposal methods
Hydrostatic Testing	
	Ensure all stationary equipment (e.g., pumps, generators, fuel containers) within specified distances from a watercourse or water body are in secondary containment
	Ensure all equipment to be used within specified distances from a watercourse or water body is clean and free of leaks and are equipped with approved spill kits
	Ensure that appropriate testing (and associated disposal) is conducted for disposal of test water
	Validate that location(s), dates, volume, diversion, and discharge rates are appropriate and consistent with environmental plans
	Ensure intake source water is being metered
	Obtain verification from the environmental representative that the hydrostatic test water can be discharged
	Check the plans for the discharge structure and ensure that the contractor's plan aligns with environmental plans

6.6 Execution of Work

As the Inspector acts as the Owner Company's authorized representative, monitoring the work for conformance to the governing revision of Owner Company Issued for Construction (IFC) drawings and specifications is critical for not only meeting site safety and environmental expectations, but it is critical for ensuring quality of construction, which is necessary for long term safety, environmental, and cost effectiveness of the facilities asset.

Best practices relevant for each phase of facilities construction are identified in the following chapters in significant detail; however, additional activities that the Inspector will undertake include:

- Disseminate and explain Owner Company specifications and project specific documentation to other Inspectors (where required); it is key that the latest 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):
    - Construction Manager / Chief Inspector (or designate)
    - Contractors and Subcontractors
    - Land Agents
    - Third Party Owner Representative (where applicable)
    - Pipeline System Operations Personnel
    - Project Manager / Engineer
- Follow site-specific communications protocol as defined in the project

6.7 Administration of Contractual Obligations

It is part of the Inspector's role to understand contractual obligations and ensure that the Contractor is carrying out construction activities / operations accordingly. The Inspector's role in the administration of contractual obligations is summarized in Table 8, and may include the need to understand the types of agreements and contracts issued or applied for by the Owner Company as detailed in Table 9.

Table 8: Inspector Role in Administration of Contractual Agreements

✓	Description
	Maintain, coordinate, and communicate progress and schedule updates per Owner Company requirements
	Ensure Owner Company agreements (e.g., Crossing agreements, Third Party Utilities agreements, Land Owner agreements) are executed
	Verify, approve, and forward Contractor work items and materials on a daily basis to the Construction Manager / Chief Inspector (or designate)
	Perform material take-off (MTO) and ascertain status of all materials
	Obtain approval from Construction Manager / Chief Inspector (or designate) prior to commencing any extra work activities
	Ensure only most current revision of Issued for Construction (IFC) drawings, approved contract documents, and specifications are referenced for construction
	Ensure that all proposed deviations from specifications, design changes, or material substitutions are discussed and approved by the Construction Manager / Chief Inspector (or designate) prior to proceeding with the work
	Communicate lessons learned and foster an environment of continuous improvement, including participating in post-job review meetings

Table 9: Typical Approvals / Contracts Issued or Applied for by Owner Company

Type	Description
Agreements	Railroad Crossing Agreements – needed to cross any operating or abandoned railroad tracks within the facility site limits or to access the facility
	Pipeline Crossing Agreements – needed to cross any existing operating or abandoned underground and above ground pipelines within the facility site limits or to access the facility
	Utility Crossing Agreements – needed to cross any operating or abandoned underground utilities (e.g., fibre-optics, telephone, or other electrical) within the facility site limits or to access the facility
	Power Line Crossing Agreements – needed to cross any overhead power lines within the facility site limits or to access the facility
	Road Use Agreements – needed to use applicable public roads during construction to access facility construction sites
	Road Crossing Agreements – required to construct pipeline under public or private roads during construction to access the facility
	Land Use Agreements – land use type of agreements, which may include provisions for: • Lease Agreement • Lay Down or Warehousing Site • Camp Site • Approved Working Hours
Permits	Regulatory and jurisdictional permits (in some cases some of these would be obtained by the Contractor), which may include: • Work Permits on Crown / Public Land • Work Permits on Private Land • Fenced Enclosure Permits • Encroachment Permits • Environmental Permits (including Air Quality) • Road Use Permits • Road Transport Permits • Safe Work Permits • Burning Permits • Blasting Permits • Third Party Crossing Permits • Water Withdrawal and Discharge Permits for Hydrostatic Test • Building Permits (both temporary and permanent construction) • Stormwater Permits
Contracts	Materials Storage
	Construction Survey
	Emergency Medical Service (EMS)
	Clearing / Grading
	Pipeline, Facility, or Integrity construction activities
	Non-destructive Examination (NDE)
	Fabrication

Type	Description
	Compaction Testing
	Contracts associated with (small) miscellaneous reclamation activities
	Heavy Lift
	Hydrovac Excavating
	As-built Documentation
	Security

6.8 Records Management

A critical element of the Inspector's role is to support Owner Company record keeping, which is critical to compliance with regulations and audits as well as the long-term management of the facility. For example, details captured during the construction phase can be one of the critical pieces of information when maintaining the structural integrity of the facility in the future. While specific record keeping requirements are identified within each chapter, general requirements are listed in Table 10. Where record keeping is incomplete, poorly worded, or lacking entirely, construction inspector duties are deemed to be incomplete.

Table 10: Typical Activities Associated with Supporting Records Management

✓	Description
General	
	Ensure the timely completion and submission of all required documentation
	Ensure all forms, reports, and submitted data are as complete and accurate as possible
	Verify all as-built information pertaining to the construction progress has been recorded
	Provide information on an ongoing basis that will assist in closing Contractor claims
	When Contractor deficiencies and / or non-conformances have been identified, ensure continuous monitoring, documentation, and follow-up of Owner Company agreed-to actions until closed
	Continually coordinate project data collection and provide reports to Construction Manager / Chief Inspector (or designate) as per specific timelines
	Continually gather data to support a post-construction evaluation and lessons learned document
	Continually review base estimates 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 and equipment present on-site
	Confirm that Near Miss Reports are completed and submitted to the Construction Manager / Chief Inspector (or designate)
	Confirm that Incident Reports are completed and submitted to the Construction Manager / Chief Inspector (or designate)
	Obtain formal approval and written agreement from the Construction Manager / Chief Inspector (or designate) prior to commencing any extra work activities
Daily	
	Complete Inspection reports (e.g., materials, workmanship, areas inspected, pictures)
	Complete Construction Progress reports (e.g., materials, workmanship, areas inspected)

✓	Description
	Record lengths, locations, and units of work completed on a daily basis
Weekly	
	Confirm that Weekly Progress reports include identification of potential cost and schedule issues as well as safety, environmental, progress, and quality control issues
	Maintain, coordinate, and communicate weekly progress and schedule on survey activities to Construction Manager / Chief Inspector (or designate)
Project End	
	Prepare an end of project report (if required by Owner Company)
	Identify lessons learned and / or participate in sessions in support of lessons learned

6.9 Personnel Qualifications and Certifications

Confirming the qualifications of individuals allowed on site is an important element of ensuring a safe construction operation as well as ensuring that the work meets an acceptable level of quality. For example, welding operations have very specific requirements for the qualification of Welders and the work they undertake. These personnel qualifications / certifications are identified in the following chapters where relevant, and completed prior to construction unless there are on-site changes. Qualifications and certifications should also comply with applicable regulatory requirements (e.g., Owner Company Operator Qualification (OQ) Plans).

6.10 Equipment Calibration

Often activities during facilities construction require specialized equipment for testing. For example, jeeping / holidaying equipment (used to detect coating film discontinuities that may compromise pipe integrity) is a critical part of ensuring long term reliability and safety of the facility. In these situations, the Inspector will ensure that only properly calibrated test equipment is used on-site and supporting calibration records are available.

When required, the Inspector will also confirm that the Contractor's Operators are properly trained and knowledgeable with application and operation techniques, their equipment, and materials as per Section 6.9.

6.11 Incident Reporting

Should an incident occur, the Inspector is expected to assist the Owner Company (and where necessary, the local authorities) in conducting a formal and objective Incident Report. In particular, the Inspector should keep in mind the items identified in Table 11.

Table 11: Typical Incident Considerations

✓	Description
	Take immediate action to ensure injuries are attended to and / or emergency services are contacted
	Freeze the work site if required, based on Construction Manager / Chief Inspector (or designate) authority (see Section 6.1)
	Immediately report all injuries, vehicle incidents, near misses, and any unsafe conditions to the Construction Manager / Chief Inspector (or designate)
	Ensure 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 Owner Company when site can be returned to services

6.12 References – Foundational Information

Note to user: The reference information provided in Table 12 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 12: List of References – Foundational

Document No.	Type	Title
American Petroleum Institute (API)		
API 570	Standard	Piping Inspector
API RP 1169	Recommended Practice	Recommended Practice for Basic Inspection Requirements – New Pipeline Construction
API Specification Q1	Specification	Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry
American Society of Mechanical Engineers (ASME)		
ASME B31.3	Standard	Process Piping
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 Bird Convention Act
N/A	Regulation	Canadian Occupational Health and Safety Regulations (COHS)
N/A	Regulation	Transport Canada – Transportation of Dangerous Goods Regulations
N/A	Regulation	Navigation Protection Act
N/A	Regulation	Species at Risk Act

Document No.	Type	Title
Canadian Standards Association (CSA)		
CSA Z662	Standard	Oil and Gas Pipeline Systems
CEPA		
N/A	Recommended Practice	Facilities Integrity Management Program
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
40 CFR Part 300	Regulation	National Oil and Hazardous Substances Pollution Contingency Plan
49 CFR Part 172	Regulation	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans
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
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
International Organization for Standardization (ISO)		
ISO 9000	Standard	Quality Management Systems – Fundamentals and Vocabulary
Interstate Natural Gas Association of America (INGAA)		
N/A	Report	Safety Every Step of the Way
INGAA Foundation		
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
N/A	Report	Construction Safety Consensus Guidelines – Basic Personal Protective Equipment
National Energy Board (NEB)		
OPR-99	Regulation	Canadian Onshore Pipeline Regulations [1]
National Fire Protection Association (NFPA)		
NFPA 30	Standard	Flammable and Combustible Liquids Code
United States Code (USC)		
16 USC Chapter 35	Regulation	Endangered Species

Document No.	Type	Title
33 USC Chapter 9	Regulation	Protection of Navigable Waters and of Harbor and River Improvements Generally

Note(s):

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

7.0 GENERAL STATION LAYOUT AND PREPARATION

7.1 Overview

General station layout and preparation consists of the following major items during the construction of a facility:

- Survey
- Clearing and Grading
- Stormwater Management Facilities
- Stockpiling and Material Handling
- Trenching and Excavation
- Foundations and Reinforced Concrete
- Backfilling

These items are presented within this section, roughly in sequence of construction.

Survey

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

If the area for the approved facility is forested, Construction Surveyors are commonly the first to arrive to flag trees so Clearing Contractors can cut them down for facility construction. The Inspector is the technical liaison for survey information between the Construction Manager / Chief Inspector (or designate), Survey Contractor, and other on-site Contractors.

Clearing and Grading

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

- Cutting, removal, or burning of trees, brush, and debris from the facility site limits
- Timber salvage; the recovery and temporary storage of useful, merchantable timber from the facility site limits
- Unsalvageable timber disposal; the removal or elimination on-site of non-merchantable timber and brush by chipping, mulching, or burning
- Grubbing; the removal of tree stumps and large roots from specific areas of the facility site limits
- Stripping and storage of topsoil for later redistribution
- Cut and fill activities for preliminary grading

- Where allowed, use of non-merchantable timber (often called rip-rap, corduroy, and rollback) to build roads or pathways for vehicles and equipment or to create barriers for erosion control
- Preparation and maintenance of facility site access
- Frost packing or insulation (for winter activities)
- Line location of buried utilities (both Owner Company and foreign)
- Fencing
- In some cases, grade rock blasting, excavation, and removal may be required

Stormwater Management Facilities

Stormwater management facilities, including site sewer systems, are typically installed after clearing and grading of the facility site. They essentially manage the surface flow of water within a site in order to:

- Contain excess rain and ground water from impervious surfaces (e.g., sidewalks)
- Manage and control snow melt
- Contain sedimentation on site
- Minimize erosion
- Minimize flooding on adjacent property

The bulk of the inspection requirements are focused on the Civil discipline.

Stockpiling and Material Handling

As materials are received at the facility site, the Inspector is typically responsible for:

- Inspection of all received materials and log into Material Receiving Reports (MRRs) as required by Owner Company
- Quarantine and return of any materials that are damaged or do not meet specifications according to the Owner Company's processes
- Storage of materials in accordance with the Manufacturer's recommended practices, standards, and / or specifications

At the point of receipt of materials on site, both the Inspector and a Contractor Representative will 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.

More specifically, the Inspector will understand and comply with the Owner Company's Inspection and Materials Traceability Standards as well as Quality Control processes and forms.

Trenching and Excavation

Trenching and excavation is the next phase of facilities construction, and typically involves excavation of a trench within the facility for pipe, conduit / cable, ground wire installation, and foundations or pipe supports. Subsurface facilities must first be located and exposed prior to any mechanical excavation taking place. Generally, this is done with hydrovac equipment and special conditions must be addressed concerning the disposal of the hydrovac slurry, especially in contaminated soils.

Foundations and Reinforced Concrete

Foundations and reinforced concrete are typically installed as part of the construction stage after trenching and excavation activities are completed. At this point, the Inspector should continuously monitor that the following items are properly performed:

- Pile installation
- Formwork erection
- Reinforcing steel placement
- Concrete pouring and testing

Backfilling

Backfilling refers to refilling the trench with the previously excavated or new fill subsoil once the foundations have cured, and the pipe sections or assemblies are in place. The Inspector should continuously monitor for the following:

- Backfill material is suitable and placed in the trench in such a way that ensures the pipe and coating are not damaged
- Coating damage is repaired per Owner Company specifications prior to backfilling
- Compaction requirements are met

7.2 Survey

7.2.1 Inputs

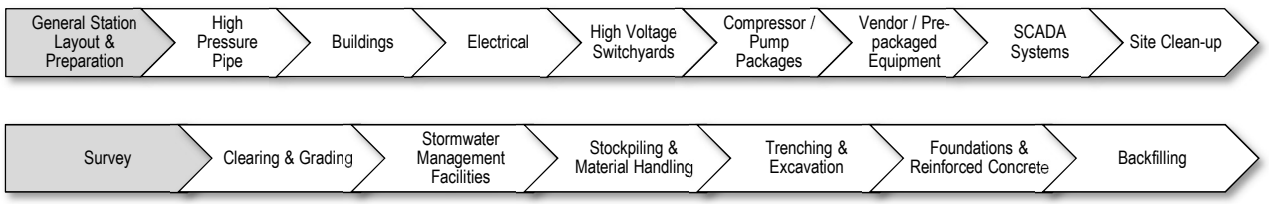
As part of preparing for inspection during the surveying process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 14.

7.2.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the surveying process are identified in a series of checklists as detailed in Table 13.

Table 13: Monitoring Requirements for Survey Inspection – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 15
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 16
General	• Identifies general items that should be monitored throughout the construction surveying process	Table 17
Buried Facilities Location	• Identifies specific survey items that should be monitored at buried facilities locations (both Owner Company and foreign)	Table 18
Facility Site Limits	• Identifies specific survey items that should be monitored for at facility site limits	Table 19
Trench Line	• Identifies specific survey items that should be monitored along the trench line	Table 20
Crossings	• Identifies specific survey items that should be monitored at crossing locations (e.g., roads, powerlines)	Table 21
Appurtenances	• Identifies specific survey items that should be monitored at appurtenance locations	Table 22
As-Builts	• Identifies specific information that should be monitored for collection in support of completing as-builts	Table 23
Foundations	• Identifies specific survey items that should be monitored for foundation locations	Table 24



7.2.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for survey inspection appear in Table 25.

Detailed Checklists – Surveying

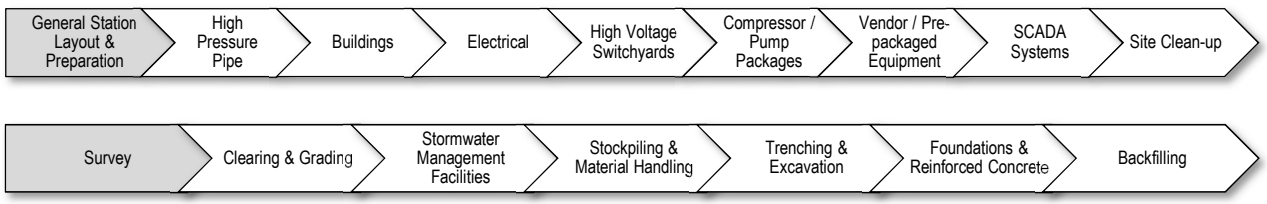
7.2.4 Typical Input Requirements for Survey Inspection

Table 14: Information Requirements for Survey Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to surveying, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	• GPS or other datum coordinates and elevations for construction control points and benchmark
	• Site and Appurtenance Surveys
	• Boundary Surveys
	• Building Permit Surveys
	• Construction Surveys

	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey • Land Owner Agreements • Third Party Crossing Agreements
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS)
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Survey Plans



7.2.5 Best Practice Items for Inspecting Typical Surveying Operations

Table 15: Prior to Commencing Work

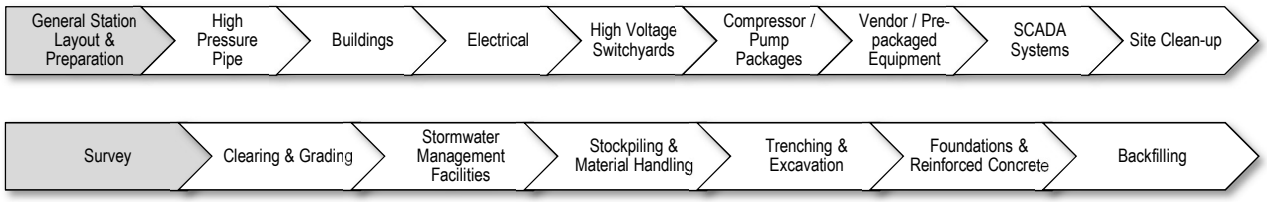
✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Confirm Survey crew credentials / qualifications per Owner Company requirements
	Review all available drawings with Surveyors to ensure no facilities or features (e.g., including previously existing facilities such as sales taps and abandoned pipelines) are overlooked in the current project drawings
	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
	Ensure Surveyor's equipment is calibrated (i.e., calibrations are current)
	Ensure that Surveyors have set up their equipment to use the Owner Company's naming convention

Table 16: Safety Concerns for Surveying

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

Table 17: Typical Monitoring Requirements – General

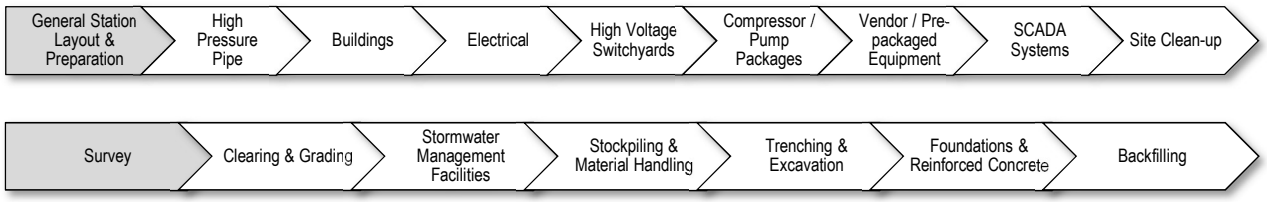
✓	Description
	Ensure construction work space, adjacent approved temporary work spaces, and staging areas are identified by surveyor's stakes, flags, paint marks, or other suitable methods in accordance with Issued for Construction (IFC) Drawings
	Ensure site cut / fill grade stakes are suitable for the task at hand (e.g., visible, allow for maneuvering of equipment)
	Ensure survey monuments are properly sited and not impeding construction flow
	Ensure all legal survey monuments are not disturbed, defaced, altered, destroyed, or removed
	Ensure survey proceeds in accordance with the contract requirements and Owner Company provided Work Plans
	Confirm the master set of construction drawings are continually updated with red pens (red-line drawings) as field changes are identified and implemented
	Ensure compliance and operation solely within facility site limits and on approved access roads and working limits as outlined within the IFC Drawings and / or as directed by an authorized Land Agent



✓	Description
	Ensure that damage or obliteration of any survey references are reported per Owner Company processes and treated as a safety concern
	Ensure Contracted Surveyors are the only personnel re-establishing obliterated, missing, or damaged survey stakes, markings, and flagging
	Confirm all stakes, markings, and flags remain visible for the duration or intended use
	Confirm that Construction Surveyors have clearly staked all underground facilities
	Ensure Construction Surveyors collect all data (e.g., mill test reports (MTRs)) from pipe as well as valves / fittings nameplates in accordance with Owner Company specifications
	Check that Construction Surveyors have signed and dated the final survey drawings (or electronic equivalent)
	Ensure that layout and setting of elevations is in accordance with IFC Drawings
	Ensure all elevation work is tied to an existing permanent bench mark or specified temporary bench mark on the site
	Ensure a topographical survey is properly performed, with grid elevations obtained at specified intervals and at all changes in grade; sufficient data must be obtained to completely define any drainage areas
	Ensure the survey grid is laid out with lines parallel and perpendicular to the pipe at sites with no existing grid system, or where monuments have already been identified, consistent with the established grid system
	Ensure sufficient ties are made between the survey baseline and existing piping to accurately identify pipe locations within the grid area; all existing points of intersection (PIs) must be tied in

Table 18: Typical Monitoring Requirements for Buried Facilities Location

✓	Description
	Consult Owner Company's Site Representatives and / or Operators with specific knowledge of a facility being excavated to help Construction Surveyors locate facilities (existing or abandoned) with incomplete or unavailable documentation
	Consult Land Owners (if applicable) with Surveyors to determine if Land Owners are aware of any additional buried facilities (e.g., water lines, electrical conduits / cables, private gas lines)
	Ensure personnel locating buried facilities are trained in a recognized line locating program and are using accepted procedures and techniques
	Confirm that all line locating equipment have current calibration certificates
	Ensure Construction Surveyors identify and document any facility that is shown on drawings but cannot be located
	Confirm all buried facilities (e.g., Third Party pipeline or conduit / cable) 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) to ensure there is no chance of disturbing the facility during construction
	Confirm all Third Party pipeline, utility crossings, and centerlines of new and Third Party pipelines are staked by Surveyors as specified in IFC Drawings
	Ensure that the point of crossing between the proposed centerline of the new pipe and the existing facility is marked with a cross lath of stakes with Owner Company specific color codes showing the name of the Owner Company and the facility size
	Ensure all offset requirements from engineering or crossing agreements are staked and clearly labelled
	Confirm that buffer stakes are placed at all Third Party facilities and expected new facilities



✓	Description
	Confirm locations of existing below grade piping, conduit / cable, tubing, concrete, and miscellaneous facilities by excavation in accordance with Section 7.6 Trenching and Excavation, as required, and tie in

Table 19: Typical Monitoring Requirements for Facility Site Limits

✓	Description
	Ensure that the Surveying Contractor will advise when stakes and marks need to be re-established
	Ensure that Surveyors are staking as per Owner Company specific color codes and obtaining approval from the Construction Manager / Chief Inspector (or designate) 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
	Ensure that Surveyors are staking the pipe route, valves, foundations, supports, and other appurtenances as shown on the drawings
	Ensure that Surveyors have correctly labelled all the stakes and these are visible from the work side or within the work area of the facility site limits
	Confirm that the boundaries of the facility site limits or temporary work spaces (TWS) are staked as per survey specifications
	Ensure that Surveyors are using frost pins or similar tools in hard or frozen ground when securing survey markers
	Ensure that taller stakes are installed in high crop areas or snow to ensure visibility, and hub staking (a means of staking that is resistant to being knocked down) is used in livestock pastures
	Ensure that progress stakes are placed along the edge of the facility site limits or TWS at specified intervals so they are visible on the work side or within the work area
	Ensure that flagging is placed more frequently in heavier vegetated and treed areas to provide better visibility for Clearing Equipment Operators

Table 20: Typical Monitoring Requirements for Trench Line

✓	Description
	Ensure the centerline of the proposed pipe trench is staked at specified intervals, except at bends and crossings where the intervals will be more frequent
	Ensure 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 to ensure that the bends fit the facility site limits)
	Ensure angles (degrees, minutes, and seconds) of deflection are recorded at all pipe deflection points
	Ensure Surveyors are using chainages / station numbers (an imaginary line used to measure distance that corresponds to the centerline of, for example, a pipe 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 U.S., use imperial station numbers (e.g., 10,000 ft would be 100+00)
	Document and inform the Construction Manager / Chief Inspector (or designate) of any major deviations or necessary changes in chainage / station equations

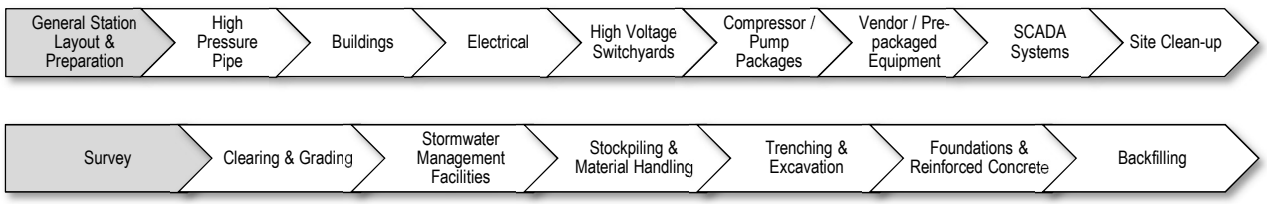


Table 21: Typical Monitoring Requirements for Crossings

✓	Description
	Ensure activities are coordinated with the Owner Company as well as Third Party Facility Owners through One Call (e.g., 811 call or similar)
	Ensure Surveyors are measuring contour changes along the trench line (if applicable)
	Ensure all features and offsets of design crossings are staked in accordance with the construction drawings
	Confirm the staking of entry and exit points of any drill or bore, to ensure the locations and respective workspaces are marked and consistent with drawings (if applicable)
	Ensure temporary bench marks are placed on the work side of the facility site limits in a location of minimal disturbance, showing an elevation referenced to the crossing drawings (temporary bench marks could be set on each side of the facility site limits 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 labelled with name of the Owner Company as well as pipe type and size
	Ensure all offset requirements from engineering or crossing agreements are staked and clearly labelled
	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 facility 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 22: Typical Monitoring Requirements for Appurtenances

✓	Description
	Ensure all appurtenances are staked showing the stop, start, and end locations
	Report any change in location, spacing, and quantity to the Construction Manager / Chief Inspector (or designate)

Table 23: Typical Monitoring Requirements for As-Builts

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

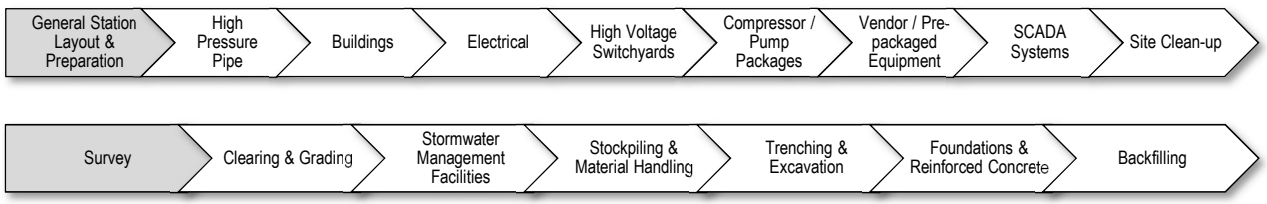


Table 24: Typical Monitoring Requirements for Foundations

✓	Description
	Ensure the Construction Surveyors, in conjunction with the Contractor, have identified locations of all foundations
	Ensure the Construction Surveyors, in conjunction with the Contractor, have marked all piles using appropriate identification methods (e.g., iron spikes and wooden laths labelled with the pile numbers)
	Ensure 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
	Verify foundation elevations in accordance with Issued for Construction (IFC) Drawings

7.2.6 Typical Outputs for Survey Inspection

Table 25: Typical Reporting Requirements

✓	Description
General	
	Ensure red-line drawings are complete, checked, and forwarded to the Construction Manager / Chief Inspector (or designate), and Others (as directed) in accordance with Survey Plan
Daily	

	Complete survey progress reports, including:
	• Work completed to date, including:
	  ○ Start and end chainage / station number, if applicable
	  ○ A complete set of red-lined drawings identifying the as-built records for the facility (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 Requests for Information (RFIs)
	• Document punch list items, as required

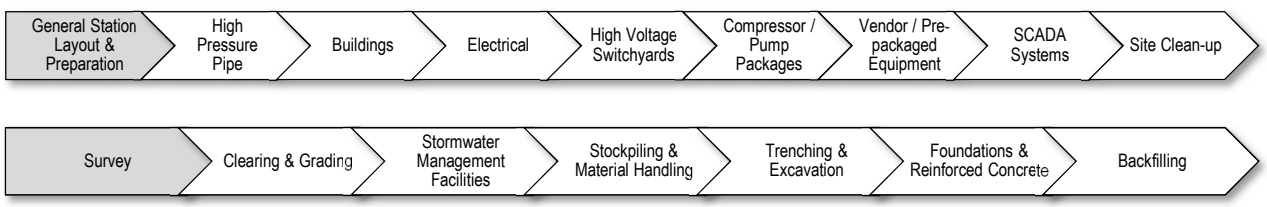
7.2.7 References – Survey

Note to user: The reference information provided in Table 26 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 26: List of References – Survey

Document No.	Type	Title
American Petroleum Institute (API)		
API RP 1102	Recommended Practice	Steel Pipeline Crossing Railroad and Highways
Common Ground Alliance (CGA)		
N/A	Recommended Practice	Best Practices

Document No.	Type	Title
INGAA Foundation		
N/A	Guideline	Guidance Documents for Construction – Natural Gas Pipeline Crossing Guidelines
CS-S-8	Guideline	Construction Safety Consensus Guidelines – Overhead Utilities Safety



7.3 Clearing and Grading

7.3.1 Inputs

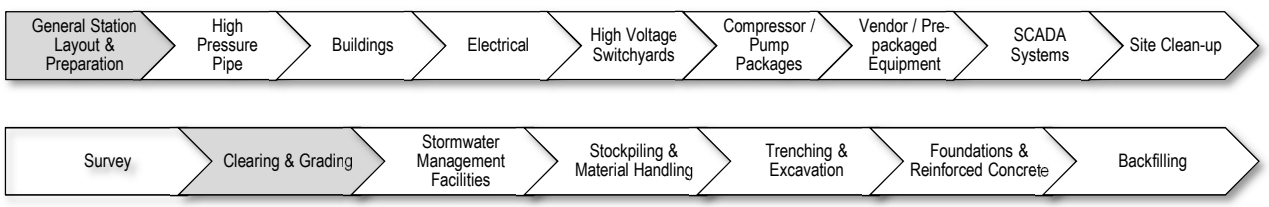
As part of preparing for inspection during the clearing and grading process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 28.

7.3.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the clearing and grading process are identified in a series of checklists as detailed in Table 27.

Table 27: Monitoring Requirements for Clearing and Grading – Civil

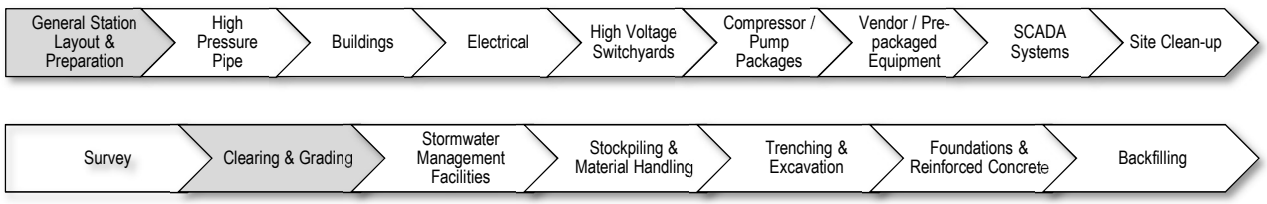
Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 29
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 30
Clearing and Grubbing	• Monitor the operations for adherence to relevant Owner Company and project specific requirements for clearing (i.e., cutting of brush and trees), grubbing (i.e., ensuring subsoil is free of stumps, roots, and debris to establish rough grade), as well as specific considerations related to creating snow piles, primarily to prevent freezing of areas to be excavated	Table 31
Temporary Work Spaces (TWS)	• TWS allow for lay down and warehousing of materials in support of facility construction, as well as temporary decking (i.e., storage) areas for salvaged timber	Table 32
Site / Access Road Preparation	• Existing roads are used to transport equipment and supplies to the facility site. Where no roads exist, permanent access roads may be constructed for all weather access • It is imperative that all access roads are capable of withstanding the loads being transported and the frequency of intended use. When access roads need to be constructed and have been approved, the Inspector will ensure they are constructed as detailed by Owner Company and project specific requirements	Table 33
Construction Gates and Fences	• Existing structures (e.g., fencing) should be altered to accommodate construction operations, and where possible, returned to their original state after construction is completed • New fencing and structures may be erected to exclude wildlife and livestock, and where possible, restrict access to the facility site	Table 34



Item	Description	Reference
Buried Facilities	• In most cases, existing buried facilities (e.g., pipelines or conduits / cables) within facility site limits will require temporary above ground mechanical support • Typically, earthen ramps or mats are installed before construction equipment can cross the surface to prevent undue stress / potential damage to underground facilities	Table 35
Timber	• Incorporates items for removal, salvage, and disposal of timber and brush • Land Owner's crop removal requirements (e.g., Contractor may cut and remove crops from the facility site limits and store per conditions established between the Owner Company and the Land Owner's requirements)	Table 36
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 37
Swamps and Muskegs	• Specific considerations relating to land that is particularly sensitive to construction activity	Table 38
Preliminary Grading	• Preliminary (or rough) grading refers to leveling the facility site so that construction can proceed smoothly and safely within the facility site limits • May involve significant earth moving (cut and fill) to bring the site to the designated rough elevation to begin trenching • Specific grading requirements for containment of surface run-off	Table 39

7.3.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for clearing and grading appear in Table 40.



Detailed Checklists – Clearing and Grading

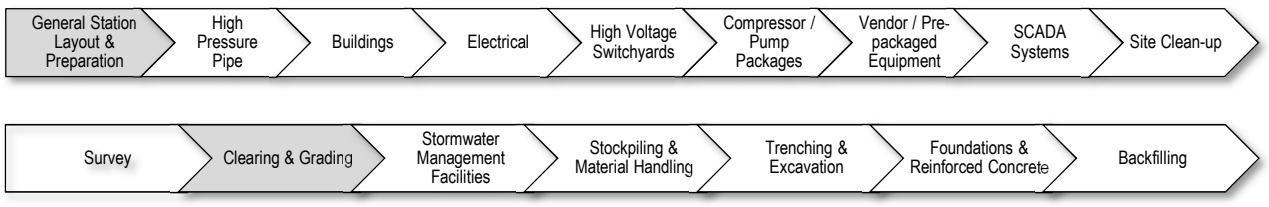
7.3.4 Typical Input Requirements for Clearing and Grading Inspection

Table 28: Information Requirements for Clearing and Grading

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to clearing and grading, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Grading Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	• Drawings related to Facility Site Limits (both permanent and temporary)

	Contracts and agreements related to: • Clearing • Grading (if required) • Road Use • Crossing for Buried Facilities • Timber Salvage (Land Owner, Forestry Management, Public Land Holder) • Construction Survey • Fencing
	Owner Company 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
	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



7.3.5 Best Practice Items for Inspecting Typical Clearing and Grading Operations

Table 29: Prior to Commencing Work

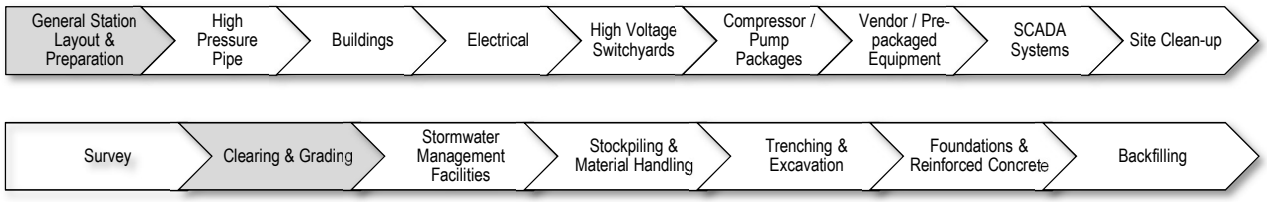
✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure Pre-Blast Survey is conducted and documented
	Ensure well water monitoring system is installed and functional
	Review geotechnical report or conduct reconnaissance to become familiar with site conditions

Table 30: Safety Concerns for Clearing and Grading

✓	Description
	Ensure that risks associated with blasting operations (e.g., fly-rock, vibration, use of explosives, undetonated explosives) are identified and sufficient safety precautions are put in place

Table 31: Typical Monitoring Requirements for Clearing and Grubbing

✓	Description
	Monitor for adherence to conditions noted in all approvals and permits issued
	Ensure all erosion and sedimentation controls are properly installed and maintained
	Ensure clearing is limited to vegetation within the approved facility site limits and approved work areas
	Monitor for proper placement of all removed trees and brush from and adjacent to the facility site limits
	Identify any areas where additional clearing (previously out of scope work) may be required
	Ensure the Contractor will strip, salvage, and store the topsoil before grading the facility site limits and store it along the facility site limits
	Ensure topsoil and subsoil is kept segregated (e.g., in separate stockpiles, use of straw barriers between topsoil and subsoil in confined areas)
	Ensure topsoil stockpiles are temporarily stabilized during construction
	Ensure drains and trenches are not blocked by topsoil or subsoil storage piles
	Identify potential for delays to planned work
	Ensure suitable permitted firebreaks are constructed per clearing and grading plan and maintained along the work area where there is a danger of spreading fire
	Ensure stumps are grubbed and other debris is cleared from the facility site limits
	Ensure leftover tree stumps are chipped to a specified height in locations where grubbing is not necessary



✓	Description
	Ensure snow berms are built to Owner Company specifications over the areas of excavation immediately after clearing to prevent frost penetration

Table 32: Typical Monitoring Requirements for Temporary Work Spaces (TWS)

✓	Description
	Ensure any TWS (area usually adjacent to the permanent facility site limits to be used for construction purposes) has been approved prior to use
	Ensure that all construction activities are contained within the TWS

Table 33: Typical Monitoring Requirements for Site / Access Road Preparation

✓	Description
	Ensure Contractor uses only approved soils for building road approaches and establishing rough grade of the site
	Ensure Clearing and Grading Contractors operate only within designated or permitted access road work areas
	Monitor Contractors for compliance with load limits on roads and bridges established by road use agreement(s) and respective authorities

Table 34: Typical Monitoring Requirements for Construction Gates and Fences

✓	Description
	Ensure Contractor installs fences and gates to prevent wildlife and livestock entry and manage security to the facility site per Owner Company specifications
	Ensure temporary fencing is properly braced and supported to prevent fence panels from falling over due to wind, wildlife, or livestock
	Monitor for damage where permanent fencing is installed during construction and ensure repair, as required
	Ensure a watchperson is present where site security is required

Table 35: Typical Monitoring Requirements for Buried Facilities

✓	Description
	Ensure only subsoil (no topsoil) is used to construct earthen ramps
	Ensure earthen ramps are constructed to the minimum height and width above natural ground surface at the point of crossing specified by crossing agreement(s)
	Ensure adequate support to pipelines, drain tiles, or other existing utilities spanning any excavation
	Ensure line list is reviewed on an ongoing basis to address all Land Owner and Third Party Utility Owner concerns
	Confirm all construction activities cease the specified distance away from any unprepared crossings

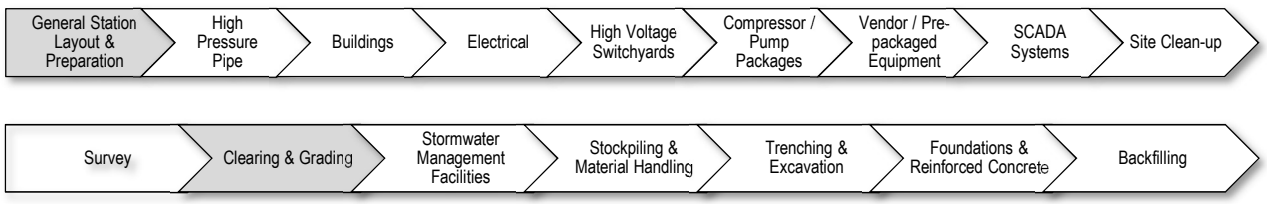
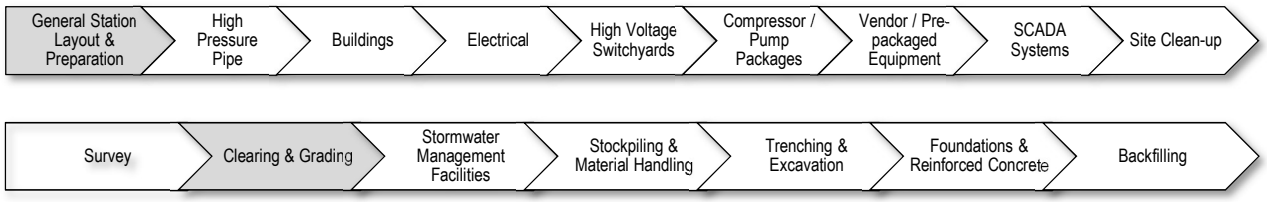


Table 36: Typical Monitoring Requirements for Timber Processing

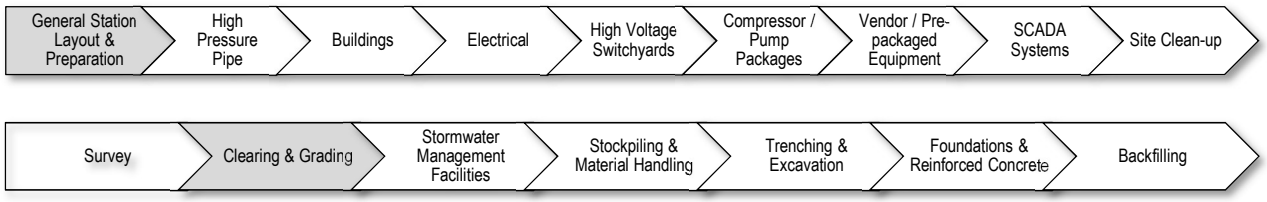
✓	Description
Timber Removal	
	Ensure that only approved equipment is used (e.g., cut-off type saw equipment to cut trees by hand)
	Ensure that specimen trees and shrubs identified in the Environmental Protection Plan (EPP) are marked and protected both along and marginally off the facility site limits or work spaces by an approved method (e.g., rubber tires or safety fences)
	Ensure Clearing Contractor has obtained approvals from the Construction Manager / Chief Inspector (or designate) before pushing any timber outside the facility site limits and / or cutting any trees off the facility site limits
	Ensure Contractor fells trees to minimize butt shatter and breakage towards and within the facility site limits
	Confirm the Contractor brings the cut trees back within the facility site limits for processing for trees felled outside the facility site limits
	Ensure cuts are treated per contract requirements where branches are removed from a standing tree outside the facility site limits (if required)
	Confirm 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 Land Owner (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 in accordance with project specifications
	Ensure Contractor refrains from skidding timber through partially thawed and / or muddy ground, watercourses, water bodies, or wetlands
	Monitor for adherence to special conditions for disposal of trees on hillsides
	Ensure the facility site is cleared of all trees, brush, and debris to prevent mixing with excavated soils that will be returned to the excavation during backfill
	Ensure salvaged topsoil is cleared of roots and debris
Timber Salvaging	
	Ensure Clearing Contractor cuts, de-limbs, and stockpiles merchantable timber per Owner Company specifications, or conditions outlined by the Land Owner, Forest Management, or Public Land Holder agreements
	Consult with the Environmental Inspector and the Timber Salvage Plan regarding any merchantable timber that appears to not meet specifications, then notify the Construction Manager / Chief Inspector (or designate) and Clearing Contractor for a decision on how to proceed
	Ensure timber stockpile sites are cleared before facility construction ends
	Confirm timber is stacked along the outer edge of the facility site limits for easier loading onto logging trucks
	Ensure stacked timber is not located in reforested areas, grade areas, muskeg areas, or wetlands
	Ensure log decks are sized adequately to accommodate loading equipment and will be located in (order of preference): • Existing cleared areas • Approved temporary work spaces (TWS) • Areas with non-merchantable timber • Areas with merchantable timber



✓	Description
	Ensure that decked logs are stacked with butt ends square, facing the same direction and with proper orientation for pickup
Timber and Brush Disposal	
	Ensure proper burn permits or other approved disposal techniques are in place
	Ensure burning activities comply with the Burn Plan, permit stipulations, Land Owner requirements, and Environmental Protection Plan (EPP)
	Ensure continuous (24/7) monitoring during any controlled burn
	Ensure fires are completely extinguished once burn pile is consumed
	Ensure 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 stumps, roots, and debris are broken down into smaller pieces before burning
	Ensure the burn pile is out of sight of fire detection equipment (fire eyes)
	Ensure every burn pile is marked using a global positioning system (GPS) and provide the Environmental Inspector and Construction Manager / Chief Inspector (or designate) with locations of all burn piles
	Ensure that all residual materials from burning are disposed in accordance with contract documents and / or Owner Company or project specifications
	Ensure no unburned timber or brush, which can mix with spoil materials, is in the disposal residue
	Ensure burn piles are located on the trench and away from an existing above ground facility to allow for sufficient space for stacking and working
	Ensure burning is never undertaken near a body of water or watercourse unless authorized by the Environmental Inspector
	If burning is not permitted, confirm chipping or mulching is conducted in accordance with contract specifications
	Ensure Clearing Contractor hauls away all timber and brush from the facility site limits that cannot be processed by the above means

Table 37: Typical Monitoring Requirements for Grade Rock Blasting and Removal

✓	Description
	Confirm pre-blast survey has been completed
	Confirm an approved Blasting Plan is in place and followed
	Ensure 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
	Ensure the Contractor has seismic monitoring equipment for blasting in place to monitor Peak Particle Velocity (PPV) limits
	Ensure blasting notifications are in place and are being clearly communicated
	Monitor for loose rock scattering onto the facility site, adjacent land, or causing damage to equipment / property
	Verify that the Contractor picks up and properly disposes of any fly-rock from blasting activities
	Ensure that segments being prepared for blasting have matting to protect the impact of fly-rock during the blast



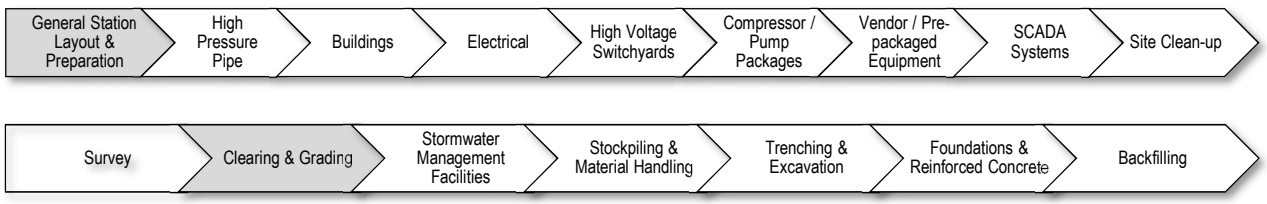
✓	Description
	Establish and maintain adequate set-back distances for all blasting personnel and non-essential personnel
	Ensure that designated physical protection is provided to any above ground utilities and equipment in the area of the blast
	Ensure blasting in close proximity to existing in-service piping is in accordance with Contract documents
	Ensure site is continuously monitored for any un-detonated charges prior to work being conducted in that area

Table 38: Typical Monitoring Requirements for Swamps and Muskegs

✓	Description
	Ensure the Clearing Contractor clears wetland and muskeg areas using approved Owner Company procedures and per the Environmental Protection Plan (EPP)
	Ensure trees are cut flush to the terrain surface
	Ensure stumps are cut flush to the terrain surface and are not grubbed to avoid unnecessary vegetation disturbance
	Ensure work boundaries / limits of disturbance around wetlands are clearly marked

Table 39: Typical Monitoring Requirements for Preliminary Grading

✓	Description
	Ensure that all overhead power lines and underground utilities are marked
	Monitor rough grading operations for compliance to Owner Company or project specifications and procedures (e.g., verify elevation tolerances are met, topsoil and subsoil are not mixed)
	Ensure resulting grading meets alignment and widths specified on drawings
	Check line list for special requirements of Land Owners
	Monitor temporary fencing requirements
	Ensure buried facilities have been properly located and ramped to Owner Company or project specifications
	Ensure equipment crossings at water courses are implemented correctly and in compliance with regulatory approvals
	Ensure survey markers are not damaged or destroyed throughout operations
	Ensure soil placement and soil compaction testing are performed, as necessary, in accordance with Owner Company or project specifications (requirements may differ between site and access roads)
	Ensure excess graded material is placed at Owner Company approved locations
	Ensure stockpiled material is secured against erosion and run-off
	Verify infill material has been approved for use
	Confirm infill material is suitable for use (i.e., visually inspected for soil type and excessive moisture or dryness)
	Monitor and record stripping depths throughout stripped areas



7.3.6 Typical Outputs for Clearing and Grading Inspection

Table 40: Typical Reporting Requirements

✓	Description
General	
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
Daily	

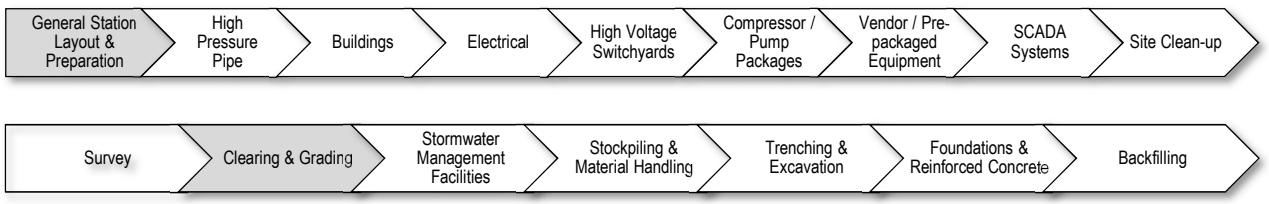
	Complete clearing and grading progress reports, including:
	• Work completed to date, including:
	  ○ Record lengths and locations of temporary fencing
	  ○ Record estimated areas of grubbing, topsoil stripping, grading, and rock grade activities
	  ○ Record stripping depths
	  ○ Detailed records (per Owner Company forms) of blasting activity
	  ○ Records of compaction testing
	  ○ Records of materials removed or brought to site (e.g., select fill)
	• Document punch list items, as required

7.3.7 References – Clearing and Grading

Note to user: The reference information provided in Table 41 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 41: List of References – Clearing and Grading

Document No.	Type	Title
American Petroleum Institute (API)		
API RP 1172	Recommended Practice	Recommended Practice for Construction Parallel to Existing Underground Transmission Pipelines



7.4 Stormwater Management Facilities

7.4.1 Inputs

As part of preparing for inspection during the stormwater management facilities construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 43.

7.4.2 Execution

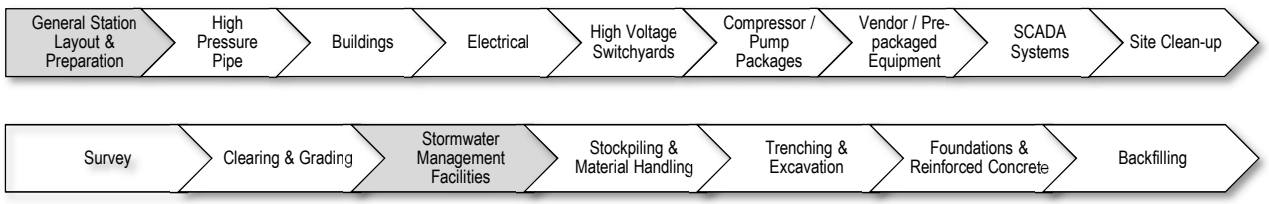
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the stormwater management facilities construction process are identified in a series of checklists as detailed in Table 42.

Table 42: Monitoring Requirements for Stormwater Management Facilities Construction – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 44
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 45
Stormwater Management Facilities Construction	• Monitoring requirements associated with stormwater management facilities, ensuring the installation conforms to the design	Table 46

7.4.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for stormwater management facilities inspection appear in Table 47.



Detailed Checklists – Stormwater Management Facilities

7.4.4 Typical Input Requirements for Stormwater Management Facilities Inspection

Table 43: Information Requirements for Stormwater Management Facilities Inspection

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to stormwater management facilities construction, such as: • Issued for Construction (IFC) Drawings (including those related to catch basin locations, pipe invert elevations, and proper sloping)
	Contracts and agreements related to: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Owner Company specific Safety Plan, including (but not limited to): • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

7.4.5 Best Practice Items for Inspecting Typical Stormwater Management Facilities Construction

Table 44: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling

Table 45: Safety Concerns for Stormwater Management Facilities Construction

✓	Description
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

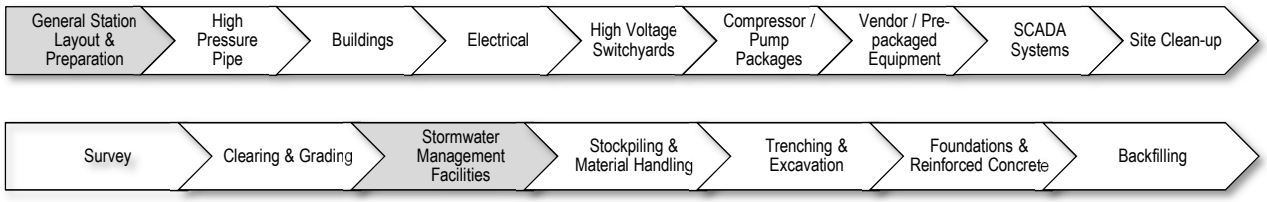


Table 46: Typical Monitoring Requirements for Stormwater Management Facilities Construction

✓	Description
	Verify layout of storm sewer system
	Verify rough grade of the site has been completed
	Ensure below grade concrete products have been properly damp proofed
	Verify materials used for storm sewer meet design requirements
	Verify material is undamaged prior to installation
	Verify that survey has checked slope requirements prior to backfill
	Verify use of appropriate bedding and backfill
	Verify compaction requirements around installed storm sewer are obtained

7.4.6 Typical Outputs for Stormwater Management Facilities Inspection

Table 47: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

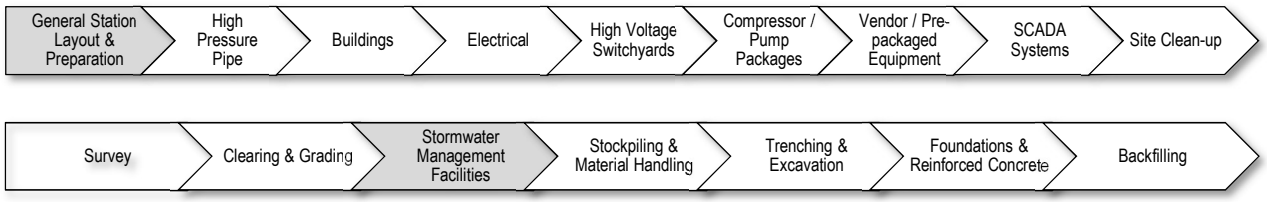
	Complete stormwater management facilities construction progress reports, including:
	• Work completed to date, including:
	  ○ Quantity of catch basins / drain structures and manholes installed
	  ○ Length and diameter of sewer drain pipe installed
	  ○ Backfill placement and compaction
	• Document punch list items, as required

7.4.7 References – Stormwater Management Facilities

Note to user: The reference information provided in Table 48 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 48: List of References – Stormwater Management Facilities

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		



7.5 Stockpiling and Material Handling

7.5.1 Inputs

As part of preparing for inspection during the stockpiling and material handling process, the Inspector will be familiar with relevant aspects of key Owner Company documents, drawings, and materials technical specifications as identified in Table 50.

7.5.2 Execution

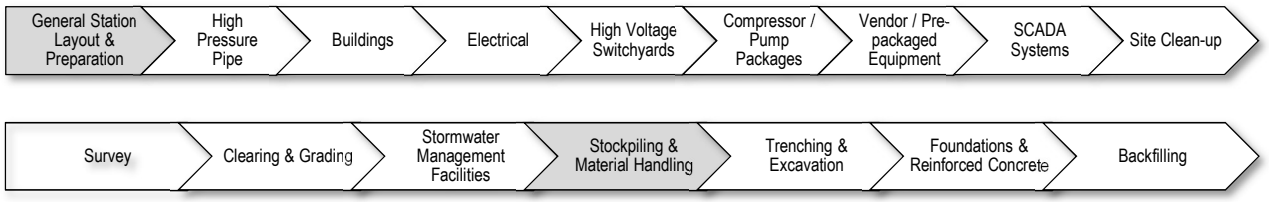
While the work is being executed, Inspectors are required to monitor workmanship and report on progress on a periodic basis. Typical items that Inspectors will monitor for during the stockpiling and material handling process are identified in Table 49.

Table 49: Monitoring Requirements for Stockpiling and Material Handling – Civil, Mechanical, Electrical (All Disciplines)

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 51
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 52
Receiving / Custody Transfer	• Involves confirmation that appropriate materials have been shipped and received in good condition and with required documentation (i.e., mill or material certifications) prior to the Contractor taking responsibility	Table 53
Transport and Material Handling	• Use of cranes, rigging and lifting, load handling, and signaling procedures to ensure safety and preserve material integrity	Table 54
Storage / Stockpiling	• Proper storage of materials (e.g., sensitive materials stored indoors)	Table 55
Identifying and Addressing Equipment / Material Damage	• Inspection and repair of any damaged equipment or materials • Damaged or otherwise unfit materials are identified and quarantined until approved for use, repaired, or removed from site	Table 56

7.5.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for stockpiling and material handling inspection appear in Table 57.



Detailed Checklists – Stockpiling and Material Handling

7.5.4 Typical Inputs for Stockpiling and Material Handling Inspection

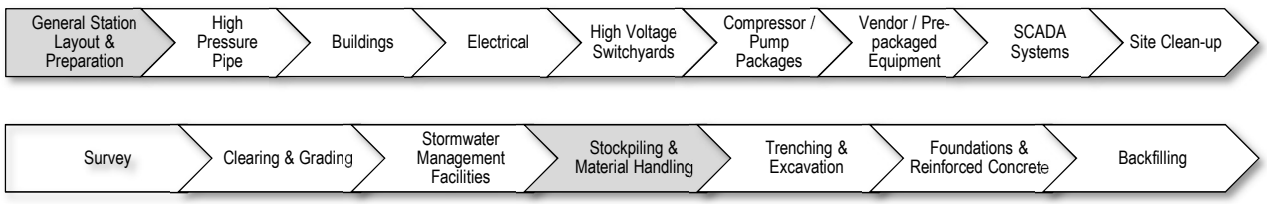
Table 50: Information Requirements for Stockpiling and Material Handling

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to stockpiling and material handling, such as: • Bill of Materials (BOM) • Purchase Orders (PO) • Mill or Material Certifications • Fabrication Shop Drawings • Manufacturer Specifications • Material Handling Specifications • Owner Company specific Custody Transfer Forms, Material Transfer Reports (or equivalent)
	Contracts and agreements related to: • Transport and Handling of Materials • Inspection of Materials • Materials Storage and Preservation
	Owner Company specific Safety Plan, including (but not limited to): • Equipment Transport • Equipment Loading / Unloading • Equipment and Materials Storage • Handling of Materials
	Other project specific Plans, which may include: • Traffic Control Plan

7.5.5 Best Practices for Typical Stockpiling and Material Handling Inspection

Table 51: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Equipment: • Confirm all Equipment Operators have appropriate certification / ticket(s)



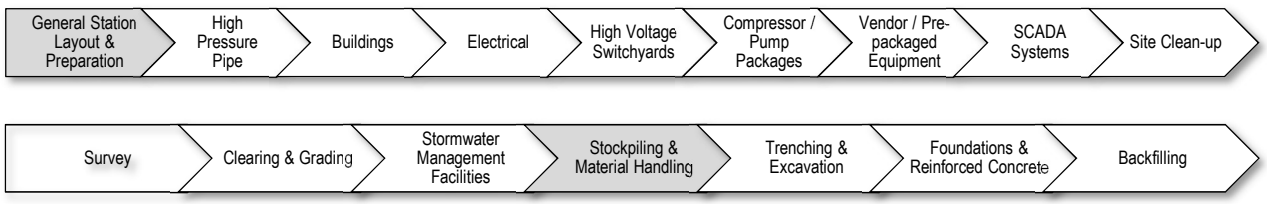
✓	Description
	• Confirm Contractor possesses Manufacturer information / manual of the machinery operated • Ensure that all lifting equipment is inspected (e.g., slings and cables) for damage and all findings documented before use

Table 52: Safety Concerns for Stockpiling and Material Handling

✓	Description
	Monitor for individuals standing between a suspended load and equipment or materials
	Ensure that workers are not standing under or near a suspended load
	Ensure all equipment or materials are properly chocked or supported
	Ensure individuals stand clear, the load is level, and materials are prevented from movement when metal banding is cut loose or other tie down means are loosened from the load
	Ensure eye contact is made with the Equipment Operator to establish an understanding of intentions when inspecting loads to be lifted and wait for Operator's signal before proceeding
	Monitor and be aware of other vehicles moving in the lay down or warehousing area
	Understand equipment limitations related to weather, such as vac-lifts and frost

Table 53: Typical Monitoring Requirements for Receiving / Custody Transfer

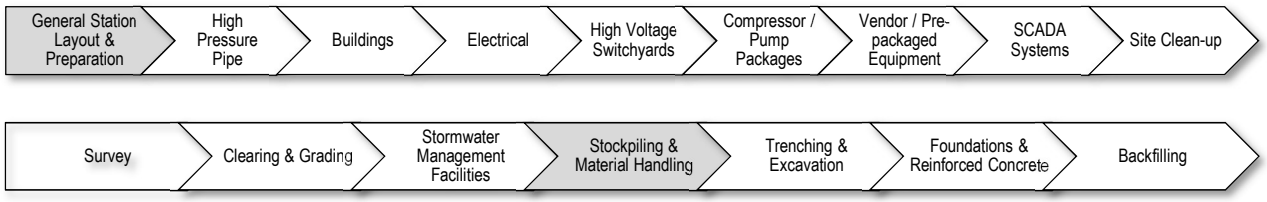
✓	Description
	Ensure all materials are free of defects or damage
	Confirm all material quantities received are in accordance with shipping reports (e.g., packing lists) and Purchase Order (PO)
	Ensure all structural steel members are piece marked in accordance with Fabrication Shop Drawings
	Check that all the pipe joints have end caps (as required by Owner Company specifications)



✓	Description
	Confirm all material is clearly marked as required. Illustrative example for pipe follows: *Ensure all pipe is clearly marked on the outside; if numbers are to be copied from the inside of the pipe to the outside, confirm the numbers have been transferred correctly. Markings should include:* • Size • Wall Thickness • Nominal Outside Diameter (OD) • Grade • Manufacturer • Coating Vendor • Thickness of the Coating at Mills • Heat Number • Applicable specification (e.g., API 5L) • Customer's PO (if mill purchased) • Date of manufacture • Date of Coating • Ensure QR code or barcode is present (if required by Owner Company)
	Verify traceability to lot / batch numbers for each component
	Ensure all pipe is received with an approved heat number; if pipe is received without an approved heat number, mark the pipe until records are received and reviewed by the Construction Manager / Chief Inspector (or designate)
	Ensure 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
	Check for damaged bevels, ovality, coating defects, internal pipe obstructions, and dents
	Check fabricated assemblies for shipping damage prior to lifting from the truck
	Confirm the date of material receipt is documented
	Verify the PO number on the Bill of Lading is matched to the Purchase Order provided
	Verify that documentation, including mill or material certifications, hydrostatic test charts, and manufacturer drawings, corresponds to materials received (i.e., all heat numbers are accounted for in documentation, material markings for grade and size match material certifications)

Table 54: Typical Monitoring Requirements for Transport and Material Handling

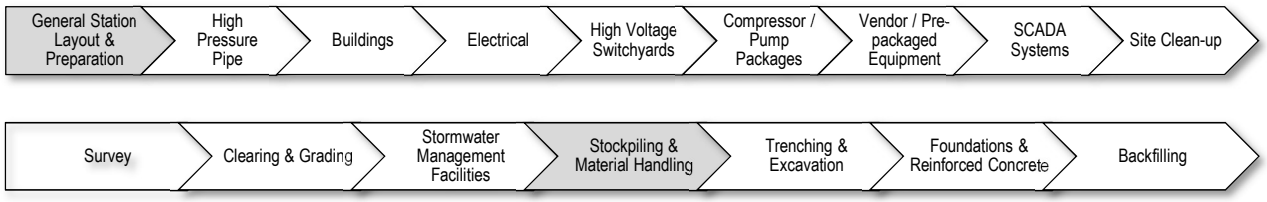
✓	Description
	Confirm equipment and materials are properly loaded, transported, and unloaded
	Monitor trucking safety and routing
	Ensure no chains or metal straps that may damage the load are used to secure or lift loads
	Confirm equipment and material loads are properly secured and tarped
	Conduct visual inspections for any damage to materials prior to and during offloading / stockpiling / placement
	Ensure Contractor uses cranes, rigging, and lifting equipment properly and according to what it was designed for, in particular:



✓	Description
	• Check that the center of balance of the machine and the center of weight of the load are balanced • Understand the rated capacity of equipment used (i.e., do not perform critical lifts of loads that exceed capacity or lift a load with under-sized machinery or equipment)
	Ensure that crane, rigging, and lifting equipment Operators operate where there are no overhead power lines
	Confirm maximum lifting angles between lifting cables and equipment are not exceeded
	Ensure that slings, hooks, cables, and tag lines used for equipment handling are constantly checked before use and replaced if defective
	Confirm pipe is handled as individual joints with vacuum lifts, grapples, belt slings, or shaped hooks surfaced with non-contaminating material
	Confirm that no brass-lined lifting hooks are used (copper in the brass may contaminate the pipe ends causing cracking of the field-produced girth welds)
	Confirm lifting mechanisms are sufficiently padded and provide sufficient weight distribution to prevent damage to the pipe
	Check that approved spreader bars are used for unloading double jointed pipe lengths or large loads (e.g., skids)
	Ensure that equipment controls are never left unattended for a suspended load
	Ensure that there are no vehicles in the vicinity of lifting / placement operations
	Ensure that boom and cable brakes are used at all times if a load is suspended for an extended period of time
	Confirm that equipment is shut down before cleaning or making adjustments / repairs
	Ensure that offloading and stockpiling operations are restricted to approved work areas
	Ensure that all equipment used to handle coated materials is adequately padded to prevent damage to the material or coating
	Ensure that all handling is performed to prevent damage to the pipe, bevels, and coating
	Ensure equipment is handled in accordance with Manufacturer specifications
	Ensure 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
	Ensure that the Operator stops immediately if there is a loss of communication with the Signal Person or misunderstanding and restarts only after communication is restored or understood

Table 55: Typical Monitoring Requirements for Storage / Stockpiling

✓	Description
	Inspect all materials for damages during offload at the allocated stockpile site
	Check and confirm all pipe joints, fittings, manufactured bends, and other tubular materials have correct markings
	Confirm that timber supports and chocks used for supporting coated pipe are padded to protect coating
	Ensure each length of pipe stored in tiers is separated from each adjacent length of pipe
	Ensure longitudinal submerged arc-welding (SAWL) and helically submerged arc-welding (SAWH) pipe is stacked so that weld to weld contact does not occur
	Confirm pipe piling height is in accordance with construction specifications
	Ensure correct stacking of pipe by diameter, wall thickness, grade, and coating



✓	Description
	Ensure pipe is stored with end caps (as required by Owner Company specifications)
	Ensure any pipe with confirmed damage is marked accordingly and stored in separate piles
	Ensure indoor materials and equipment stored temporarily outside are protected from moisture, contamination, and physical damage
	Ensure a proper storage maintenance plan is implemented for all rotating equipment
	Ensure storage and preservation practices of Owner Company and / or Manufacturer are identified and followed

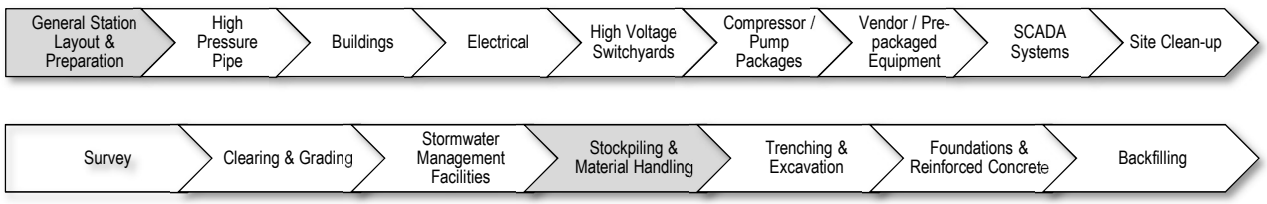
Table 56: Typical Monitoring Requirements for Identifying and Addressing Equipment / Material Damage

✓	Description
	Ensure pipe is inspected for damage per Owner Company 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
	Check crating or packaging for indications of material shipping and handling damage and ensure damage is documented
	Confirm that all damaged pipe is either: • Repaired per Owner Company specifications using Owner Company approved techniques, or • Marked as damaged goods and stored separately in the marshalling area for disposition

7.5.6 Typical Outputs for Stockpiling and Material Handling Inspection

Table 57: Typical Reporting Requirements

✓	Description
General	
	Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress
Daily	
	Complete stockpiling and material handling progress reports, including: • Work completed to date, including: o Actual hours of work utilized for labor and equipment o Number of transport loads received o Conditions that enhanced or delayed the planned progress of the day o Custody Transfer Forms, Material Transfer Reports (or equivalent) o Material Receiving Reports (MRR) o Material Exception Reports (MER) o Material Damage Reports



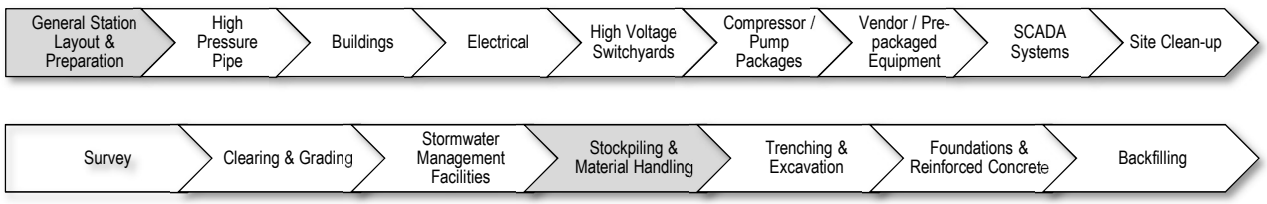
✓	Description
	• Document punch list items, as required

7.5.7 References – Stockpiling and Material Handling

Note to user: The reference information provided in Table 58 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 58: List of References – Stockpiling and Material Handling

Document No.	Type	Title
American Petroleum Institute (API)		
API 5L1	Recommended Practice	Recommended Practice for Railway 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)		
CSA C22.3 No. 6	Recommended Practice	Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines
ENFORM		
N/A	Report	Sideboom Operator Training Standard (Entry Level)



7.6 Trenching and Excavation

7.6.1 Inputs

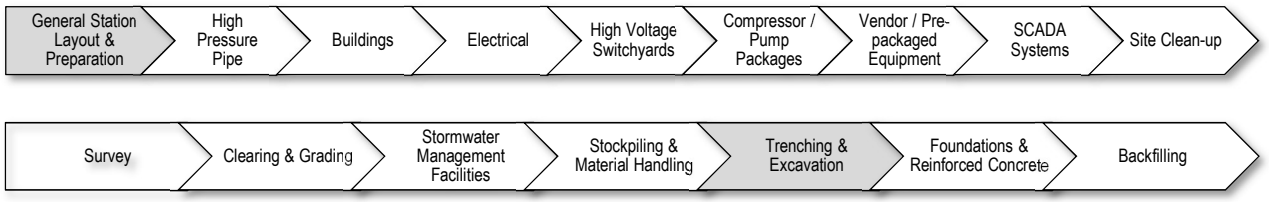
As part of preparing for inspection during the trenching and excavation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 60.

7.6.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the trenching and excavation process are identified in a series of checklists as detailed in Table 59.

Table 59: Monitoring Requirements for Trenching and Excavation – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 61
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 62
Excavation Equipment	• Monitor the operations for adherence to relevant Owner Company and project specific requirements; in particular, ensure that equipment does not damage pipe, buried facilities, or roadways in any way	Table 63
Trenching and Excavation	• Ensure that the trench is excavated to project requirements, including: o Specifications for alignment of centerline and dimensions of slope of sides, width, and depth o Installation of padding and buoyancy controls in preparation for lowering-in	Table 64
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 will ensure that the Blasting Plan is followed without exception	Table 65
Crossing Underground Facilities	• New pipe will be constructed either under or over existing facilities (depending on their depths of cover), so the Inspector needs to ensure that crossing agreements are followed and appropriate (i.e., hand trenching or hydrovac) near buried facilities	Table 66
Trench Plugs and Sub-drains / Drain Tiles	• Ensure that drainage and erosion control devices or measures, such as trench plugs and sub-drains (drainage systems that divert water away from the facility) / drain tiles (perforated tubing that allows water to enter and be drained away from the facility), are used as per Owner Company specifications	Table 67



Item	Description	Reference
Seasonal (Winter) Considerations	• Itemizes considerations that are specific to the construction season	Table 68
Addressing Additional Work	• Identifies items of particular note during this phase of the operation that can result in additional costs and therefore require close monitoring for contractual / cost reasons	Table 69
Historic Sites	• In a conscious effort to preserve history, trenching and excavating operations will be suspended upon discovery of historic sites or resources until formal notice is received from Owner Company to recommence construction	Table 70

7.6.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for trenching and excavation inspection appear in Table 71.

Detailed Checklists – Trenching and Excavation

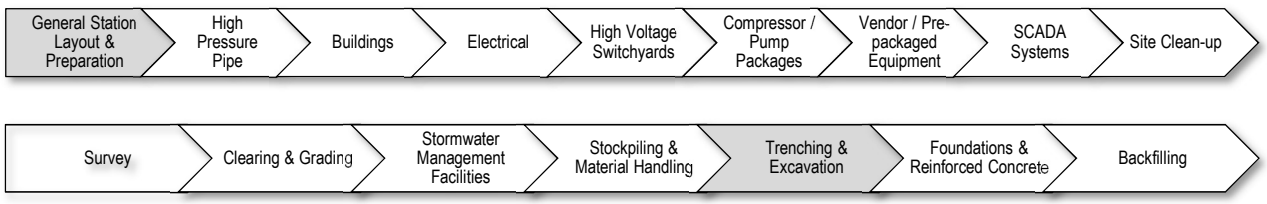
7.6.4 Typical Input Requirements for Trenching and Excavation Inspection

Table 60: Information Requirements for Trenching and Excavation

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to trenching and excavation, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	  ○ Underground Conduit / Cable Routing Plan
	  ○ Grounding Plan
	• Trenching Specifications and Procedures
	• Topsoil Segregation Requirements
	• Depth of Cover Requirements
	• Blasting Specification (if required)
	• Ground Disturbance Documentation

	Contracts and agreements related to: • Road Use • Crossings for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to):

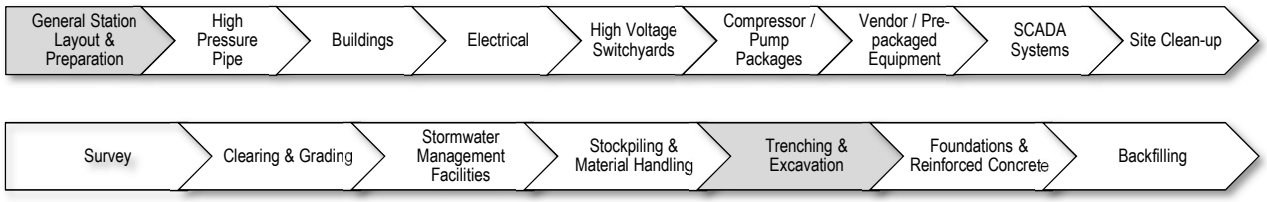


✓	Description
	• Excavation Plan • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS)
	Other project specific Plans, which may include: • Blasting Plan • Fire Prevention / Firefighting Plan • Heritage Sites • Engineered Shoring and Dewatering Plans (as required)

7.6.5 Best Practice Items for Inspecting Typical Trenching and Excavation Operations

Table 61: Prior to Commencing Work

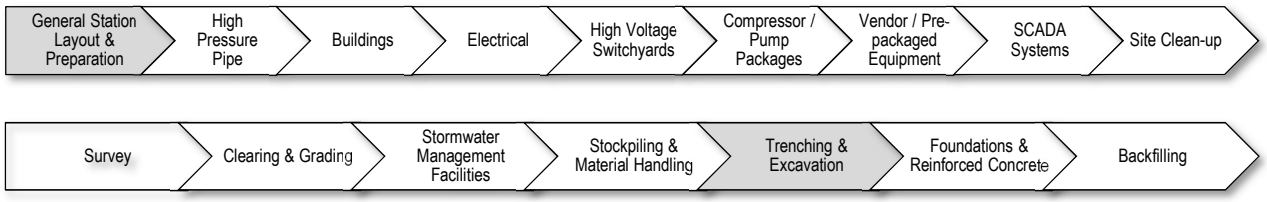
✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure required excavation permits have been obtained
	Ensure that all required ground disturbance documents and required inspections are current, and in place
	Confirm everyone understands start and stop orders and signaling for equipment operation
	Ensure exclusion zones are established and site personnel are aware of the boundaries
	Crossing underground facilities including Third Party pipelines, power cables, communications cables, cables for cathodic protection purposes, and all public works will be identified, surveyed, and staked prior to any ground disturbance
	The Owner Company of a Third Party facility may locate, expose and excavate the facility themselves or allow the Contractor to do so (according to the Owner Company's procedures, specifications, and the crossing agreement); however, before the crossing construction begins, the existing buried utilities should be positively located
	Equipment: • Confirm all Equipment Operators have appropriate certification(s) / ticket(s) • Confirm Contractor possesses Manufacturer information / manual of the machinery operated
	Work area: • Check that Third Party pipeline crossing ramps have been built • Check that warning signs and temporary fencing are installed on open excavations where required • Ensure that all necessary hand or hydrovac excavations of buried facilities and Third Party pipelines have been carried out in advance of trenching activities



✓	Description
	• Ensure mechanical and hand digging requirements of the utility owner are understood prior to excavation (i.e., minimum distance from the utility that mechanical excavation can continue when excavating a foreign line)
	Ensure an approved plan is in place to manage disposal of hydrovac slurry

Table 62: Safety Concerns for Trenching and Excavation

✓	Description
	Ensure One Calls / 811 Calls for underground facilities are made by the Contractor and ensure that a valid One Call / 811 Call ticket is in place in advance of commencing work
	Ensure Equipment Operators use spotters while traversing under powerlines and overhead hazards
	Ensure Equipment Operators make eye contact with other Equipment Operators before approaching
	Monitor, where applicable, that the Contractor follows the excavation checklist (i.e., is aware of the hazards, roles, and responsibilities associated with excavation equipment and operation)
	Ensure sloping, benching, or trench box requirements are followed at each excavation as per project safety requirements
	Ensure spoils are set back from the edge of any excavation as per project requirements
	Ensure review and agreement with excavation entry permits before entering excavation for closer inspections
	Ensure egress points are in place as per project safety requirements
	Confirm that Equipment Operators follow start and stop orders and proper signaling for equipment operation
	Be aware of boot leg holes and their impact (undetonated dynamite which can explode) when excavating rock trench
	Confirm that Equipment Operators are working only in the exclusion zone and know the boundaries
	Shut down work immediately if any unauthorized personnel enter the exclusion zone
	Ensure that all lifting equipment (e.g., slings and cables) is inspected for damage, issues, and wear, and all findings are documented before use
	Observe any specific requirements related to the jurisdiction (e.g., Occupational Safety and Health Administration (OSHA))
	Ensure that signage, barriers, warning flashers, or fencing are erected and maintained around excavations left overnight or for an extended period of time in accordance with applicable regulations
Blasting	
	Confirm pre-blast survey has been completed
	Confirm an approved Blasting Plan is in place and followed
	Ensure 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
	Ensure the Contractor has seismic monitoring equipment for blasting in place to monitor Peak Particle Velocity (PPV) limits
	Ensure blasting notifications are in place and are being clearly communicated
	Monitor for loose rock scattering onto the facility site, adjacent land, or causing damage to equipment / property
	Verify that the Contractor picks up and properly disposes of any fly-rock from blasting activities



✓	Description
	Ensure 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 non-essential personnel
	Ensure that designated physical protection is provided to any above ground utilities and equipment in the area of the blast
	Ensure blasting in close proximity to existing in-service piping is in accordance with Contract documents
	Ensure site is continuously monitored for any un-detonated charges prior to work being conducted in that area

Table 63: Typical Monitoring Requirements for Excavation Equipment

✓	Description
	Ensure 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 Construction Manager / Chief Inspector (or designate) is notified; the machine is not to be moved or extricated without Owner Company approval
	Ensure 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
	Ensure roadways are protected from tracked equipment at road crossings

Table 64: Typical Monitoring Requirements for Trenching and Excavation

✓	Description
Trench Dimensions	
	Periodically measure minimum trench dimensions to conform with specifications
	Ensure the trench bottom is excavated to provide continuous support for the pipeline and yard piping
	Confirm that the specified depth of cover requirements are followed
	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), and proper separation from existing utilities
	Confirm trenching requirements are met for underground electrical ductbanks and foundations (including overexcavation and select fill as indicated on the Issued for Construction (IFC) drawings, including listed specifications and notes)
Open Trench Considerations	
	Confirm the length of the trench left open during facility construction is approved by the Construction Manager / Chief Inspector (or designate) based on the stability of the trench and weather conditions
	Ensure that the Contractor will not leave a trench open for extended periods; in particular, monitor for: • Safety concerns for workers and the general public • Large accumulations of water • Excavated soil becoming frozen in winter • Snow and ice accumulation • Foreign material

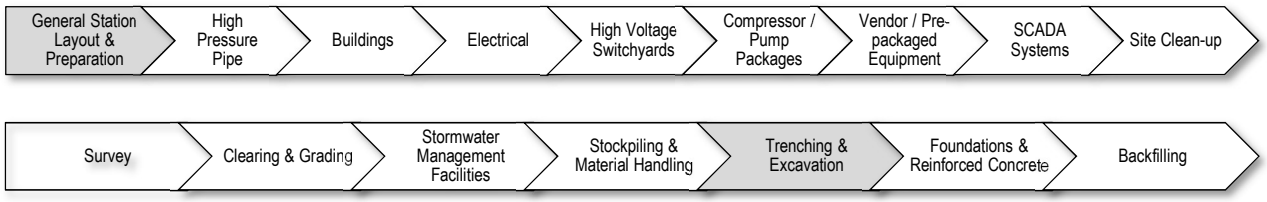


Table 65: Typical Monitoring Requirements for Trenching through Rock

✓	Description
	Confirm that loose rocks are disposed of by the Contractor to an authorized site or piled neatly in rows along the side of the facility site as per line list
	Confirm that the trench will be dug for an additional depth based on Owner Company specifications (i.e., greater than the minimum trench depth shown on the drawings) to allow for trench bottom padding

Table 66: Typical Monitoring Requirements for Crossing Underground Facilities

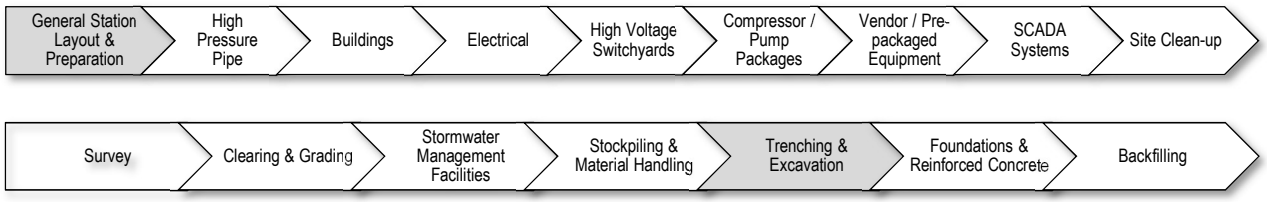
✓	Description
	Ensure that the Contractor will excavate the trench at crossing locations with a gap between the underground facility and the proposed pipe as specified in the contract documents / crossing agreements
	Validate the locations of buried facilities after the Contractor exposes these by hand or the use of hydrovac tools prior to mechanical excavation
	Observe the Contractor during the exposure of an operating pipeline and ensure compliance to project requirements (in case of potential inconsistency between the Owner Company's specification, the construction contract, or the crossing agreement, the most stringent requirements will apply)

Table 67: Typical Monitoring Requirements for Trench Plugs and Sub-drains / Drain Tiles

✓	Description

	Trench plugs and sub-drains may be constructed based on construction drawings; however, in some cases the quantity and their location are best determined in the field after the trench is excavated. Monitor for:
	• Specific terrain features / drainage patterns
	  ○ Groundwater flowing or seeping from the bottom or sides of the trench, then a sub-drain (drain tile) may be required immediately downhill of the discharge point to collect the water and divert it off the ROW
	  ○ Locations where water can enter the trench and flow downhill through the backfill
	• Trench water encountered on slopes and hills

	Ensure Owner Company specifications are met or exceeded for erosion control (e.g., a sack breaker may be installed as an alternative to trench plugs if a trench plug is difficult to install)
	Confirm silt fence and straw bale sediment control measures are installed and maintained
	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 sub-drains in the trench per Owner Company drawings and specifications or as required
Sub-drains / Drain Tiles	
	If drain tiles are cut: • Ensure location is marked • Confirm ends are capped to prevent clogging from dirt or debris • Ensure temporary flumes are installed to maintain drainage
	If unmarked utilities are discovered or damaged, ensure the Contractor contacts the Facility Owner for approval and requirements for the repair



✓	Description
	Ensure 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 68: Typical Monitoring Requirements for Seasonal (Winter) Considerations

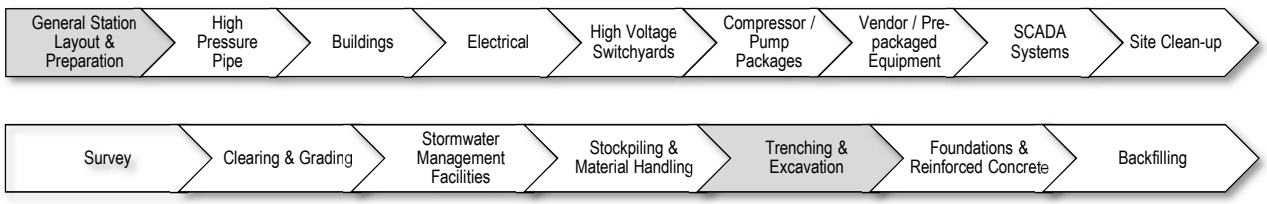
✓	Description
	Ensure Contractor blades (using the blade on a grader) a berm of loose material or snow (e.g., snow roach) to Owner Company specifications over the centerline of the trench immediately after grading the facility site to prevent frost penetration into the ground along trenches
	Ensure frozen lumps resulting from ripping the trench line are removed by the Contractor and stored separately from the trench subsoil pile
	Monitor for subsoil freezing into lumps in sub-zero temperatures (as it can damage pipe coating during lowering-in and result in non-uniform compaction over the pipe)
	Confirm the Contractor lowers and backfills within a specified window following trenching so the backfill does not freeze; any exceptions are to be approved by the Construction Manager / Chief Inspector (or designate)
	Ensure that snow and ice in trench is removed before installation commences

Table 69: Typical Monitoring Requirements for Additional Work Items

✓	Description
	Monitor and record the following additional work items, which have potential cost implications: • Extra-depth trench • Rock-trench excavation by specialized mechanical excavation techniques • Rock-trench 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

Table 70: Typical Monitoring Requirements for Historic Sites

✓	Description
	Immediately suspend trenching activity and notify the Construction Manager / Chief Inspector (or designate) if any historic sites or resources are discovered
	Ensure trenching will not resume until formal notification provided by Construction Manager / Chief Inspector (or designate)



7.6.6 Typical Outputs for Trenching and Excavation Inspection

Table 71: Typical Reporting Requirements

✓	Description
General	
	Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress
Daily	

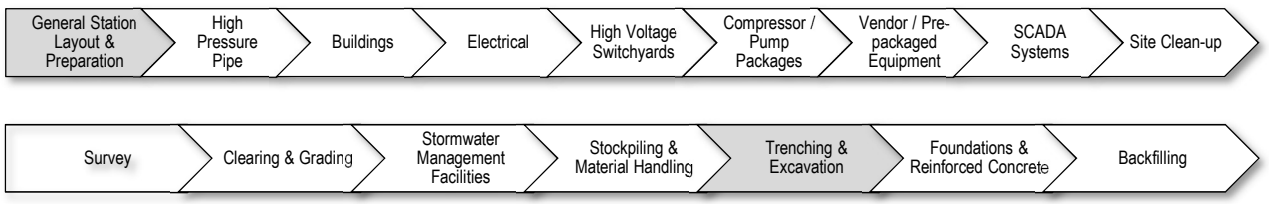
	Complete trenching and excavation progress reports, including:
	• Work completed to date, including:
	  o Record the quantities of any rock excavation
	  o Record the trench depths and widths
	  o Start and end chainages / station numbers of dug trench
	  o Detailed records (per Owner Company forms) of blasting activity
	• Document punch list items, as required

7.6.7 References – Trenching and Excavation

Note to user: The reference information provided in Table 72 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 72: List of References – Trenching and Excavation

Document No.	Type	Title
INGAA Foundation		
CS-S-12	Guideline	Construction Safety Consensus Guidelines – Trenching and Excavation Safety



7.7 Foundations and Reinforced Concrete

7.7.1 Inputs

As part of preparing for inspection during the foundations and reinforced concrete construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 74.

7.7.2 Execution

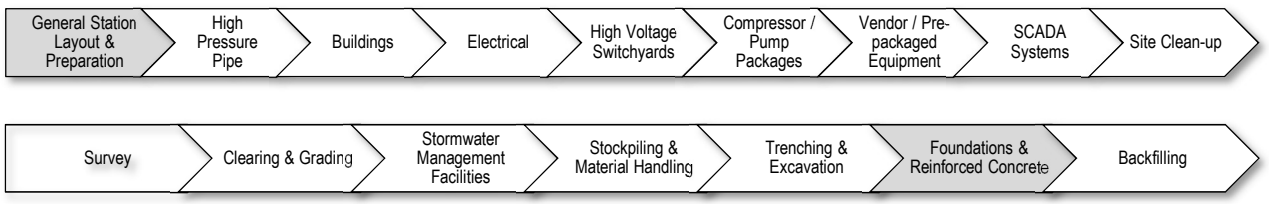
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the foundations and reinforced concrete construction process are identified in a series of checklists as detailed in Table 73.

Table 73: Monitoring Requirements for Foundations and Reinforced Concrete Construction – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 75
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 76
Foundations and Reinforced Concrete Construction	• Monitoring requirements associated with foundations and reinforced concrete, ensuring the installation conforms to the design	Table 77

7.7.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for foundations and reinforced concrete inspection appear in Table 78.



Detailed Checklists – Foundations and Reinforced Concrete

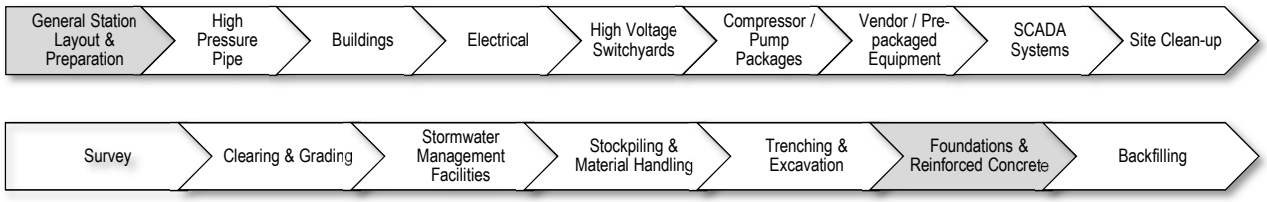
7.7.4 Typical Input Requirements for Foundations and Reinforced Concrete Inspection

Table 74: Information Requirements for Foundations and Reinforced Concrete Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to foundations and reinforced concrete, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Plans, Sections, and Details
	  ○ Pile Schedules (including Electrical Grounding Plans and Details)
	  ○ Rebar Drawings
	  ○ Formwork Drawings
	• Foundation Specifications, including
	  ○ Plain and Reinforced Concrete, including Concrete Mix Design
	  ○ Embedded Steel
	  ○ Anchor Bolts (including allowable use of post-installed adhesive (epoxy) anchors)
	  ○ Grout
	• Manufacturer Specifications (including Additives)

	Contracts and agreements related to: • Technical Advisors / Vendor Representatives
	Owner Company specific Safety Plan, including (but not limited to): • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Other project specific Plans, which may include: • Concrete Production Facilities Certification • Placement Plans for Mass Concrete Foundations (e.g., mats, engine blocks, towers), including truck cycle times, testing protocols, and placement of concrete to ensure no initial set takes place between adjacent pours • Coordination for Embedded Water and / or Sewer Pipe, Conduits / Cables, and Grounding • Methods for Protection of Anchor Bolt Threads • Reciprocating Compressor Package Grout Plan • Hot / Cold Weather Concrete Plans



7.7.5 Best Practice Items for Inspecting Typical Foundations and Reinforced Concrete Construction

Table 75: Prior to Commencing Work

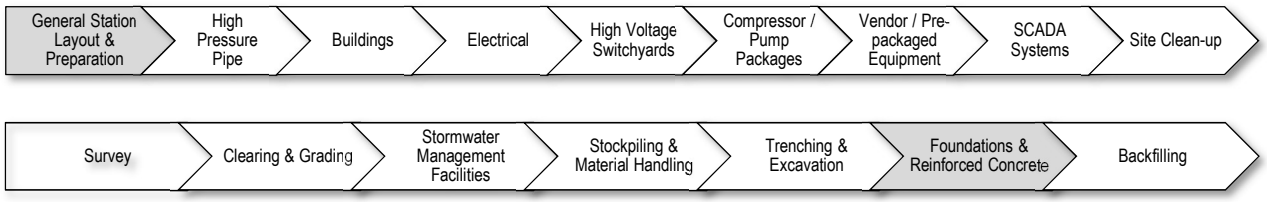
✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Verify local jurisdictional inspections have been completed prior to pouring concrete
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure excavations are complete per Section 7.6 Trenching and Excavation
	Verify electrical inspection is complete per Section 10.0 Electrical prior to concrete placement, where concrete is required to be placed in contact with embedded conduits / cables and grounding
	Verify conduit stub-up locations

Table 76: Safety Concerns for Foundations and Reinforced Concrete Construction

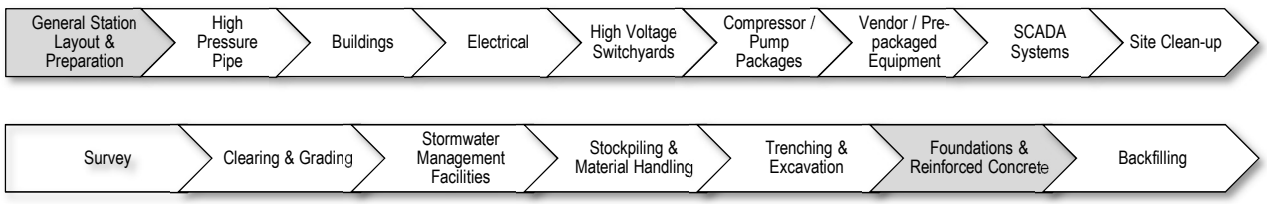
✓	Description
	Ensure appropriate chemical burn protection is used
	Confirm rebar end protectors for impalement protection are installed

Table 77: Typical Monitoring Requirements for Foundations and Reinforced Concrete Construction

✓	Description
	Ensure piles are installed within acceptable tolerances
	Ensure lifting is only by means of lifting inserts after removal of concrete from formwork
	Ensure reinforcing steel is free of dirt, oil, excessive rust or scale, structural defects, or any injurious coating
	Ensure rebar splices are properly completed
	Ensure foundation bases are properly compacted
	Ensure vapor barriers are properly installed prior to concrete placement, as required
	Ensure forms and blockouts are properly installed, including correct dimensions, locations, and elevations, prior to concrete placement
	Ensure form release agents are not applied on surfaces that will be covered with epoxy finish
	Ensure reinforcing steel is properly installed prior to concrete placement, (e.g., rebar size, spacing, distance between rebar and edge and bottom of foundations) with welding performed in accordance with Section 8.4 Welding and Joini, if required



✓	Description
	Ensure reinforcing steel is properly grounded in accordance with Section 10.4 Grounding
	Verify anchor bolts are properly installed, including braced or framed templates to maintain position and vertical orientation, proper projection, thread protection, and anchor bolt sleeves sealed against entrance of concrete or grout
	Ensure expansion, control, isolation, and construction joints are properly located and installed
	Ensure waterstops are properly located and installed
	Ensure internal temperature sensors are installed prior to placing concrete for mass foundations (e.g., mats, engine blocks, towers) if required by Owner Company
	Ensure concrete materials, including cement, fly ash, mixing water, and aggregate, are in accordance with Concrete Mix Design and Owner Company or project specifications
	Ensure concrete mix proportions (e.g., water-cement ratio) are in accordance with Concrete Mix Design and Owner Company or project specifications
	Ensure high early strength cement is only used with Owner Company approval
	Ensure concrete that has achieved initial set or has been contaminated by foreign matter is not used
	Ensure concrete is properly placed, finished, cured, and protected (including provisions for inclement weather conditions)
	Ensure hot and cold weather concrete placement and curing requirements are followed as determined by weather conditions
	Verify anchor bolts have remained in their proper position as concrete is placed around them (i.e., they have not been moved or rotated)
	Ensure concrete is placed as quickly as possible to avoid exposure of footing bottoms to wetting and drying
	Ensure formwork is properly removed and is removed only after the required cure time
	Ensure any concrete defects are repaired
	Ensure field concrete test requirements and testing intervals are understood prior to placing concrete
	Ensure concrete testing cylinders are properly taken and stored
	Ensure air tests of concrete are performed and results documented, if required
	Ensure laboratory tests of sample concrete cylinders are performed and results documented
	Ensure concrete slump is within allowable variance from design
	Ensure no vehicular traffic, construction equipment, or materials are placed on foundations or floor slabs until required compressive strength has been achieved
	Ensure concrete surface preparation and finish is performed, as required
	Ensure concrete surface is properly prepared and grout is properly mixed, handled, placed (including location of joints), finished, and cured
	Ensure all form joints, expansion joints, and interfaces between forms and concrete foundations are sealed



7.7.6 Typical Outputs for Foundations and Reinforced Concrete Inspection

Table 78: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Ensure survey of top of concrete elevations prior to backfill in accordance with Section 7.8 Backfilling
Daily	

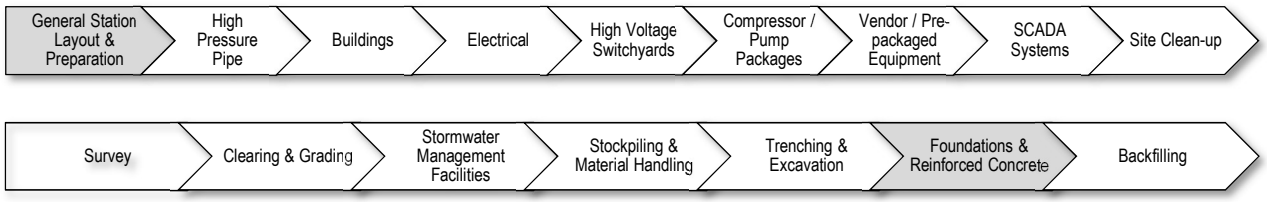
	Complete foundations and reinforced concrete progress reports, including:
	• Work completed to date, including:
	  ○ Concrete cylinder field and laboratory reports
	  ○ Mass concrete temperature reports (if required by Owner Company)
	  ○ Concrete pour release forms
	  ○ Daily concrete placement reports
	  ○ Piling logs
	  ○ Concrete batch tickets for each pour
	• Document punch list items, as required

7.7.7 References – Foundations and Reinforced Concrete

Note to user: The reference information provided in Table 79 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 79: List of References – Foundations and Reinforced Concrete

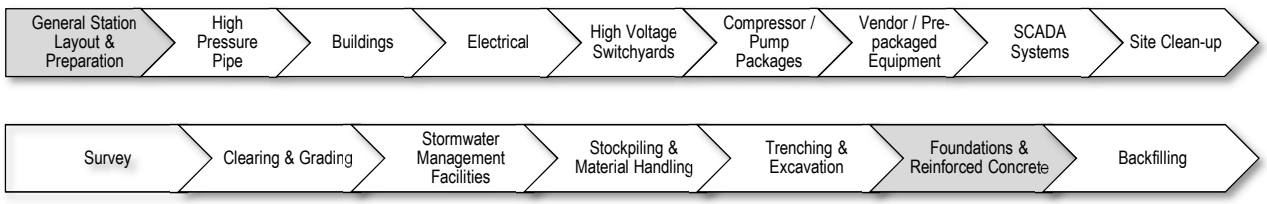
Document No.	Type	Title
American Concrete Institute (ACI)		
ACI 117	Specification	Specification for Tolerances for Concrete Construction and Materials
ACI 301	Specification	Specifications for Structural Concrete
ACI 302.1R	Guideline	Guide to Concrete Floor and Slab Construction
ACI 304R	Guideline	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Guideline	Guide to Hot Weather Concreting
ACI 306R	Guideline	Guide to Cold Weather Concreting
ACI 309R	Guideline	Guide for Consolidation of Concrete
ACI 311.4R	Guideline	Guide for Concrete Inspection



Document No.	Type	Title
ACI 315R	Guideline	Guide to Presenting Reinforcing Steel Design Details
ACI 318	Standard	Building Code Requirements for Structural Concrete
ACI 336.1	Specification	Specification for the Construction of Drilled Piers
ACI 347R	Guideline	Guide to Formwork for Concrete
ACI 351.5	Specification	Specification for Installation of Epoxy Grout between Foundations and Equipment Bases
ACI 543R	Guideline	Guide to Design, Manufacture, and Installation of Concrete Piles
SP-004	Recommended Practice	Formwork for Concrete
SP-017	Handbook	The Reinforced Concrete Design Handbook
SP-066	Recommended Practice	ACI Detailing Manual
Canadian Standards Association (CSA)		
CSA A23.1	Standard	Concrete Materials and Methods of Concrete Construction
CSA A23.2	Standard	Test Methods and Standard Practices for Concrete
CSA A23.3	Standard	Design of Concrete Structures
CSA A23.4	Standard	Precast Concrete – Materials and Construction
CSA S269.1	Standard	Falsework and Formwork
Cement Association of Canada (CAC)		
N/A	Handbook	Concrete Design Handbook
International Code Council (ICC)		
N/A	Standard	The International Building Code (IBC) [1]
National Research Council Canada (NRC)		
N/A	Standard	The National Building Code of Canada (NBC) [1]

Note(s):

1) Provincial / Territorial and / or State Building Codes govern, where applicable



7.8 Backfilling

7.8.1 Inputs

As part of preparing for inspection during the backfilling process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 81.

7.8.2 Execution

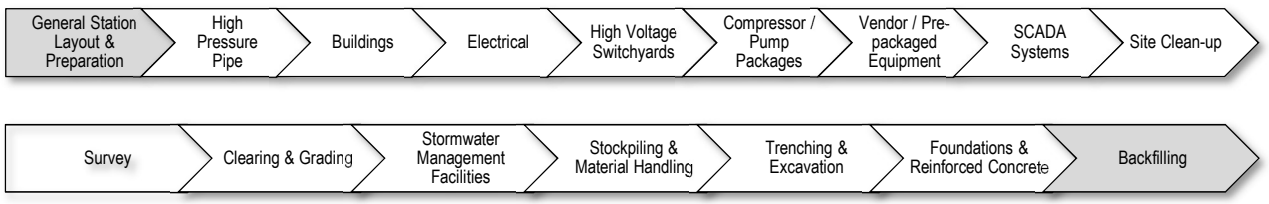
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor during the backfilling process are identified in a series of checklists as detailed in Table 80.

Table 80: Monitoring Requirements for Backfilling – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 82
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 83
General Backfilling Operations	• Identifies overall items that Inspectors should monitor during backfilling operations	Table 84
Backfilling 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 Owner Company specifications in order to prevent damage to the pipe	Table 85

7.8.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for backfilling inspection appear in Table 86.



Detailed Checklists – Backfilling

7.8.4 Typical Inputs for Backfilling Inspection

Table 81: Information Requirements for Backfilling

✓	Description

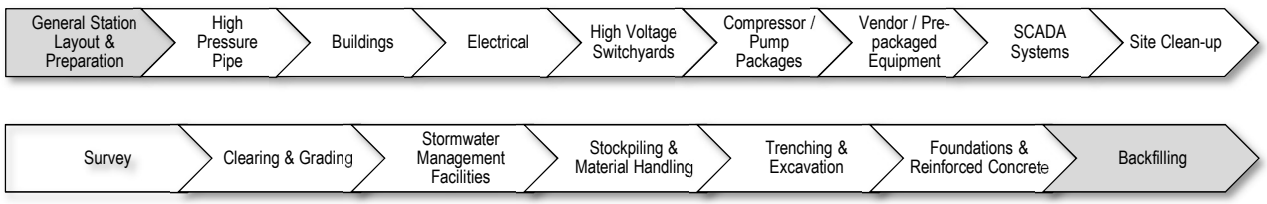
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to backfilling, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	• Backfill Specifications

	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Permits related to: • Environmental • Road Use
	Owner Company 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) • Trenching and Excavation Plan
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

7.8.5 Best Practice Items for Inspecting Typical Backfilling Operations

Table 82: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure that the Owner Company witnesses and acquires approval before commencing the backfilling operation



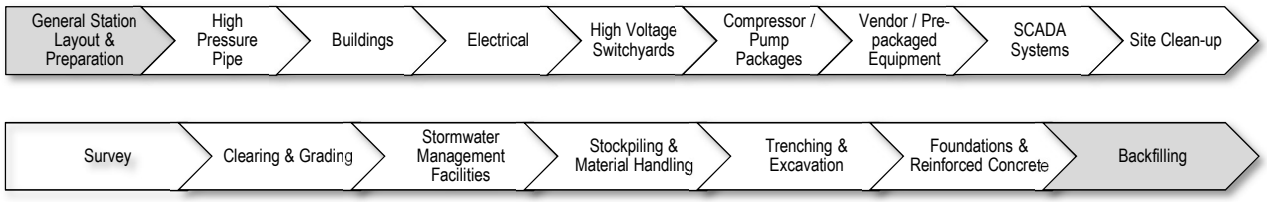
✓	Description
	Ensure the trench has been re-inspected to make sure it is free of debris
	Ensure that cover, sandbags, rock shield, and Third Party lines have been inspected and documented
	Ensure that Contractor repairs all coating damage
	Ensure the Construction Survey crew collects as-built data before backfilling commences
	Ensure any required survey (GPS or conventional) is complete prior to backfilling
	Verify coating has been completed and documented
	Verify holiday detection has been completed and documented

Table 83: Safety Concerns for Backfilling

✓	Description
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

Table 84: Typical Monitoring Requirements for General Backfilling Operations

✓	Description
	Ensure backfilling commences as soon as practical after lowering-in the assembly
	Ensure cathodic protection test leads are installed as per construction drawings and specifications
	Check that the open ends of pipe are protected by appropriate plugs
	Confirm that the Contractor uses only Owner Company approved select / imported bedding and backfill
	Ensure that Proctor density tests (which will help determine the compaction characteristics of the soil) are conducted as required
	Ensure pipe is shaded with approved padding, packing it around and under the pipe where warranted
	Ensure trench is filled with excavated material to provide firm support for the pipe
	Ensure 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 Contractor does not place rocky backfill directly on the lowered pipe
	Ensure larger rocks with sizes too large for backfill are hauled away or stacked neatly along the facility site limits as specified in Owner Company specifications and drawings
	Check that marker tape is installed in the trench above the pipe, where required
	Continuously monitor that pipes sharing a common trench maintain the minimum separation as specified in the design documents
	Ensure padding and backfill material is compacted as per project requirements, in lift heights no more than the allowed amount
	Ensure final backfilled surface is level across the trench
Winter Construction	
	Confirm that during winter construction, trench excavation, assembly installation, and backfilling are completed by the Contractor as agreed with the Owner Company



✓	Description
	Ensure that any snow or ice is removed from the compacted layer prior to placement of subsequent layers

Table 85: Typical Monitoring Requirements for Backfilling Materials

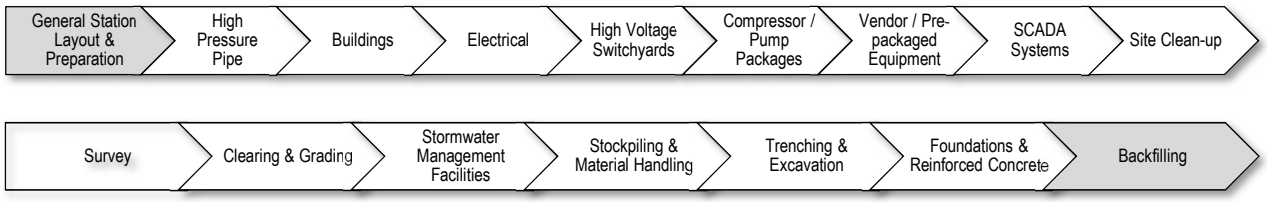
✓	Description
	Ensure that top soil is never used as padding material or fill
	Ensure that the backfill material is soft, free from large rocks, stumps, frozen material, or any other foreign material that can dent the pipe or scratch the external coating
	Ensure that when excavated material is not suitable for backfill, Owner Company approved imported material is used for padding above and below the pipe
	Ensure that acceptable backfill and compaction techniques are used that will yield the specified compaction around foundations, utilities, and piping
	Confirm erosion control measures such as earth filled sacks or rock riprap (rock or other support material used to armor drainage trenches and trench walls) are placed, as required
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 pipe
	Ensure that where sand is used for padding, it is dry, unfrozen, and free from any rocks larger than specification or having sharp edges
	Ensure Contractor applies sand padding after sandbags and foam support pillows are placed in the trench
	Ensure Contractor uses sandbags, foam pillows, or other approved materials to support the pipe at the correct spacing
	Ensure Contractor places the minimum thickness specified of sand-padding on top of the lowered pipe as indicated in Owner Company or project specifications, construction drawings, and agreements

7.8.6 Typical Outputs for Backfilling Inspection

Table 86: Typical Reporting Requirements

✓	Description
General	
	Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress
Daily	

	Complete backfilling progress reports, including:
	• Work completed to date, including:
	  ○ Minimum cover obtained
	  ○ Description of the areas backfilled
	  ○ Description of compaction equipment and methods used, including test results
	  ○ Schedule changes including any delay or acceleration and reasons
	  ○ As-built alignment and profile of installed pipe
	  ○ Holiday detector settings and calibration



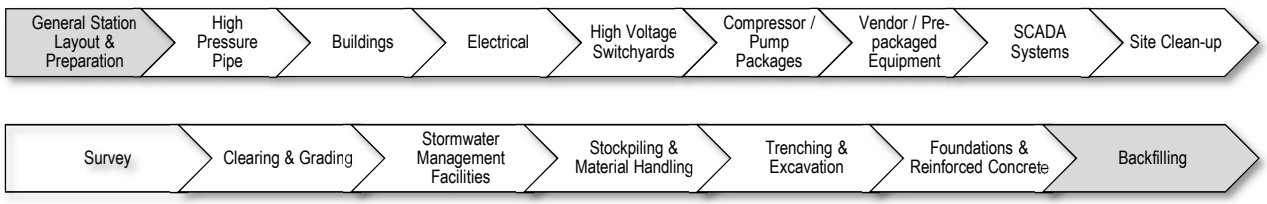
✓	Description
	○ Locations of damaged drain tiles for repair ○ Locations and type of pipe protection materials installed • Document punch list items, as required

7.8.7 References – Backfilling

Note to user: The reference information provided in Table 87 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 87: List of References – Backfilling

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		



8.0 HIGH PRESSURE PIPE

8.1 Overview

High pressure pipe and piping components are used for the transportation of hydrocarbons in gaseous or liquid form within a facility. High pressure pipe may also be used for power gas systems (e.g., gas-powered valve actuators) and supply feed to utility gas or fuel gas systems for gas turbines (if present). Components of these systems include, but are not limited to, inlet gas filter separators, blowdown, condensate, inlet piping, flow meters, pressure regulating devices, and scraper traps.

Construction of high pressure pipe consists of the following major items during the construction of a facility:

- Trenching and Excavation (refer to Section 7.6)
- Foundations and Reinforced Concrete (refer to Section 7.7)
- Structural Steel
- Lifting and Setting
- Welding and Joining
- Coating / Painting
- Hydrostatic Testing
- Cathodic Protection

These items are presented within this section, roughly in sequence of construction.

Structural Steel

Pipe racks are considered to be structural steel and need to be installed prior to lifting and setting of high pressure pipe. At this point, associated joints and connections of structural steel are also inspected.

Lifting and Setting

Lifting and setting involves the placement of pipe sections, assemblies, and other large components onto foundations, pipe supports, pipe racks, or into excavations. This activity requires specialized lifting equipment, trained Operators, and pre-planning.

Welding and Joining

Welding is a process that uses fusion to join two or more materials together to become a manufactured or fabricated item. Welding during facilities construction is performed to join pipe, fittings, and valves together along with structural steel.

While welding requires specialized expertise, not just for the execution of the work, but also inspection of the work, there are a number of items that the Inspector should be aware of as part of undertaking their role effectively (i.e., working

alongside Welding Inspectors). Welding inspection should only be performed by a Welding Inspector who has been qualified and has been specifically assigned this task. As such, the information presented within this section deviates somewhat from the majority of chapters in this document and focuses on providing the Inspector with sufficient knowledge to understand the limitations of their role in the context of welding inspection. In some cases, flanges are used to join lengths of pipe (e.g., need for electrical isolation). These bolted joints require particular attention to ensure additional stresses are not imposed on the pipe.

Coating / Painting

Coating of the pipe sections and equipment assemblies provides a protective barrier against damage (e.g., corrosion). The majority of the coating operations will occur near to where the facilities are fabricated.

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

Hydrostatic Testing

A hydrostatic test is a form of pressure testing used to confirm that the pipe has acceptable strength and will not leak under operating conditions. Hydrostatic testing uses water (as opposed to air) to perform the test. Owner Companies pressure test new pipe 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, to ensure the safety of the public, environment, and surrounding property
- Confirm the quality of fabricated assemblies, materials supplied by Manufacturers, and fabrication welds to ensure the pipe can safely operate within the specified maximum operating pressure (MOP) or maximum allowable operating pressure (MAOP)
- Prove the workmanship of Fabricators
- Comply with industry and governing body regulations

Caution: Air contains significantly more stored energy compared to water and poses increased risk during the test; as a result, it is only used for pressure testing under situations where the elevation differences result in an impractical number of test sections or if there is a shortage of water. For this reason, the scope of this document is limited to hydrostatic testing.

Cathodic Protection

Cathodic protection (CP) is a technique used, in conjunction with anti-corrosion coatings, to control the external corrosion of a buried pipe's metal surface by making the pipe the cathode of an electrochemical cell. In other words, CP is a simple method of protection where the pipe is connected to a more easily corroded (sacrificial) metal (e.g., magnesium) which acts as the anode. The sacrificial metal then corrodes instead of the pipe. There are two basic methods of CP – galvanic and induced current. The selection of the method depends on many factors, including the amount of pipe to protect, soil conditions, and availability of commercial power. Galvanic systems are passive and do not require any outside power source, whereas induced current systems require an electrical power source (rectifier) to provide the protective current.

The style and selection of anode material also varies by design. Galvanic systems tend to use several discrete anodes spaced near the pipe and buried at the same depth as the pipe. Induced current systems place the anodes away from the pipe to prevent "over protection" (i.e., high voltages that could cause coating damage). These anodes can be shallow (about the same burial depth of the pipe) or deep wells (typically 200 to 300 feet or 75 to 100 meters deep).

As part of the CP system, test stations are required to take readings on a periodic basis. These can be stand alone posts like those found on pipeline rights-of-way or dedicated connection points at above ground pipe connections. Cathodic test leads, isolation flange kits, anodes, negative drain leads, junction boxes, decoupling devices, lighting protection, and ground bed cables are some of the major components that are installed to complete a CP system.

While connection of test lead (wire) to buried pipe and isolation flange kits are commonly installed by the general pipeline Contractor, the other components are more likely to be installed by a dedicated CP specialty Contractor or Electrician.

8.2 Structural Steel

8.2.1 Inputs

As part of preparing for inspection during the structural steel construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 89.

8.2.2 Execution

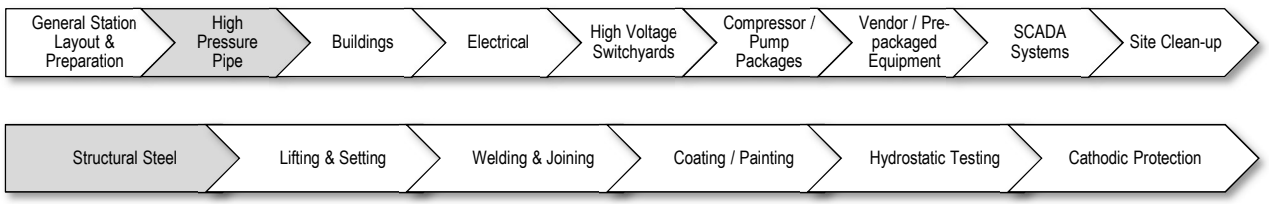
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the structural steel construction process are identified in a series of checklists as detailed in Table 88.

Table 88: Monitoring Requirements for Structural Steel Construction – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 90
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 91
Trenching and Excavation Operations	• Previously discussed monitoring requirements associated with trenching and excavation operations	Section 7.6
Foundations and Reinforced Concrete Construction	• Previously discussed monitoring requirements associated with foundations and reinforced concrete construction	Section 7.7
Structural Steel Construction	• Monitoring requirements associated with structural steel, ensuring the installation conforms to the design	Table 92

8.2.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for structural steel inspection appear in Table 93.



Detailed Checklists – Structural Steel

8.2.4 Typical Input Requirements for Structural Steel Inspection

Table 89: Information Requirements for Structural Steel Inspection

✓	Description

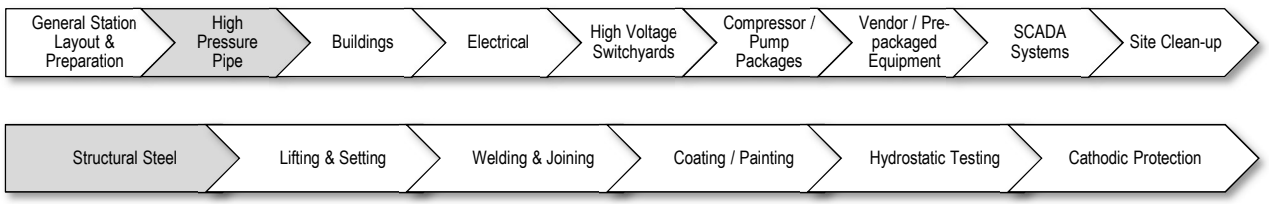
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to structural steel, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Pipe Support Drawings
	  ○ Vent Support Drawings
	• Fabrication Shop Drawings
	• Structural Steel Specifications
	• Construction Specifications
	• Manufacturer Specifications and Drawings

	Contracts and agreements related to: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Owner Company specific Safety Plan, including (but not limited to): • Working at Elevations • Lift Plan
	Other project specific Plans, which may include: • Traffic Management Plan

8.2.5 Best Practice Items for Inspecting Typical Structural Steel Construction

Table 90: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all structural steel members are piece marked in accordance with Fabrication Shop Drawings
	Ensure material Mill Test Reports (MTRs) for steel components and joining materials (e.g., bolts, nuts, washers) are reviewed prior to use



✓	Description
	Ensure Contractor is familiar with and competent in the proper joining method (e.g., bolt torquing values, turn-of-nut bolting method)

Table 91: Safety Concerns for Structural Steel Construction

✓	Description
	Ensure structures are not loaded with weight that endangers design integrity
	Ensure erection steel is adequately braced until permanently connected and self-supporting
	Ensure proper safeguards and plans related to working at elevations are followed

Table 92: Typical Monitoring Requirements for Structural Steel Construction

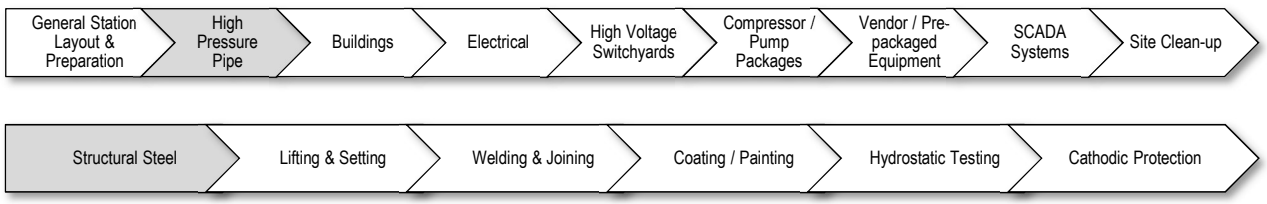
✓	Description
	Ensure that joint surfaces are free from loose mill scale, dirt, oil, burrs, pits, or other defects that prevent solid seating
	Ensure bolts and nuts are adequately torqued / tensioned and documented
	Ensure all pre-painted surfaces are inspected to meet Owner Company or project specifications
	Ensure all pre-painted surfaces damaged during construction are repaired
	Ensure all galvanized surfaces damaged during construction are coated
	Ensure any required anti-abrasion coatings or padding are installed under clamps or pipe rests
	Ensure platforms and elevated structures are properly installed
	Ensure pipe supports, anchors, and sliders are installed at correct locations
	Ensure welding is completed in accordance with Section 8.4 Welding and Joini

8.2.6 Typical Outputs for Structural Steel Inspection

Table 93: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings and MTRs as required by Owner Company
Daily	

	Complete structural steel progress reports, including:
	• Work completed to date, including:
	  ○ Number and location of structural steel members erected
	  ○ Description and location of placed structural steel
	• Document punch list items, as required

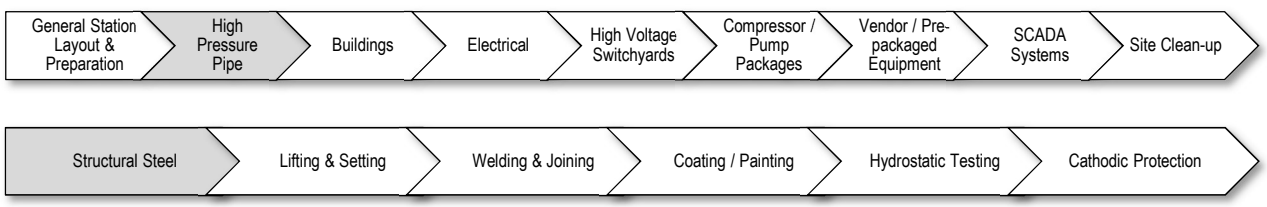


8.2.7 References – Structural Steel

Note to user: The reference information provided in Table 94 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 94: List of References – Structural Steel

Document No.	Type	Title
American Institute of Steel Construction (AISC)		
AISC 206	Standard	Certification Program for Structural Steel Erectors
AISC 207	Standard	Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 325	Handbook	Steel Construction Manual
American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)		
ANSI / AISC 303	Standard	Code of Standard Practice for Steel Buildings and Bridges
ANSI / AISC 360	Specification	Specification for Structural Steel Buildings
American Society for Testing and Materials (ASTM)		
ASTM A36	Specification	Standard Specification for Carbon Structural Steel
ASTM A123	Specification	Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	Specification	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	Specification	Standard Specification for Carbon and Alloy Steel Nuts
ASTM F3125	Specification	Standard Specification for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength
N/A	Standard	Selected ASTM Standards for Structural Steel Fabrication
American Society of Civil Engineers (ASCE)		
ASCE 7	Standard	Minimum Design Loads for Buildings and Other Structures
Canadian Institute of Steel Construction (CISC)		
N/A	Recommended Practice	Code of Standard Practice
N/A	Handbook	Handbook of Steel Construction
Canadian Standards Association (CSA)		



Document No.	Type	Title
CSA G40.20 / G40.21	Standard	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CSA G164	Standard	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA S16	Standard	Design of Steel Structures
CSA S136	Specification	North American Specification for the Design of Cold-Formed Steel Structural Members
International Code Council (ICC)		
N/A	Standard	The International Building Code (IBC) [1]
National Research Council Canada (NRC)		
N/A	Standard	The National Building Code of Canada (NBC) [1]
Research Council on Structural Connections (RCSC)		
N/A	Specification	Specification for Structural Joints Using High-Strength Bolts

Note(s):

1) Provincial / Territorial and / or State Building Codes govern, where applicable

8.3 Lifting and Setting

8.3.1 Inputs

As part of preparing for inspection during the lifting and setting process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 96.

8.3.2 Execution

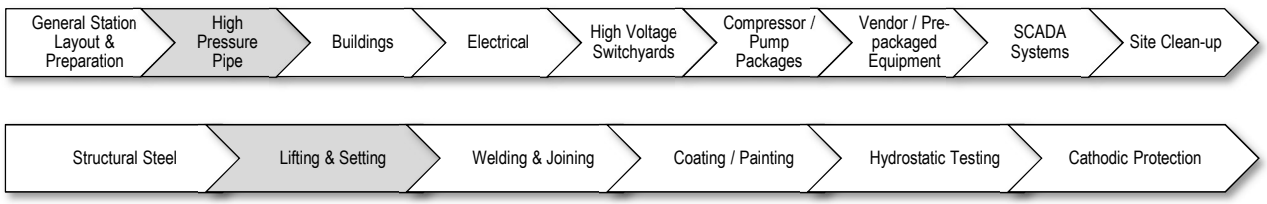
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the lifting and setting process are identified in a series of checklists as detailed in Table 95.

Table 95: Monitoring Requirements for Lifting and Setting – Mechanical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 97
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 98
Lifting and Setting	• Monitor lifting and setting operations for safety and ensure that no damage occurs to the pipe and coating	Table 99

8.3.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for lifting and setting inspection appear in Table 100.



Detailed Checklists – Lifting and Setting

8.3.4 Typical Input Requirements for Lifting and Setting Inspection

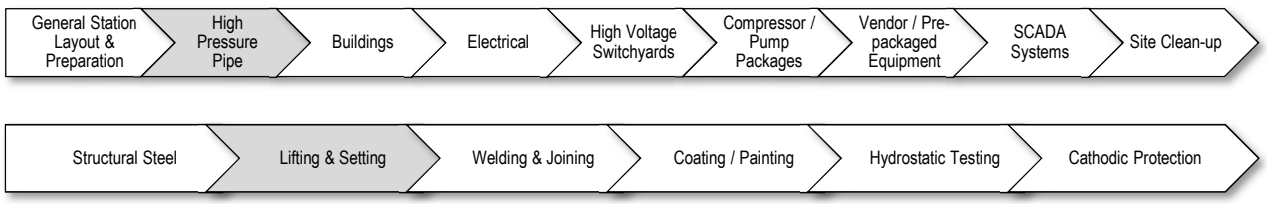
Table 96: Information Requirements for Lifting and Setting

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to lifting and setting, such as: • Issued for Construction (IFC) Drawings, including o Piping and Instrumentation Diagrams (P&IDs) • Equipment Manufacturer Specifications and Drawings • Lifting Equipment Specifications and Drawings, including maximum allowed equipment spacing for pipe
	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Heavy Lift Plan • Lock-out / Tag-out Procedures
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Relevant Contingency Plans • Loading, Securing, and Rigging Practices

8.3.5 Best Practice Items for Inspecting Typical Lifting and Setting Operations

Table 97: 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) • Facility 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 lifting and setting to make sure all personnel involved are aware of:



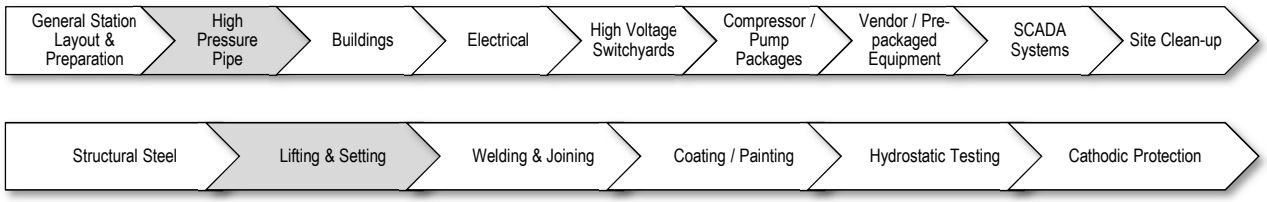
✓	Description
	• Lifting sequence • Critical lift circumstances • Equipment size and numbers • Individual roles and responsibilities • Weather restrictions (e.g., wind, lightning)
	Verify qualifications and training certificates of all Crane Operators and Riggers to ensure they are competent and trained
	Verify the weight of the load, confirm equipment is certified (e.g., cranes, forklifts), and lifting components can withstand load limits / weight requirements
	Confirm spreader bars, slings, belts, cradles, etc. have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and ensure their suitability for lifting to avoid equipment / pipe damage
	Inspect spreader bars, slings, belts, cradles, etc. visually for damage

Table 98: Safety Concerns for Lifting and Setting

✓	Description
	Ensure a job safety analysis (JSA) is conducted and strictly adhered to throughout lifting and setting operations
	Ensure that the JSA is updated as required
	Ensure Equipment Operators use spotters while backing up and traversing near or under powerlines and overhead hazards
	Ensure that personnel are never allowed between the suspended load and an obstacle, which could result in a pinch point safety hazard
	Ensure bell holes (an excavation that allows access for tie-ins, installation, inspection, maintenance, repair, or replacement of a pipe section or appurtenance) are excavated in a manner that will allow for safe entry and egress. The Contractor is responsible for determining the type of soil, benching requirements, etc. for safe entry and egress and the need for benching techniques and / or trench box(es)
	Ensure loads are not suspended over workers
	Ensure barricades, fencing, etc. are in place prior to lifting and setting to properly rope off the swing radius
	Ensure lighting is adequate for the entire period of the lift (light kits and generators may be required)
	Ensure the entire lift sequence can be undertaken in safe weather conditions (i.e., no lightning or high winds)

Table 99: Typical Monitoring Requirements for Lifting and Setting

✓	Description
	Ensure lifting is secured from specified lifting points
	Check that the excavation has been dewatered (drained) where warranted before lowering-in the assembly to ensure the assembly will not float off the trench base
	Check that pipe racks and pipe supports are clear of obstructions and ready to accept pipe
	Verify embedded fasteners have been placed in the appropriate locations in accordance with IFC Drawings



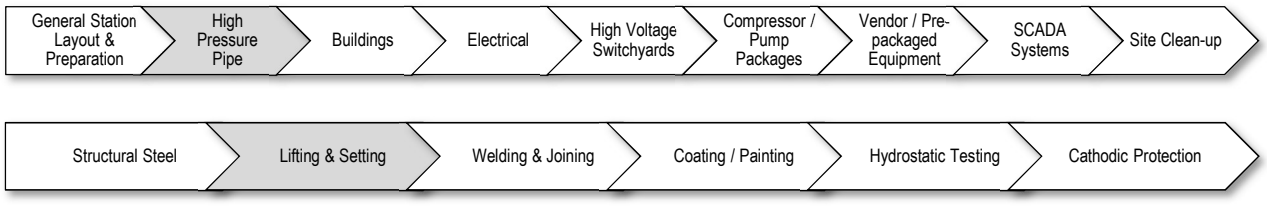
✓	Description
	Verify pipe clamps have been set to ensure pipe will rest at the designed elevation
	Check connection of cathodic protection test lead cables where installed
	Ensure that at no time will an assembly be lowered that has not had all weld repairs made and girth weld protection applied and tested
	Ensure no workers at any time are in the excavation, on the assembly, between assembly and trench wall, or assembly and equipment during lowering-in operations
	Monitor for trench wall failure while assembly is suspended over or in the excavation
	Ensure the coated pipe is never dragged or pulled on the trench base
	Review and amend the JSA, tailgate documents, and Lift Plan if there has been any deviation
	Ensure that lifting equipment is labelled for maximum capacity
	Ensure the use of approved safety latches on all lifting hooks
	Ensure the use of tag lines when required
	Confirm presence of designated signal person using proper hand signals
	Ensure all coated pipe is visually inspected and checked with a holiday detector immediately prior to installation and, if found damaged, coating is repaired in accordance with Section 8.5 Coating / Painting
	Ensure no skids, brush, stumps, trees, rocks, boulders, or other debris are in the trench after lowering-in has been completed, but before backfilling
	Ensure the Contractor has a rigging control in place and removes and destroys all defective rigging
	Ensure 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 distributes load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes
	Ensure lowered assembly never swings or rubs against trench walls or sidebooms, and is not dropped or subjected to jarring or sudden impacts
	Verify that any crane certification documents are received and safeguarded to turn over to Operations in a turn-over package

8.3.6 Typical Outputs for Lifting and Setting Inspection

Table 100: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

	Complete lifting and setting progress reports, including:
	• Work completed to date, including:
	  ○ Description and location of placed pipe or structural steel
	  ○ Any damage incurred during lifting and setting



✓	Description
	• Document punch list items, as required

8.3.7 References – Lifting and Setting

Note to user: The reference information provided in Table 101 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 101: List of References – Lifting and Setting

Document No.	Type	Title
American Society of Mechanical Engineers (ASME)		
ASME B30.05	Standard	Mobile Cranes
ASME B30.14	Standard	Sideboom Cranes
ASME B30.2	Standard	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
Canadian Standards Association (CSA)		
CSA B167	Standard	Overhead Cranes, Gantry Cranes, Monorails, Hoists, and Jib Cranes

8.4 Welding and Joining

8.4.1 Inputs

While the Inspector is not expected to undertake significant welding inspection activities, some indication of typical inputs is provided as orientation (i.e., background information) for all disciplines. Relevant information for joining is also included. This information is detailed in Table 103.

8.4.2 Execution

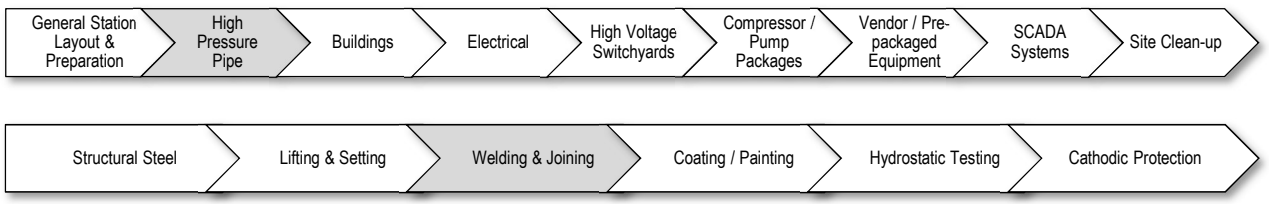
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Since welding inspection is a specialized role, the listing provided in this section is focused on items that would typically require specialized welding expertise (i.e., indication of items that would prompt the Inspector to escalate identified issues).

It should be noted that joining is not specialized expertise and a checklist to support this aspect of construction is included for the Mechanical discipline.

Typical items that the Inspector will monitor for during the welding and joining process are identified in a series of checklists as detailed in Table 102.

Table 102: Monitoring Requirements for Welding and Joining

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 104
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 105
Civil, Mechanical, Electrical (All Disciplines)		
General Welding Operations	• Typical monitoring requirements for a non-specialized Inspector. Note that it is important to identify those situations that require a specialized Welding Inspector	Table 106
Mechanical		
Joining Operations	• Monitoring requirements associated with joining (e.g., bolting of pipe flanges), ensuring the installation conforms to the design	Table 107



8.4.3 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 welding outputs, in addition to reporting associated with joining, is provided as background information as detailed in Table 108.

Detailed Checklists – Welding and Joining

8.4.4 Typical Input Requirements for Welding and Joining Inspection

Table 103: Information Requirements for Welding and Joining

✓	Description

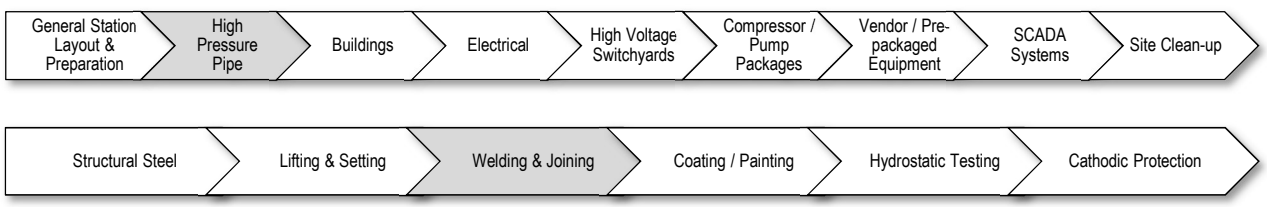
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to welding and joining, such as:
	• All applicable Welding Procedure Specifications (WPS)
	• All applicable Owner Company's Welding Standards
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Bills of Materials (BOMs)

	Contracts and agreements related to: • Welding ○ All Welders' qualifications records to specific applicable processes and WPS • Non-destructive Examination (NDE) • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS)
	Other project specific Plans, which may include: • Welding Plan

8.4.5 Best Practice Items for Inspecting Typical Welding and Joining Operations

Table 104: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Ensure all Welders have welding qualifications on hand for the process and specified WPS • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required)



✓	Description
	• Ad-hoc meetings with Contractors to discuss and clarify questions or concerns • Conduct and record tailgate meetings with Welders to ensure they clearly understand the Owner Company Quality, Safety, Welding Standards, and Welding Procedure Specifications (WPS) • Communicate and monitor all hold points prior to start of welding operations • Ensure every new welder to site is briefed on the above points during onboarding
	Ensure torqueing or bolt tensioning equipment calibration has been verified

Table 105: Safety Concerns for Welding and Joining

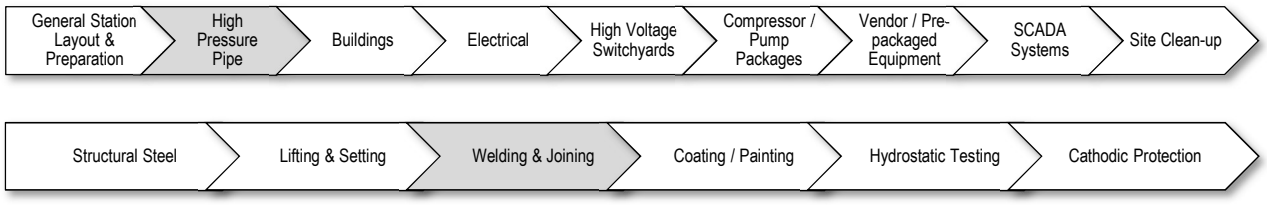
✓	Description
	There are hazards unique to the welding phase that all Inspectors should be aware of. These include, but are not restricted to: hot surfaces (pre-heat or post weld), sharp edges (beveling), pinch points between pipe ends or line up clamps, weld flash, pressurized containers of flammable gas requiring special transportation and storage, and working in proximity to moving equipment
	Additional safety requirements require the input of a specialized Welding Inspector

Table 106: Typical Monitoring Requirements for Welding Operations

✓	Description
	Ensure all materials are inspected for compliance with Owner Company specifications
	Check joint preparation and fit up for compliance with WPS requirements and specified drawings
	Ensure material identification is transferred on pipe that is cut
	Ensure all required quality inspections, including confirming that the interior of the pipe and fittings is free and clear of debris or snow / ice, and non-destructive examination (NDE) are performed
	General housekeeping related to clean-up of welding related debris (e.g., bevel shavings, weld rod ends)
	Ensure 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 • Confirmation of qualifications of Tackers, 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 • Conformance to WPS (e.g., volts, amps, travel speed, pre-heat, post-weld heat maintenance, post-weld heat treatment)

Table 107: Typical Monitoring Requirements for Joining Operations

✓	Description
	Ensure all pipe dimensions and elevations are field verified
	Ensure all pipe systems are thoroughly cleaned on the inside to remove dirt and loose materials
	Ensure all pipe is installed at correct location and elevation

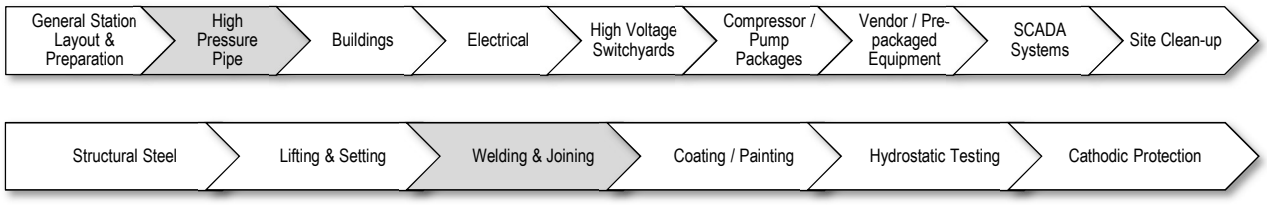


✓	Description
	Ensure plugs on buried pipe are seal welded, as required
	Ensure all man-ways and blind flanges are removed and reinstalled on all vessels, tanks, and separators, gasket faces and bolt threads cleaned, man-way or blind flange reinstalled, and repainting in accordance with Section 8.5 Coating / Painting, as required
	Monitor cleaning of pipe to remove all contaminants, ensuring extra precaution is taken in lines between fuel gas filter separator and gas turbine skid, as required
	Ensure insulation is properly installed, after coating / painting in accordance with Section 8.5 Coating / Painting, and hydrostatic testing in accordance with Section 8.6 Hydrostatic Testing
	Ensure correct installation of all valves, including location and orientation (e.g., check valves, hand wheel location)
	Ensure correct installation of orifice plates, as required
	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 flange fit-ups and screwed connections are properly installed, including verification of the following: • Torque / tension requirements • Proper support and torqueing / tensioning per Owner Company 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 special bolting requirements, if any, including specific fasteners, installation order and location, and coating or protective cover, are met
Main Process Piping and Inlet Gas Filter Separators	
	Check horizontal vessels and pipe to ensure that sliding end is free to slide, as required
Fuel Gas Systems	
	Ensure correct installation of filter elements in fuel gas filter
	Verify odorant level in gas odorizer, as required

8.4.6 Typical Outputs for Welding and Joining Inspection

Table 108: Typical Reporting Requirements

✓	Description
General	
	Safety Hazard Observation Report
	Job Safety Analysis (JSA) / Hazard Identification Report
	Ensure completion of as-built red-lined drawings



✓	Description
Non-destructive Examination (NDE)	
	NDE Records (e.g., Radiographic Testing (RT), Magnetic Particle Testing (MT), Penetrant Testing (PT), Ultrasonic Testing (UT) Reports)
	Visual Inspection Report(s)
	NDE Technique Qualification Records
	NDE Personnel Qualification Reports
Welding	
	Welding Parameter Compliance Form
	Weld Pre-heat Record
	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
	Owner Company Specific Requirements, (e.g., Heat Mapping)
Joining	
	Flanged Torque / Tension Report (including size, class, bolt size, torque / tension value)
Other	
	Damaged Pipe Report
	Non-pipe Material / Equipment Damage Report
Daily	

	Complete welding and joining progress reports, including:
	• Work completed to date, including:
	  ○ Number of welds completed and the number of welds rejected on a daily basis
	  ○ Owner Company specific Welding Inspection Forms
	• Any and all specific daily reports required by the Owner Company
	• Document punch list items, as required

8.4.7 References – Welding and Joining

Note to user: The reference information provided in Table 109 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 ensure that the correct, and most current, documents are referenced as appropriate.

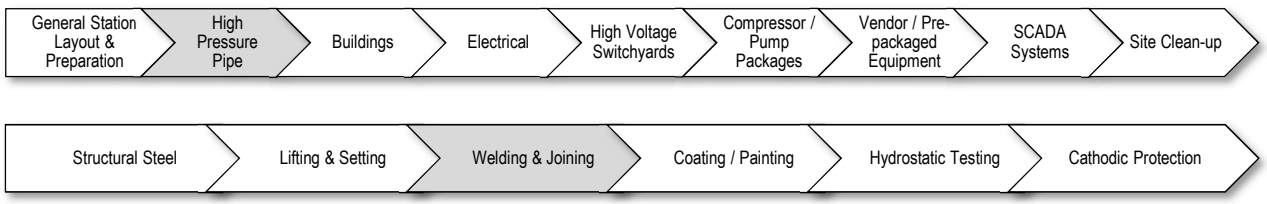
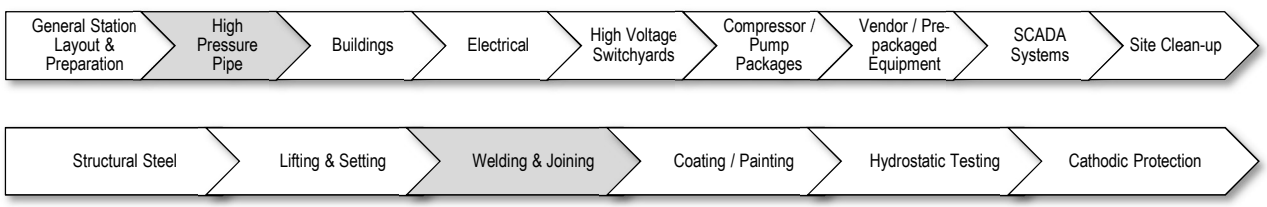


Table 109: List of References – Welding and Joining

Document No.	Type	Title
American Concrete Institute (ACI)		
ACI 318	Standard	Building Code Requirements for Structural Concrete
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 PCC-1	Guideline	Guidelines for Pressure Boundary Bolted Flange Joint Assembly
ASME BPVC Section IX	Standard	Boiler and Pressure Vessel Code (BPVC) Section IX – Welding, Brazing, and Fusing Qualifications
American Welding Society (AWS)		
AWS D1.1	Standard	Structural Welding – Steel
AWS QC1	Standard	Standard for AWS Certification of Welding Inspectors
Canadian General Standards Board (CGSB)		
CGSB 48.9712	Standard	Non-Destructive Testing – Qualification and Certification of NDT Personnel
Canadian Standards Association (CSA)		
CSA W47.1	Standard	Certification of Companies for Fusion Welding of Steel
CSA W48	Standard	Filler Metals and Allied Materials for Metal Arc Welding
CSA W55.3	Standard	Certification of Companies for Resistance Welding of Steel and Aluminum
CSA W59	Standard	Welded Steel Construction (Metal Arc Welding)
CSA W117.2	Standard	Safety in Welding, Cutting, and Allied Processes
CSA W178.2	Standard	Certification of Welding Inspectors
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
Pipe Fabrication Institute (PFI)		
PFI ES3	Standard	Fabricating Tolerances
PFI ES7	Standard	Minimum Length and Spacing for Welded Nozzles



8.5 Coating / Painting

8.5.1 Inputs

While the Inspector is not expected to undertake significant coating / painting inspection activities, some indication of typical inputs is provided as orientation (i.e., background information) for all disciplines. This information is detailed in Table 111.

8.5.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Since coating inspection is a specialized role, the listing provided in this section is focused on items that would typically require specialized coating expertise (i.e., indication of items that would prompt the Inspector to escalate identified issues).

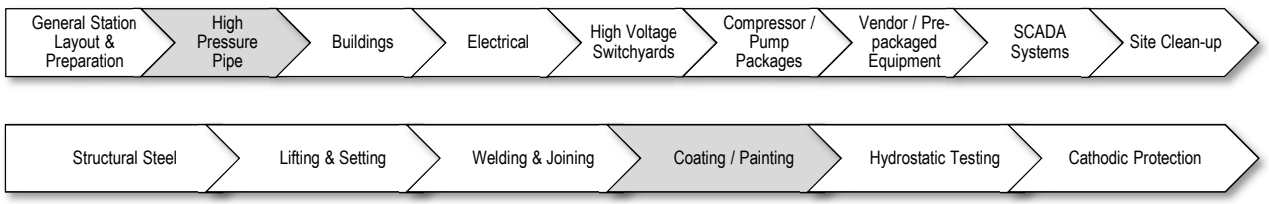
Typical items that the Inspector will monitor for during the coating / painting process are identified in a series of checklists as detailed in Table 110.

Table 110: Monitoring Requirements for Coating / Painting – Civil, Mechanical, Electrical (All Disciplines)

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 112
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 113
General Pipe Surface Preparation and Coating / Painting Operations	• Typical monitoring requirements for a non-specialized Inspector. Note that it is important to identify those situations that require a specialized Coating Inspector • Ensure that all pipe coating damage has been identified and repaired prior to the physical installation of pipe	Table 114

8.5.3 Outputs

While general Inspectors may be asked to assist a Coating Inspector, they are not to perform coating inspection activities on their own. Some indication of typical outputs is provided as background information as detailed in Table 115.



Detailed Checklists – Coating / Painting

8.5.4 Typical Input Requirements for Coating / Painting Inspection

Table 111: Information Requirements for Coating / Painting

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to coating / painting, such as: • Coating / Painting Procedures • Coating / Painting Specifications • Manufacturer supplied information (e.g., storage and handling requirements) • Safety Data Sheet (SDS) for Coating / Painting material
	Contracts and agreements related to: • Coating / Painting Application • Handling and Disposal of Waste
	Owner Company specific Safety Plan, including (but not limited to): • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS)
	Other project specific Plans, which may include: • Coating / Painting Plan

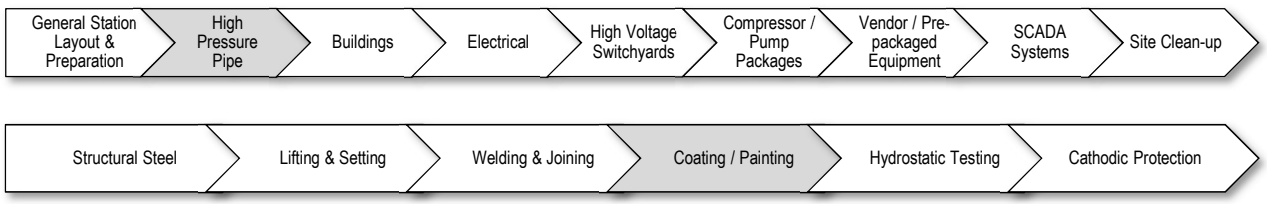
8.5.5 Best Practice Items for Inspecting Typical Coating / Painting Operations

Table 112: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Verify that blasting medium and coating / painting materials are approved
	Verify product quantities, batch numbers, expiry dates, and types

Table 113: Safety Concerns for Coating / Painting

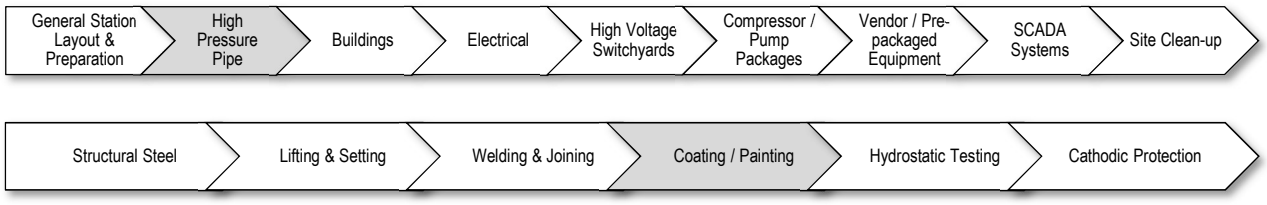
✓	Description
	Ensure proper pressure-rated whip checks are installed on hoses
	Ensure protection is in place to prevent blast media from entering valves, pipe, fittings, and appurtenances



✓	Description
	Ensure specialized Coating Inspector is engaged to identify additional safety requirements
	Ensure adequate ventilation and / or PPE

Table 114: Typical Monitoring Requirements for General Pipe Surface Preparation and Coating / Painting Operations

✓	Description
	Ensure all materials are handled, stored, and applied in accordance with Manufacturer and Owner Company specifications
	Ensure all materials being used (e.g., paint system, primer, top coat) match Owner Company or project specifications
	Ensure materials are not expired per Manufacturer expiry date(s)
	Ensure all containers for coating / painting material are in good condition and not damaged in any way
	Ensure all surfaces are properly prepared and coated in accordance with Manufacturer recommendations
	Ensure sharp edges and weld splatter are removed by filing or grinding prior to coating
	Ensure that all required non-destructive examination (NDE) is completed before applying protective coatings
	Ensure all jeep equipment settings are appropriate for different thicknesses of coating
	Monitor holiday detection activities for compliance with Owner Company requirements
	Monitor continually Construction Contractor supplied jeeping / holiday detectors (instruments that use electricity to locate coating discontinuities) to ensure that detectors are set at correct voltage and have proper grounding
	Confirm that all coating defects are marked, repaired, and pipe sections re-jeeped before installing pipe
	Ensure that coating repairs are completed in accordance with the project coating standards and Manufacturer recommendations
	Ensure general housekeeping of coating related debris (e.g., gloves, brushes, rollers, containers, overspray) is maintained
	Identify situations that require specialized coating expertise for any items associated with the following: • Confirmation of qualifications of Coating Applicators • Confirmation of appropriate pre-heat temperatures around circumference of pipe • Confirmation that coatings are only applied within the surface, weather, and atmospheric requirements of Owner Company specifications and the Manufacturer's specifications • Confirm that surface cleanliness requirements are met prior to applying coating • Ensure that surface profile is checked for compliance with Owner Company specifications and recorded (i.e., anchor profile specifications (pipe surface roughness / pattern that achieves maximum coating adhesion)) • Identification of substandard quality of work • Examination of finished work for compliance with code, standards, specifications, and drawings • Interpretation of specifications and codes • Confirmation of any issues related to coating repair
	Ensure proper coating of fabricated materials that are to be installed below grade and / or will be pressurized
	Ensure paint colors are in accordance with Owner Company or project specifications
	Ensure minimum paint coverage and mill thickness is obtained



✓	Description
	Verify pot life of materials used is documented
	Verify dew point and ambient temperatures are measured and documented
	Verify stripe coating is completed, if required

8.5.6 Typical Outputs for Coating / Painting Inspection

Table 115: Typical Reporting Requirements

✓	Description
General	
	Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress
	Record holiday detector settings and calibration results per Owner Company forms
	Ensure completion of as-built red-lined drawings
Daily	

	Complete coating / painting progress reports, including:
	• Work completed to date, including:
	  ○ Coating / Painting Inspection Report, including:
	  ▪ Conditions of the coating / painting product containers
	  ▪ Number and types of coating / painting products
	  ▪ Names of the Manufacturers of coating / painting products
	  ▪ Color of coating / painting products
	  ▪ Batch and / or lot numbers of coating / painting products
	  ▪ Expiration date of coating / painting products in use
	  ▪ Pot life of materials used
	  ▪ Dew point and ambient temperatures
	  ▪ Holiday test voltages and results
	  ▪ Coating repair records
	  ▪ Surface anchor profiles
	  ▪ Dry film thickness of all layers in the coating system
	  ▪ Quality of workmanship
	  ○ Owner Company specific Coating / Painting Inspection Forms
	• Any and all specific daily reports required by the Owner Company
	• Document punch list items, as required

8.5.7 References – Coating / Painting

Note to user: The reference information provided in Table 116 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 ensure that the correct, and most current, documents are referenced as appropriate.

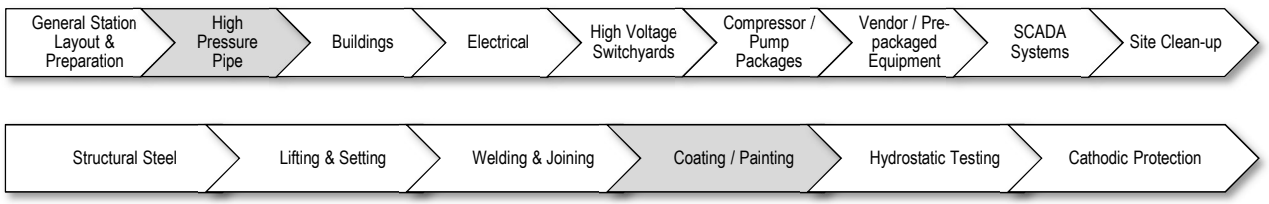
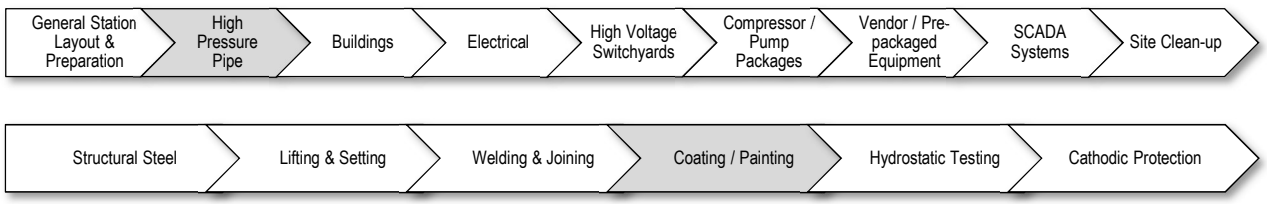


Table 116: List of References – Coating / Painting

Document No.	Type	Title
Canadian Standards Association (CSA)		
CSA Z245.20	Standard	Fusion Bond Epoxy (FBE) Coatings
CSA Z245.21	Standard	Polyethylene Coatings
CSA Z245.22	Standard	Polyethylene Foam Insulation Coatings
INGAA Foundation		
N/A	Action Plan / Best Practice	Field Applied Coatings Best Practices
NACE International		
NACE No. 1 / SSPC-SP 5	Standard	White Metal Blast Cleaning
NACE No. 2 / SSPC-SP 10	Standard	Near-White Metal Blast Cleaning
NACE No. 3 / SSPC-SP 6	Standard	Commercial Blast Cleaning
NACE No. 4 / SSPC-SP 7	Standard	Brush-off Blast Cleaning
NACE No. 8 / SSPC-SP 14	Standard	Industrial Blast Cleaning
NACE WJ-1 / SSPC-SP WJ-1	Standard	Waterjet Cleaning of Metals – Clean to Bare Substrate
NACE WJ-2 / SSPC-SP WJ-2	Standard	Waterjet Cleaning of Metals – Very Thorough Cleaning
NACE WJ-3 / SSPC-SP WJ-3	Standard	Waterjet Cleaning of Metals – Thorough Cleaning
NACE WJ-4 / SSPC-SP WJ-4	Standard	Waterjet Cleaning of Metals – Light Cleaning
NACE SP0185	Standard	Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE SP0188	Standard	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE SP0490	Standard	Holiday Detection of Fusion-Bonded Epoxy External Coatings of 250 to 760µm (10 to 30mil)
The Society for Protective Coatings (SSPC)		
SSPC-PA 2	Standard	Procedure for Determining Conformance to Dry Coatings Thickness
SSPC-SP 1	Standard	Solvent Cleaning
SSPC-SP 2	Standard	Hand Tool Cleaning
SSPC-SP 3	Standard	Power Tool Cleaning
SSPC-SP 11	Standard	Bare Metal Power Tool Cleaning



8.6 Hydrostatic Testing

8.6.1 Inputs

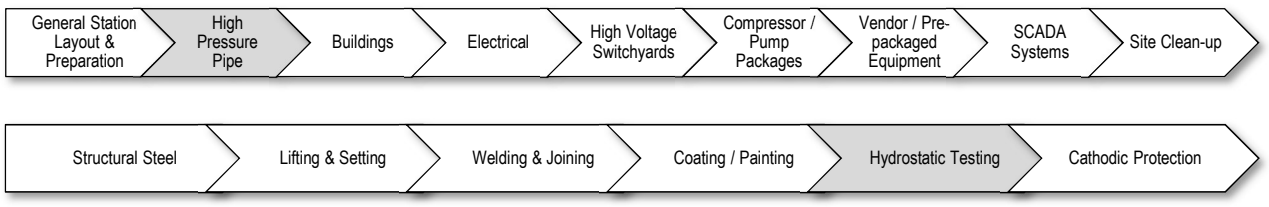
As part of preparing for inspection during the hydrostatic testing process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 118.

8.6.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will 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 117.

Table 117: Monitoring Requirements for Hydrostatic Testing – Mechanical

Item		Description	Reference
Prior to Commencing Work		• On a daily basis, ensure key issues that have been identified are detailed and addressed • Review and confirm all testing equipment has been certified as fully functional in advance of the testing operations • Monitor Contractor work to ensure that the test section is prepared (e.g., installation of test heads, cleaning, test water removal, and equipment use) to Owner Company specifications	Table 119
Safety		• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 120
Preparing for Pressure Test		• Ensure all required permits, plans, and calculations are approved and in place prior to commencing hydrostatic test operation	Table 121
Filling the Pipe		• Confirm pipe is filled as per Hydrostatic Test Plan	Table 122
Preparing for Pressurization		• Ensure all instrumentation and equipment is in place prior to pressuring the test section, including setting up a “Test Vehicle”	Table 123
Pressurization	Strength Test	• Proof of strength of installed pipe as per Hydrostatic Test Plan	Table 124
	Leak Test	• Follow controlled depressurization process from strength test to leak test	Table 125



Item	Description	Reference
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 to 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 Owner Company of further action • The Inspector will notify the Construction Manager / Chief Inspector (or designate) 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 126
Depressurizing	• Ensure depressurizing happens safely in preparation for dewatering and drying	Table 127
Dewatering	• Confirm dewatering happens in a manner consistent with environmental permits and approvals	Table 128
Test Head Removal / Replacement	• The Contractor will supply all materials, equipment, and personnel to remove test heads	Table 129
Drying	• In order to prevent internal corrosion, one of three methods of drying should be undertaken to the Owner Company's specifications (i.e., use of drying pigs, air drying, or methanol)	Table 130

8.6.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for hydrostatic testing inspection appear in Table 131.

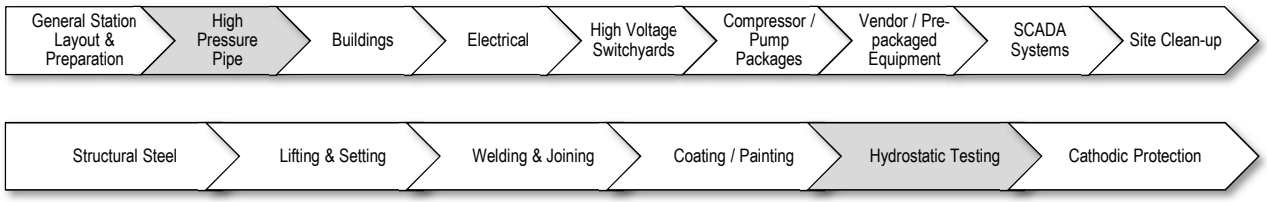
Detailed Checklists – Hydrostatic Testing

8.6.4 Typical Input Requirements for Hydrostatic Testing Inspection

Table 118: Information Requirements for Hydrostatic Testing

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to hydrostatic testing, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Isometric Drawings
	  ○ Line List (e.g., special concerns for each Land Owner); for Facility Piping, should include tabulated test pressures, duration, and radiography requirements
	• Pipeline Facility Drawings

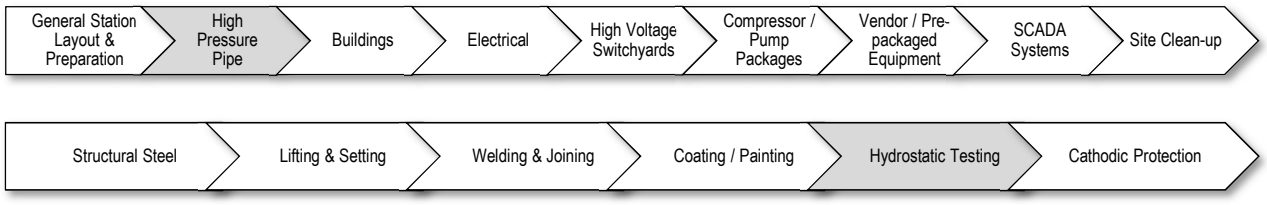


✓	Description
	• Hydrostatic Test Specification • Drawings specific to hydrostatic test
	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Specified Minimum Setback Distance for Personnel and Testing Equipment • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Emergency Contact List
	Other project specific Plans, which may include: • Hydrostatic Test Plan addressing (but not limited to) the following items: o Number of hydrostatic tests required o Site specific safety / hazards and appropriate analysis o Emergency Response Plan in the event of a rupture during the test o Testing personnel emergency contact list o Location of testing equipment o Types of discharge structures to be built and used o Volume of water required for each test o Test water sourcing, filling, pressurizing, depressurizing, and dewatering o Signage o The sequencing of hydrostatic tests o Test pressure calculations (i.e., test letter) o Minimum test head rating o Testing crew credentials o Test equipment list and capacities o Test schedule and sequence of tests o Instrumentation and their certification o Provision of protective berms around fuel storage used to supply fuel-driven line fill pumps (as required) o Leak Detection Mechanism / Plan (if required)

8.6.5 Best Practice Items for Inspecting Typical Hydrostatic Testing Operations

Table 119: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues



✓	Description
	• Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Confirm that the Hydrostatic Test Plan is approved
	Check that signage and contact information is posted and, if required, temporarily restrict access points
	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 / or permits are in place
	Confirm that the schedule will allow for the full length of strength and leak tests from start to completion
	Ensure water source volumes and flow rates are sufficient for the test sections and meet regulatory conditions
	Prior to and upon completion of a hydrostatic test, ensure that the local authorities are alerted
	Check all testing equipment certification (e.g., pressure recorders, test weights, calibration dates) and ensure a copy of the certification documents are on site
	Verify that all flanges are torqued or tensioned
	Verify whip checks are in place on all high pressure hose connections
	Verify appropriate valve types are installed at pressure bleed locations (e.g., needle valves for slow release)
	Verify the contractor's test manifolds meet or exceed the rating of the material to be tested and the welds have been inspected by NDE
	Inspect the test caps, test manifolds, and valves for any gouges, dents, or other defects, and report to Construction Manager / Chief Inspector (or designate) if they are defective
	Verify all component pressure ratings are greater than the proposed test pressure
	Verify that all valves are between 1/3 open and 2/3 open, or as specified
	Ensure that during winter construction, hoarding (plastic insulation over a wood frame used to maintain temperature around an exposed section of pipe) and heating is installed for exposed test section ends where test heads are to be welded
	Confirm that the Environmental Inspector is collecting and sending fill water for laboratory testing so that results are available before filling
	Ensure that the discharge sample bottles are onsite
	Verify that the discharge structure is compliant
	Verify high point vents and low point drains are visible and accessible

Table 120: Safety Concerns for Hydrostatic Testing

✓	Description
	Confirm comprehensive safety / hazard requirements are covered in detail within the Hydrostatic Test Plan

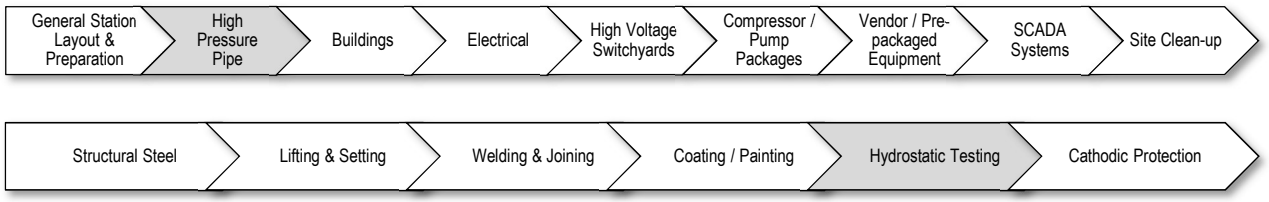
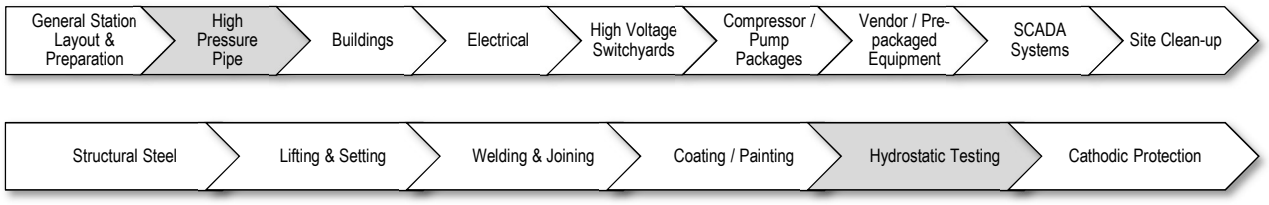


Table 121: Typical Monitoring Requirements for Preparing for Pressure Test

✓	Description
Test Section	
	Ensure that the final test pressure calculation sheet is signed and dated by the Owner Company 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 winter season) are in working order
	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 meter is installed on the fill water line connected to a test head
	Check that all hoses connecting to the instruments in the test vehicle are installed
	Ensure that supply and discharge lines are adequately anchored and supported
	Ensure that all other hoses are correctly installed and secure; monitor on an ongoing basis
	Check that lights / generators are in working order for testing during low light conditions
	Confirm that a portable laboratory for testing the water quality is available (if required)
Mobile Test Vehicle	
	Ensure that the test vehicle is supplied with the following: • Basic first aid supplies • Tables, chairs, lights, and heaters • 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 • Verify the serial numbers correspond to that identified on the certifications • Test system spare parts
	Ensure the Contractor will install a thermometer outside the test vehicle in the shade to measure the ambient temperatures during pressure testing

Table 122: Typical Monitoring Requirements for Filling the Pipe

✓	Description
	Ensure accuracy of the flow meter and / or flow totalizer are confirmed and any discrepancies are resolved prior to proceeding
	For winter testing of buried pipe, ensure any pre-heating requirements as identified in the Hydrostatic Test Plan are executed
	Check and record continually the total injected volume of water



✓	Description
	Monitor to ensure that the filling procedure, as specified in the Hydrostatic Test Plan, is followed

Table 123: Typical Monitoring Requirements for Preparing for Pressurization

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

Table 124: Typical Monitoring Requirements for Strength Test

✓	Description
	Ensure all instrument and equipment is installed and set as per Owner Company Hydrostatic Test Plan
	Confirm that established start and stop pressures are used
	Ensure that the pre-established pressure increase rate is maintained
	Ensure 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 pressure-time chart
	At the appropriate time, ensure 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 Owner Company
	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 125: Typical Monitoring Requirements for Leak Test

✓	Description
	Ensure 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 124

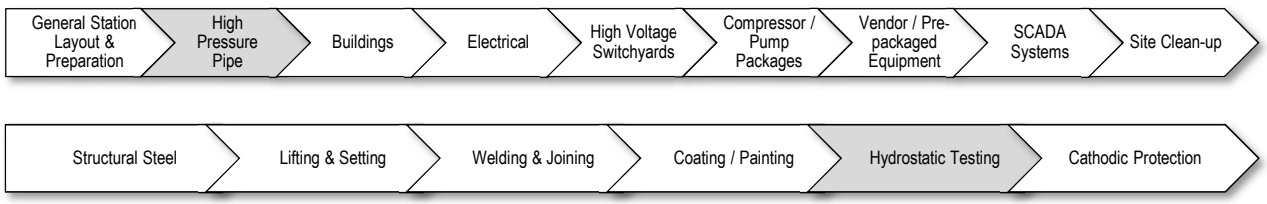


Table 126: Typical Monitoring Requirements for Leak or Failure Investigation

✓	Description
	Advise the Owner Company of further action in the event that the Contractor cannot locate a pipe leak or determine the cause of failure during hydrostatic testing through visual inspection
	Notify the Construction Manager / Chief Inspector (or designate) and work with the Contractor to develop a Leak Detection Plan and have it approved
	When a leak is discovered, ensure the Contractor repairs the leak per Owner Company specifications and other portions of this document are referenced prior to conducting the hydrostatic test again

Table 127: Typical Monitoring Requirements for Depressurizing

✓	Description
	Ensure that the Contractor does not start depressurizing until all required personnel are on site
	Confirm that the Contractor has taken all safety precautions before starting to depressurize the test section
	Check that the Contractor has secured the depressurizing piping to prevent vibration during pressure release
	Ensure that the Contractor is opening the test head slowly to protect it from shock-loading the pipe
	Ensure that the Contractor or other personnel does not, under any circumstance, open the bleed-off assembly fully

Table 128: Typical Monitoring Requirements for Dewatering

✓	Description
	Ensure that the Contractor does not start dewatering until all required personnel are on site
	Ensure that the Contractor dewaters to locations approved in the water permit or the Environmental Protection Plan (EPP)
	Ensure 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
	Confirm that the Contractor does not use mechanical connections on dewatering line
	Ensure that the Contractor installs an energy absorbing diffuser at the discharge end of the dewatering line to prevent erosion, bottom scour, or damage to vegetation

Table 129: Typical Monitoring Requirements for Test Head Removal / Replacement

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

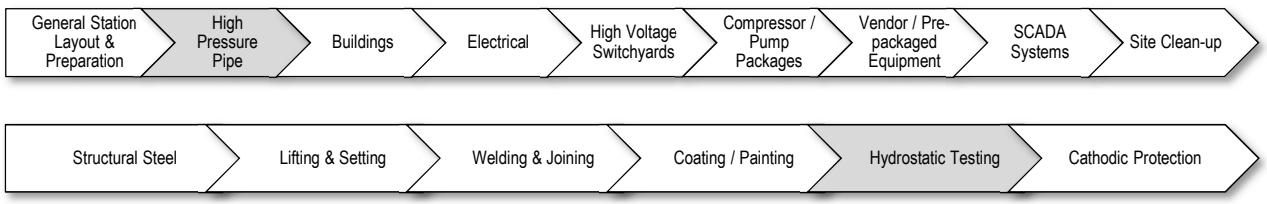


Table 130: Typical Monitoring Requirements for Drying

✓	Description
General	
	Confirm that drying method used by Contractor is consistent with Hydrostatic Test Plan requirements
	Ensure that Owner Company criteria for a “dry line” are met
	If the pipe will not be commissioned soon after drying, ensure the pipe is purged with dry nitrogen to meet Owner Company specifications
Air Drying	
	Ensure injected dried air relative humidity readings meet specifications
Methanol Wash	
	If Owner Company has specified methanol wash as the acceptable drying method, ensure specifications for injection, recovery, and disposal are followed

8.6.6 Typical Outputs for Hydrostatic Testing Inspection

Table 131: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Record all hydrostatic test calculations and results
	Complete Safety Hazard Observation Report
	Complete test head inspection documentation, if required
	Establish Pressure-Time Charts – Log the time and test section pressure
	Leak Check – Record results
	Strength Test – Fill out the strength test data log as required by Owner Company
Daily	
	Complete hydrostatic testing progress reports, including: • Any and all of the monitoring and inspection items as defined in previous tables within Section 8.6 Hydrostatic Testing • Any and all specific daily reports required by the Owner Company • Document punch list items, as required

8.6.7 References – Hydrostatic Testing

Note to user: The reference information provided in Table 132 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 ensure that the correct, and most current, documents are referenced as appropriate.

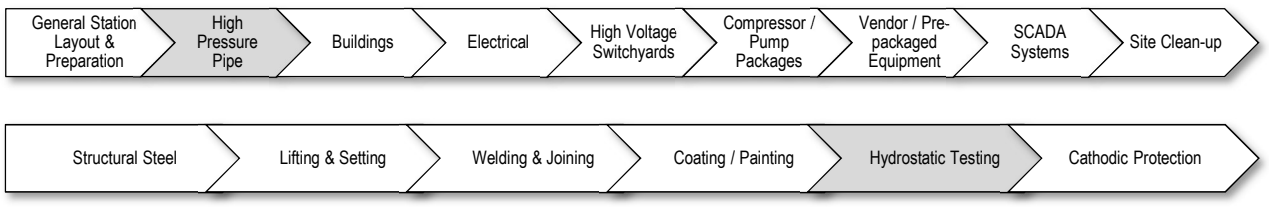
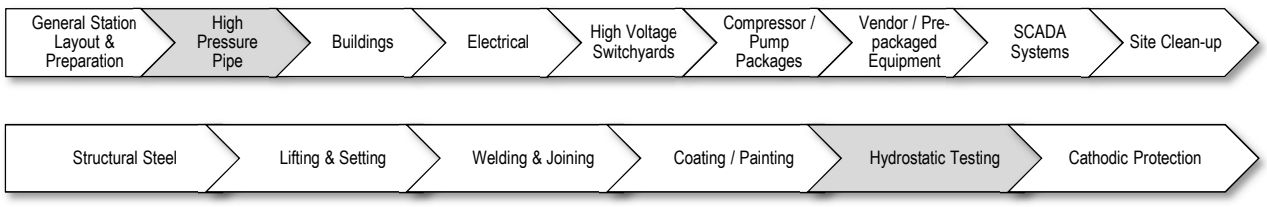


Table 132: List of References – Hydrostatic Testing

Document No.	Type	Title
American Petroleum Institute (API)		
API RP 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 Consensus Guidelines – Pressure Testing (Hydrostatic / Pneumatic) Safety Guidelines



8.7 Cathodic Protection

8.7.1 Inputs

As part of preparing for inspection during the cathodic protection process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 134.

8.7.2 Execution

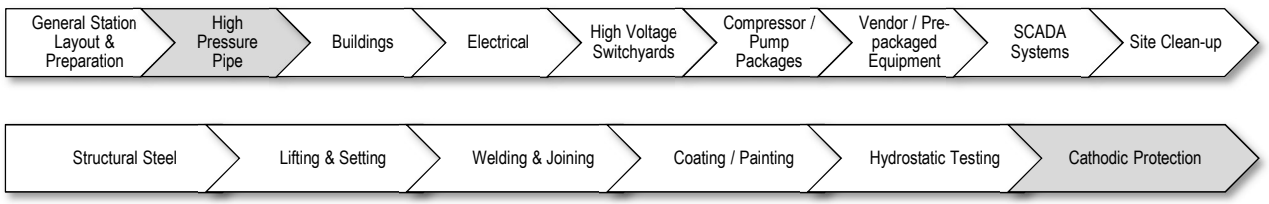
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the cathodic protection process are identified in a series of checklists as detailed in Table 133.

Table 133: Monitoring Requirements for Cathodic Protection – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 135
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 136
Cathodic Protection Installation	• Monitor the installation of cathodic protection systems for safety as well as adherence to Owner Company specifications. In particular, incorporate considerations for locating cathodic protection test stations such as: o Ease of accessibility of proposed installation location o Use of existing facilities (e.g., valve or scraper trap locations)	Table 137

8.7.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for cathodic protection inspection appear in Table 138.



Detailed Checklists – Cathodic Protection

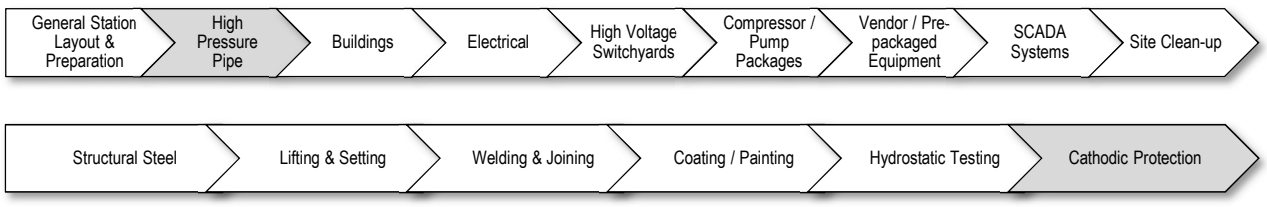
8.7.4 Typical Input Requirements for Cathodic Protection Inspection

Table 134: Information Requirements for Cathodic Protection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to cathodic protection, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	  ○ Ground Bed Installation Details
	  ○ Rectifier Installation Details
	  ○ Isolation Kit Installation Details
	• Cathodic Protection Installation Specifications
	• Cathodic Protection Testing Specifications
	• Third Party utility locations where CP 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
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS)
	Other project specific Plans, which may include: • Cathodic Protection and Installation



8.7.5 Best Practice Items for Inspecting Typical Cathodic Protection Operations

Table 135: Prior to Commencing Work

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

Table 136: Safety Concerns for Cathodic Protection Installation

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

Table 137: Typical Monitoring Requirements for Cathodic Protection Installation

✓	Description
	Ensure proper installation of cable connections with thermite welds
	Ensure installation of cathodic protection test stations as indicated on project drawings
	Ensure 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 / cable leading up to the junction box are reamed out to remove any burrs that may cause a short in test lead wires
	Ensure test leads are tested electrically after backfill to confirm that wire-to-pipe connections have not been broken
	Ensure that cathodic protection isolation points are properly installed

8.7.6 Typical Outputs for Cathodic Protection Inspection

Table 138: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete cathodic protection (CP) installation / test station report, including: • Number and Location of Test Station Installations • Continuity Test Results (i.e., upon backfilling to ensure test leads have not broken)
	Complete Third Party pipeline crossing report, including:

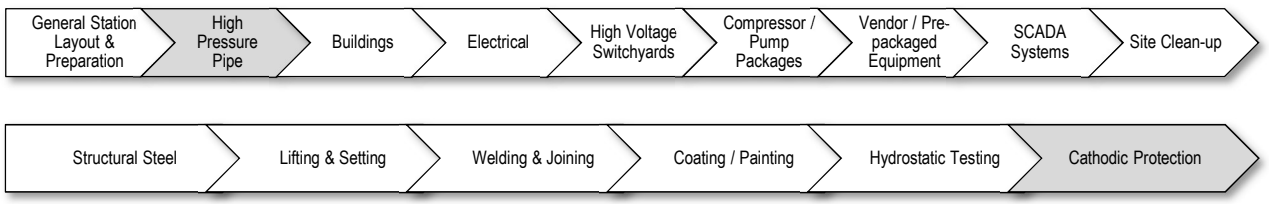
✓	Description
	• Survey Station Numbers at Crossings • Name of Third Party Pipeline Companies • Pipeline Size and Use • Type and Condition of Coating • Clearance Above or Below Pipeline • Distance from Nearest Third Party Rectifier • Type and Output from Third Party Rectifier • Pipe to Soil Readings at Crossing for Both Parties • If test leads are installed, Size and Color of Wire • Description of Location; Township, Range, Section, and Land Owner (tract number from alignment sheet) • Sketch of the Pipeline Crossing Showing Available Landmarks
Daily	
	Complete CP progress reports, including: • Document punch list items, as required

8.7.7 References – Cathodic Protection

Note to user: The reference information provided in Table 139 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 139: List of References – Cathodic Protection

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



9.0 BUILDINGS

9.1 Overview

Buildings, in the context of a facility, include all of the structures on the site regardless of whether they are used to house equipment or personnel.

Construction of buildings consists of the following major items during the construction of a facility:

- Foundations and Reinforced Concrete (refer to Section 7.7)
- Structural Steel
- Welding and Joining (refer to Section 8.4)
- Coating / Painting (refer to Section 8.5)
- Lifting and Setting
- Utility Power (AC Electrical Systems) (refer to Section 10.2)
- Heating, Ventilation, and Air Conditioning (HVAC)
- Fire Suppression and Domestic Systems
- Building Lighting

These items are presented within this section, roughly in sequence of construction.

Structural Steel

All buildings within a facility have a structural component that is typically steel, regardless of their function (i.e., housing equipment versus offices). At this point, the steel structure is erected along with the building envelope (i.e., external cladding). Vent bracing (used to prevent movement of the vent under blowdown conditions) is considered to be structural steel. At this point, associated joints and connections of structural steel are also inspected.

Lifting and Setting

Lifting and setting involves the placement of pre-fabricated buildings and structural steel onto foundations or into excavations. This activity requires specialized lifting equipment, trained Operators, and pre-planning.

Heating, Ventilation, and Air Conditioning (HVAC)

HVAC systems are installed to provide an appropriate environment (e.g., temperature, air quality) for both workers and equipment within a facility. The bulk of the inspection activity is focused on the Mechanical discipline.

Fire Suppression and Domestic Systems

Fire suppression and domestic systems are typically some of the last items installed during building construction. Fire suppression systems are installed in order to extinguish or prevent the spread of potential fires in buildings, with the bulk of the inspection activity focused on the Electrical discipline.

Domestic systems include domestic water and sanitary sewer systems within buildings, with the bulk of the inspection activity focused on the Mechanical discipline. Domestic water is water supplied to buildings for indoor and outdoor use. Sanitary sewer systems essentially contain the building sanitary drain line, holding and processing tanks, and field percolation system (if required).

Building Lighting

Building and yard lighting provide adequate illumination to perform tasks safely in hazardous and non-hazardous environments. In the event that failure of normal lighting can pose a hazard to personnel or interfere with plant operations, emergency lighting is provided. The bulk of the inspection activity is focused on the Electrical discipline.

9.2 Structural Steel

9.2.1 Inputs

As part of preparing for inspection during the structural steel construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 141.

9.2.2 Execution

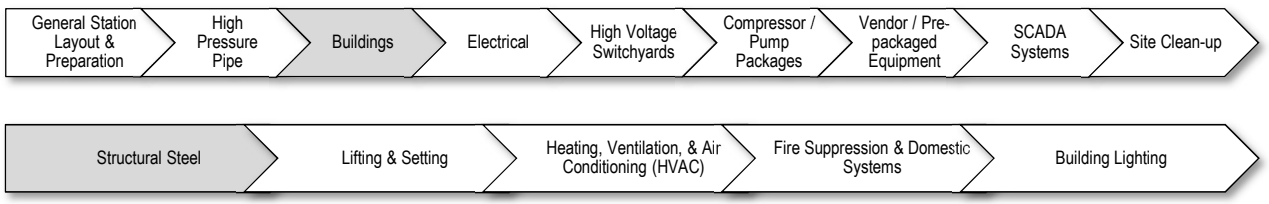
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the structural steel construction process are identified in a series of checklists as detailed in Table 140.

Table 140: Monitoring Requirements for Structural Steel

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 142
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 143
Civil		
Foundations and Reinforced Concrete Construction	• Previously discussed monitoring requirements associated with foundations and reinforced concrete construction	Section 7.7
Structural Steel Construction	• Monitoring requirements associated with structural steel, ensuring the installation conforms to the design	Table 144
Civil, Mechanical, Electrical (All Disciplines)		
Welding and Joining Operations	• Previously discussed monitoring requirements associated with welding and joining operations	Section 8.4
Coating / Painting Operations	• Previously discussed monitoring requirements associated with coating / painting operations	Section 8.5

9.2.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for structural steel inspection appear in Table 145.



Detailed Checklists – Structural Steel

9.2.4 Typical Input Requirements for Structural Steel Inspection

Table 141: Information Requirements for Structural Steel Inspection

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to structural steel, such as: • Issued for Construction (IFC) Drawings • Fabrication Shop Drawings • Structural Steel Specifications • Building Specifications • Construction Specifications • Manufacturer Specifications and Drawings
	Contracts and agreements related to: • Fabrication and Erection of Buildings • Municipal / County Permits and Inspection (if applicable)
	Owner Company specific Safety Plan, including (but not limited to): • Working at Elevations • Lift Plan
	Other project specific Plans, which may include: • Traffic Management Plan

9.2.5 Best Practice Items for Inspecting Typical Structural Steel Construction

Table 142: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all structural steel members are piece marked in accordance with Fabrication Shop Drawings

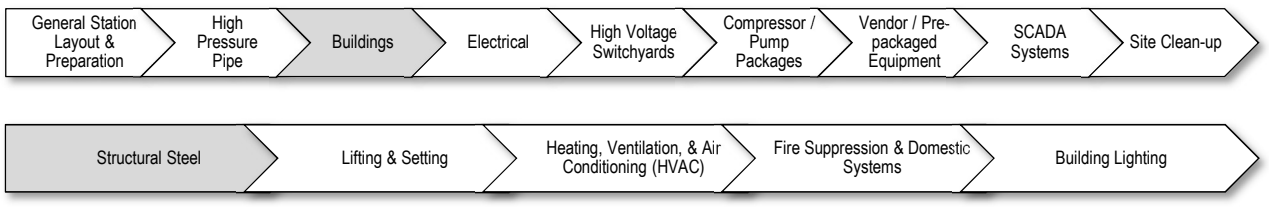
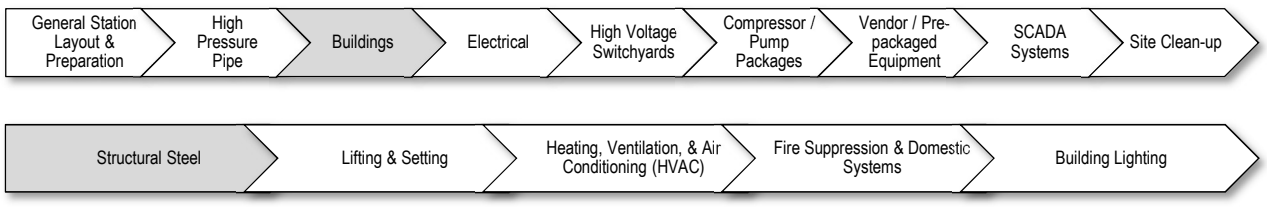


Table 143: Safety Concerns for Structural Steel Construction

✓	Description
	Ensure that safe means are provided for worker access to erect buildings, including man lifts, scaffolding, and ladders
	Ensure structures are not loaded with weight that endangers design integrity
	Ensure erection steel is adequately braced until permanently connected and self-supporting
	Ensure that work areas have proper housekeeping and that debris and hazards are promptly removed

Table 144: Typical Monitoring Requirements for Structural Steel Construction

✓	Description
	Ensure that joint surfaces are free from loose mill scale, dirt, oil, burrs, pits, or other defects that prevent solid seating
	Ensure structural steel is installed in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings
	Confirm that erection bolts are removed and replaced with specified bolts and nuts
	Ensure bolts and nuts are adequately torqued / tensioned and documented
	Ensure doors, windows, and flashing are properly installed
	Ensure roof and wall insulation and panels are properly installed
	Ensure framed openings in building walls are properly installed
	Ensure cut-outs for appurtenances, including pipe or tubing, are properly performed
	Ensure building is weathertight, including proper installation, fitting, and sealing of all roofing, siding, flashing, trim, windows, doors, and roof and wall penetrations are sealed on both interior and exterior walls
	Ensure eaves, ridge caps, and gutter lap flanges are sealed with closure strips matching the profile of the siding or roofing material and all areas, including but not limited to corner trim, are bird-proofed
	Ensure steel gutters and downspouts are properly installed
	Ensure floor plates and grating, including field cut-outs for pipe, conduit / cable, and equipment penetrations, are properly installed
	Ensure doors are keyed to Owner Company's standard key and equipped with anti-panic hardware and closure
	Ensure all structural steel members, window frames, and doors are thoroughly cleaned and shop coated
	Ensure all pre-painted surfaces damaged during construction are repaired
	Ensure all galvanized surfaces damaged during construction are coated
	Ensure skid-mounted buildings are leveled and properly secured to the foundation
	Ensure field modifications to fabricated steel for major structural framing members are approved by the building Manufacturer
	Ensure interior gutters, used to prevent drains from freezing, are welded at the seams
	Ensure continuous ridge ventilators, including bird screen and damper, are properly installed
	Ensure vents and vent fans are properly installed
	Ensure inlet air louvers and screens are properly installed
	Ensure bridge cranes, trolleys, and hoists are properly installed



✓	Description
	Ensure platforms and elevated structures are properly installed
	Ensure welding is completed in accordance with Section 8.4 Welding and Joini

9.2.6 Typical Outputs for Structural Steel Inspection

Table 145: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

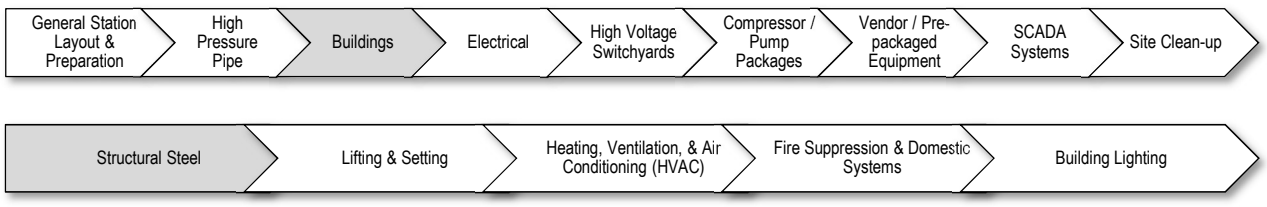
	Complete structural steel progress reports, including:
	• Work completed to date, including:
	  ○ Number and location of structural steel members erected
	  ○ Description and location of placed structural steel
	  ○ Progress on installation of internal and external cladding
	  ○ Progress on installation of doors and windows
	  ○ Descriptions of buildings set on foundations (e.g., metering building / skid)
	  ○ Descriptions of facilities where vent bracing has been installed
	• Document punch list items, as required

9.2.7 References – Structural Steel

Note to user: The reference information provided in Table 146 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 146: List of References – Structural Steel

Document No.	Type	Title
American Institute of Steel Construction (AISC)		
AISC 206	Standard	Certification Program for Structural Steel Erectors
AISC 207	Standard	Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 325	Handbook	Steel Construction Manual
American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)		

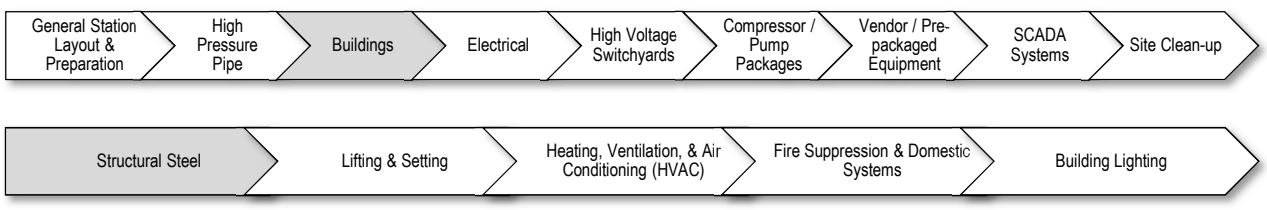


Document No.	Type	Title
ANSI / AISC 303	Standard	Code of Standard Practice for Steel Buildings and Bridges
ANSI / AISC 360	Specification	Specification for Structural Steel Buildings
American Society for Testing and Materials (ASTM)		
ASTM A36	Specification	Standard Specification for Carbon Structural Steel
ASTM A123	Specification	Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	Specification	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	Specification	Standard Specification for Carbon and Alloy Steel Nuts
ASTM F3125	Specification	Standard Specification for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength
N/A	Standard	Selected ASTM Standards for Structural Steel Fabrication
American Society of Civil Engineers (ASCE)		
ASCE 7	Standard	Minimum Design Loads for Buildings and Other Structures
Canadian Institute of Steel Construction (CISC)		
N/A	Recommended Practice	Code of Standard Practice
N/A	Handbook	Handbook of Steel Construction
Canadian Standards Association (CSA)		
CSA G40.20 / G40.21	Standard	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CSA G164	Standard	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA S16	Standard	Design of Steel Structures
CSA S136	Specification	North American Specification for the Design of Cold-Formed Steel Structural Members
International Code Council (ICC)		
N/A	Standard	The International Building Code (IBC) [1]
National Research Council Canada (NRC)		
N/A	Standard	The National Building Code of Canada (NBC) [1]
Research Council on Structural Connections (RCSC)		

Document No.	Type	Title
N/A	Specification	Specification for Structural Joints Using High-Strength Bolts

Note(s):

1) Provincial / Territorial and / or State Building Codes govern, where applicable



9.3 Lifting and Setting

9.3.1 Inputs

As part of preparing for inspection during the lifting and setting process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 148.

9.3.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the lifting and setting process are identified in a series of checklists as detailed in Table 147.

Table 147: Monitoring Requirements for Lifting and Setting – Mechanical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 149
Safety	Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 150
Lifting and Setting	• Monitor lifting and setting operations for safety and ensure that no damage occurs to the buildings or structural steel	Table 151

9.3.3 Outputs

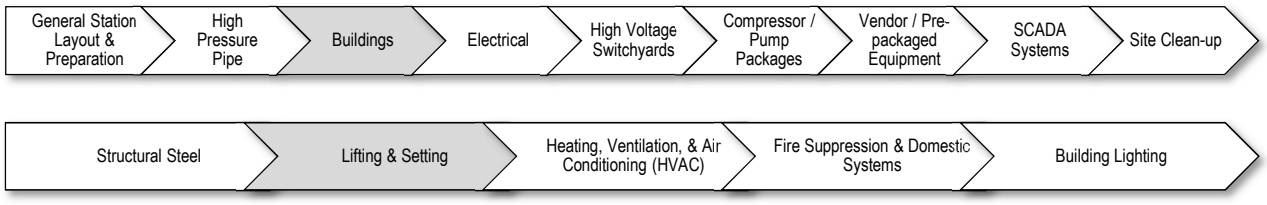
The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for lifting and setting inspection appear in Table 152.

Detailed Checklists – Lifting and Setting

9.3.4 Typical Input Requirements for Lifting and Setting Inspection

Table 148: Information Requirements for Lifting and Setting

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to lifting and setting, such as: • Issued for Construction (IFC) Drawings • Equipment Manufacturer Specifications and Drawings • Lifting Equipment Specifications and Drawings

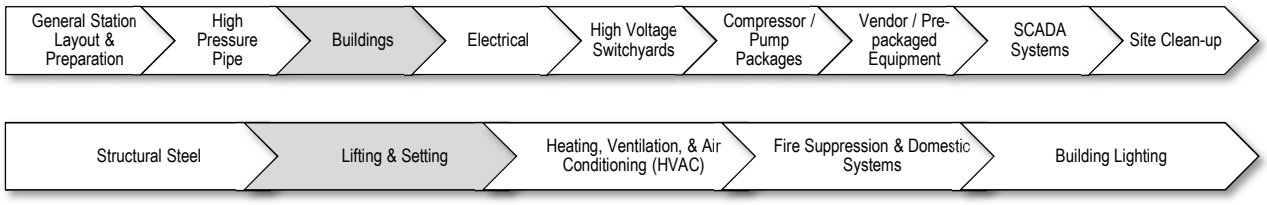


✓	Description
	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Heavy Lift Plan • Lock-out / Tag-out Procedures
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Relevant Contingency Plans • Loading, Securing, and Rigging Practices

9.3.5 Best Practice Items for Inspecting Typical Lifting and Setting Operations

Table 149: 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) • Facility 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 lifting and setting to make sure all personnel involved are aware of: • Lifting sequence • Critical lift circumstances • Equipment size and numbers • Individual roles and responsibilities • Weather restrictions (e.g., wind, lightning)
	Verify qualifications and training certificates of all Crane Operators and Riggers to ensure they are competent and trained
	Verify the weight of the load, confirm equipment is certified (e.g., cranes, forklifts), and lifting components can withstand load limits / weight requirements
	Confirm spreader bars, slings, belts, cradles, etc. have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and ensure their suitability for lifting to avoid equipment damage



✓	Description
	Inspect spreader bars, slings, belts, cradles, etc. visually for damage
	Confirm that floor slabs on which the crane may sit have cured adequately†
	Confirm that building foundations have cured and grout preparations have been completed†

† From API RP 686 Recommended Practice for Machinery Installation and Installation Design. Copyright © 2009 American Petroleum Institute. Used with permission.

Table 150: Safety Concerns for Lifting and Setting

✓	Description
	Ensure a job safety analysis (JSA) is conducted and strictly adhered to throughout lifting and setting operations
	Ensure that the JSA is updated as required
	Ensure Equipment Operators use spotters while backing up and traversing near or under powerlines and overhead hazards
	Ensure that personnel are never allowed between the suspended load and an obstacle, which could result in a pinch point safety hazard
	Ensure loads are not suspended over workers
	Ensure barricades, fencing, etc. are in place prior to lifting and setting to properly rope off the swing radius
	Ensure lighting is adequate for the entire period of the lift (light kits and generators may be required)
	Ensure the entire lift sequence can be undertaken in safe weather conditions (i.e., no lightning or high winds)

Table 151: Typical Monitoring Requirements for Lifting and Setting

✓	Description
	Ensure lifting is secured from specified lifting points
	Review and amend the job safety analysis (JSA), tailgate documents, and Lift Plan if there has been any deviation
	Ensure that lifting equipment is labelled for maximum capacity
	Ensure the use of approved safety latches on all lifting hooks
	Ensure the use of tag lines when required
	Confirm presence of designated signal person using proper hand signals
	Ensure the Contractor has a rigging control in place and removes and destroys all defective rigging
	Ensure lifting equipment is placed on level ground
	Ensure 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 distributes load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes
	Ensure suspended load never swings or rubs against any obstacles or equipment, and is not dropped or subjected to jarring or sudden impacts

9.3.6 Typical Outputs for Lifting and Setting Inspection

Table 152: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

	Complete lifting and setting progress reports, including:
	• Work completed to date, including:
	  ○ Description and location of placed buildings or structural steel
	  ○ Any damage incurred during lifting and setting
	• Document punch list items, as required

9.3.7 References – Lifting and Setting

Note to user: The reference information provided in Table 153 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 153: List of References – Lifting and Setting

Document No.	Type	Title
American Society of Mechanical Engineers (ASME)		
ASME B30.05	Standard	Mobile Cranes
ASME B30.14	Standard	Sideboom Cranes
ASME B30.2	Standard	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
Canadian Standards Association (CSA)		
CSA B167	Standard	Overhead Cranes, Gantry Cranes, Monorails, Hoists, and Jib Cranes

9.4 Heating, Ventilation, and Air Conditioning (HVAC)

9.4.1 Inputs

As part of preparing for inspection during the HVAC installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 155.

9.4.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the HVAC installation process are identified in a series of checklists as detailed in Table 154.

Table 154: Monitoring Requirements for HVAC – Mechanical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 156
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 157
HVAC Installation	• Monitoring requirements associated with HVAC, ensuring the installation conforms to the design	Table 158

9.4.3 Outputs

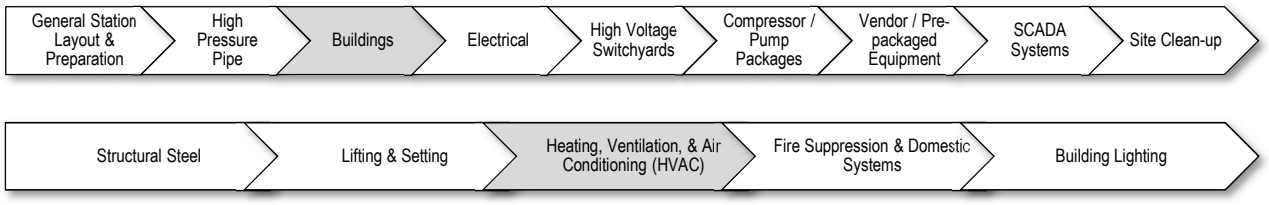
The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for HVAC inspection appear in Table 159.

Detailed Checklists – HVAC

9.4.4 Typical Input Requirements for HVAC Inspection

Table 155: Information Requirements for HVAC Inspection

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to HVAC, such as: • Issued for Construction (IFC) Drawings • Manufacturer Specifications
	Contracts and agreements related to: • HVAC Performance Standards



✓	Description
	• Municipal / County Permits and Inspection (if applicable)
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

9.4.5 Best Practice Items for Inspecting Typical HVAC Installation

Table 156: Prior to Commencing Work

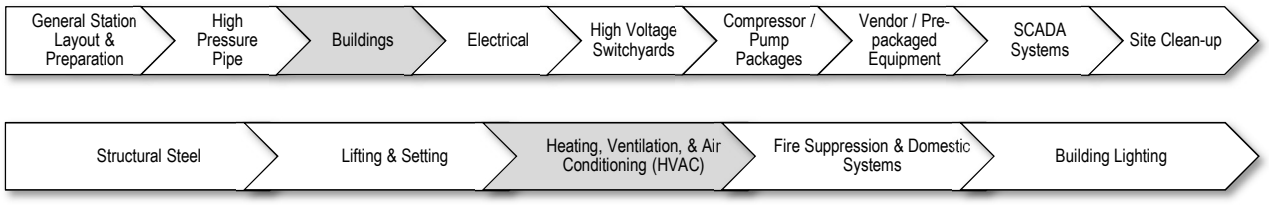
✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling

Table 157: Safety Concerns for HVAC Installation

✓	Description
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

Table 158: Typical Monitoring Requirements for HVAC Installation

✓	Description
	Ensure correct size, configuration, location, and orientation of ductwork
	Ensure ductwork insulation is acceptable and joints sealed
	Ensure correct size, type, location, and application of gaskets
	Ensure correct type, installation, and operation of ducting hardware
	Ensure unit is properly mounted and securely fastened, such that connections are tight and there are no loose items that may vibrate or work loose
	Verify all shipping braces, shipping gags, and temporary coverings (e.g., plastic wrap, plywood covers) have been removed
	Ensure unit is properly cleaned of loose dirt and debris, if needed, particularly near fans and inside ducts
	Ensure all parts that typically ship loose (e.g., filters, guards, hoods, belts) are properly installed



✓	Description
	Verify electric motors and fan bearings are lubricated per Manufacturer specifications, if required
	Ensure fan motors are tight and fan spins freely with adequate clearance (i.e., no contact with guards)
	Ensure belts on belt driven motors are tight and free of damage such as cuts or wear marks
	Verify drain pipe installation is complete, if equipped
	Confirm proper operation of dampers (i.e., free range of motion with no binding)
	Verify size, rating, and proper installation of circuit and power cable feeding HVAC unit
	Verify correct installation of all external devices (e.g., thermostats, controllers, remote controls, indicating devices)
	Ensure there is no physical damage to pipe or equipment by visually inspecting the HVAC system
	Ensure adequate containment and absorbents if a static check includes the adding or draining of fluid
	Ensure preservation oil in the casing of equipment (e.g., gearboxes, pumps) is removed and replaced with oil per Manufacturer specifications
	Ensure vibration supports are installed under the compressor / pump to absorb vibration and reduce noise reverberating in the air conditioner cabinet
	Ensure enclosure access door seals and panels are not damaged or hanging off
	Ensure no binding of louvers when manually opening and closing
	Verify damper position indicator and linkage is properly set per Manufacturer specifications
	Ensure weighted dampers have the adjustable weight secured
	Ensure drain lines are properly installed on both evaporator and condenser
	Ensure water trap is properly installed on condenser
	Verify directional arrows indicating correct direction of rotation are installed on both motor and driven equipment
	Ensure belts and couplings are removed to perform a rotational check on motors
	Ensure tension on belts is adjusted without over-tightening prior to energization, after a no-load test is complete (if required)
	Ensure damper blades are adjusted, if required, so each damper blade closes at the same time for a tight seal
	Ensure fins are not bent or restricting air flow through the unit when inspecting coils
	Ensure weather hood is properly installed, caulked, and flashed to prevent moisture from entering the building
	Ensure bird screen is properly installed
	Ensure unit is properly tagged
	Ensure system leak test and / or pressure test is completed
	Ensure air flow test is completed
	Ensure temperature controls are calibrated and tested

9.4.6 Typical Outputs for HVAC Inspection

Table 159: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete HVAC test reports, including: • Leak / Pressure Test Records • Air Flow Test Records • Temperature Control Calibration and Test Records
Daily	
	Complete HVAC progress reports, including: • Work completed to date, including: ○ System Performance Standards • Document punch list items, as required

9.4.7 References – HVAC

Note to user: The reference information provided in Table 160 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 160: List of References – HVAC

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		

9.5 Fire Suppression and Domestic Systems

9.5.1 Inputs

As part of preparing for inspection during the fire suppression and domestic systems installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 162.

9.5.2 Execution

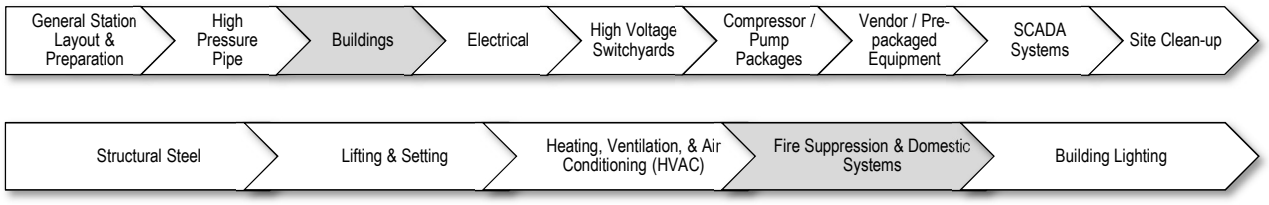
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the fire suppression and domestic systems installation process are identified in a series of checklists as detailed in Table 161.

Table 161: Monitoring Requirements for Fire Suppression and Domestic Systems

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 163
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 164
Mechanical		
Domestic Water Installation	• Monitoring requirements associated with domestic water, ensuring the installation conforms to the design	Table 165
Sanitary Sewer Systems Installation	• Monitoring requirements associated with sanitary sewer systems, ensuring the installation conforms to the design	Table 166
Electrical		
Fire Suppression Systems Installation	• Monitoring requirements associated with fire suppression systems, ensuring the installation conforms to the design	Table 167

9.5.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for fire suppression and domestic systems inspection appear in Table 168.



Detailed Checklists – Fire Suppression and Domestic Systems

9.5.4 Typical Input Requirements for Fire Suppression and Domestic Systems Inspection

Table 162: Information Requirements for Fire Suppression and Domestic Systems Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to fire suppression and domestic systems, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Plot Plans
	  ○ Line List (e.g., special concerns for each Land Owner)
	  ○ Fire and Gas Plans and Details
	• Piping Specifications
	• Electrical Specifications

	Contracts and agreements related to: • Water Utility Requirements • Potable Water Standards • Municipal / County Codes and Requirements (e.g., for drilling wells) • Municipal / County Permits and Inspection (if applicable)
	Owner Company specific Safety Plan, including (but not limited to): • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

9.5.5 Best Practice Items for Inspecting Typical Fire Suppression and Domestic Systems Installation

Table 163: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure local jurisdictional inspections are completed in accordance with permit requirements
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling

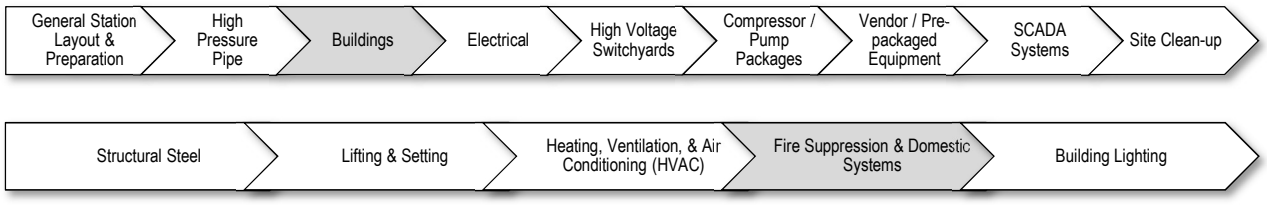


Table 164: Safety Concerns for Fire Suppression and Domestic Systems Installation

✓	Description
	Identify and monitor hazardous situations associated with installation of oxygen suppression systems

Table 165: Typical Monitoring Requirements for Domestic Water Installation – Mechanical

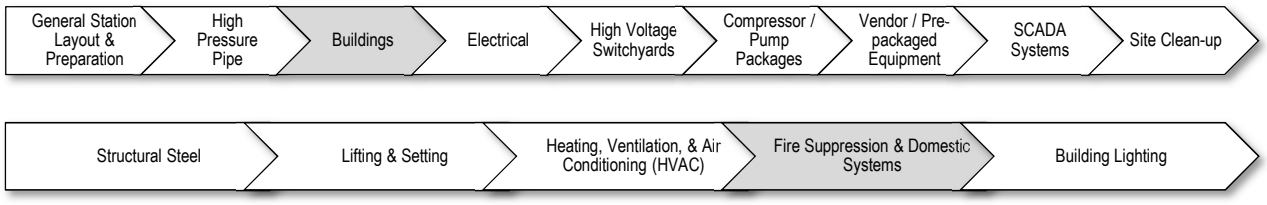
✓	Description
	Verify location of water well
	Ensure tag numbers are in accordance with Issued for Construction (IFC) Drawings
	Verify nameplate data against IFC Drawings
	Check anchor bolts for proper support and tightness
	Check pipe configuration in accordance with Piping Specifications and IFC Drawings
	Monitor leak test of pipe in accordance with line list and record results
	Monitor cleaning of pipe to remove all contaminants
	Ensure correct installation of all valves

Table 166: Typical Monitoring Requirements for Sanitary Sewer Systems Installation – Mechanical

✓	Description
	Verify layout of sanitary sewer system
	Ensure below grade concrete products have been properly damp proofed
	Ensure sewer pump has been adjusted for proper flow
	Ensure sewage system, including septic tank and disposal field, is inspected before it is backfilled (in accordance with Section 7.8 Backfilling)

Table 167: Typical Monitoring Requirements for Fire Suppression Systems Installation – Electrical

✓	Description
	Ensure tag numbers are in accordance with Issued for Construction (IFC) Drawings
	Ensure correct instrument installation
	Monitor calibration of instruments and verify software
	Ensure correct installation of instrumentation wiring loops
	Monitor calibration of instrumentation wiring loops
	Monitor calibration of fire and gas end devices



9.5.6 Typical Outputs for Fire Suppression and Domestic Systems Inspection

Table 168: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete Water Quality Report
Daily	

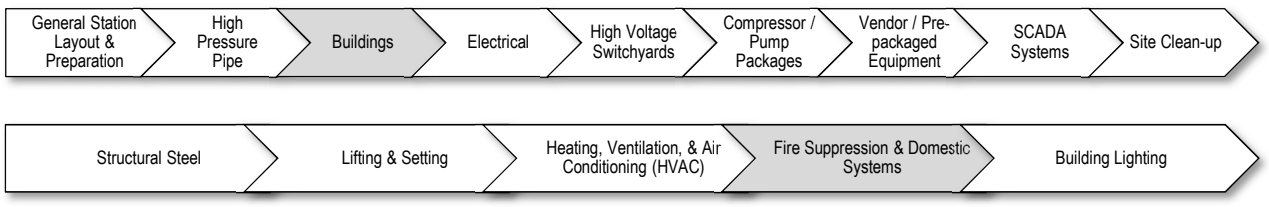
	Complete fire suppression and domestic systems progress reports, including:
	• Work completed to date, including:
	  ○ Domestic Water Leak Test Records
	  ○ Fire Suppression Instrumentation Calibration Record Forms
	• Document punch list items, as required

9.5.7 References – Fire Suppression and Domestic Systems

Note to user: The reference information provided in Table 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 169: List of References – Fire Suppression and Domestic Systems

Document No.	Type	Title
National Fire Protection Association (NFPA)		
NFPA 11	Standard	Standard for Low-, Medium-, and High-Expansion Foam
NFPA 14	Standard	Standard for the Installation of Standpipe and Hose Systems
NFPA 16	Standard	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 24	Standard	Standard for the Installation of Private Fire Service Mains and their Appurtenances
NFPA 25	Standard	Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems



9.6 Building Lighting

9.6.1 Inputs

As part of preparing for inspection during the building lighting installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 171.

9.6.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor during the building lighting installation process are identified in a series of checklists as detailed in Table 170.

Table 170: Monitoring Requirements for Building Lighting – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 172
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 173
Building Lighting Installation	• Monitoring requirements associated with building lighting, ensuring the installation conforms to the design	Table 174

9.6.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for building lighting inspection appear in Table 175.

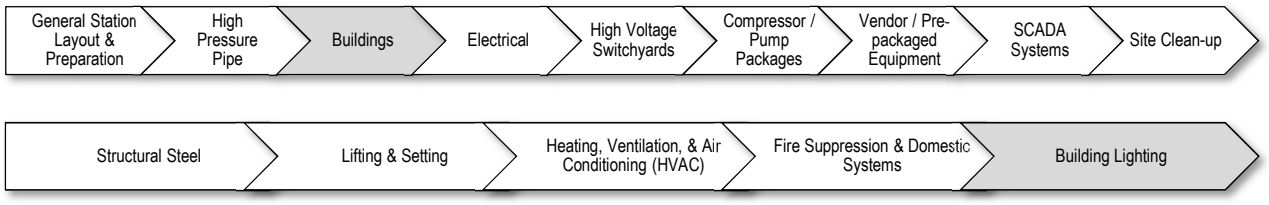
Detailed Checklists – Building Lighting

9.6.4 Typical Input Requirements for Building Lighting Inspection

Table 171: Information Requirements for Building Lighting Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to building lighting, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Single Line Diagrams
	  ○ Panel Schedules
	  ○ Panel Assemblies



✓	Description
	○ Wiring Diagrams ○ Lighting Plans, Sections, and Details ○ Conduit / Cable Schedules • Electrical Specifications • Lighting Specifications • Electrical Vendor Drawings • Manufacturer Specifications • Routing Plans
	Contracts and agreements related to: • Electrical Work ○ All Electricians' qualifications records to specific applicable processes • Building Lighting Installation
	Owner Company specific Safety Plan, including (but not limited to): • Requirements for Personal Protective Equipment (PPE) • Lock-out / Tag-out Procedures
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

9.6.5 Best Practice Items for Inspecting Typical Building Lighting Installation

Table 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) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all material markings and tag numbers are in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and Manufacturer's name

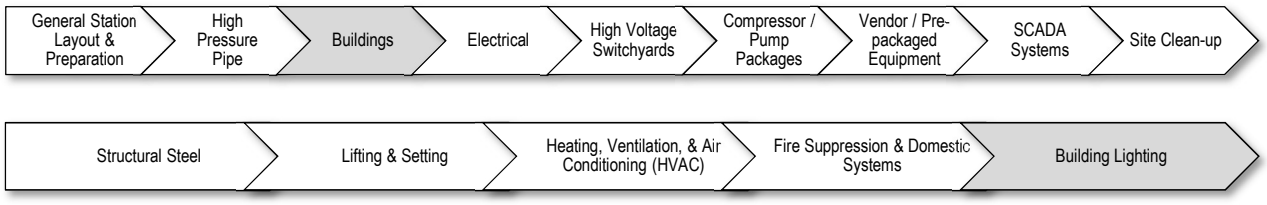


Table 173: Safety Concerns for Building Lighting Installation

✓	Description
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

Table 174: Typical Monitoring Requirements for Building Lighting Installation

✓	Description
	Ensure lighting branch circuits are properly identified at the breaker panels
	Ensure light fixtures, globes, guards, and reflectors are properly installed and there are no obstructions to lamp output
	Ensure proper grounding of lighting system
	Ensure lamps of correct voltage and wattage are installed in each fixture
	Check all lighting circuits to confirm lights are functional
	Ensure actual installed lighting intensity levels meet the design intensity levels
	Ensure proper operation of emergency lighting system when interrupting normal lighting power
	Ensure mounting and supports are secure

9.6.6 Typical Outputs for Building Lighting Inspection

Table 175: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	
	Complete building lighting progress reports, including: • Work completed to date, including: ○ Number and Location of Light Fixtures Installed • Document punch list items, as required

9.6.7 References – Building Lighting

Note to user: The reference information provided in Table 176 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 ensure that the correct, and most current, documents are referenced as appropriate.

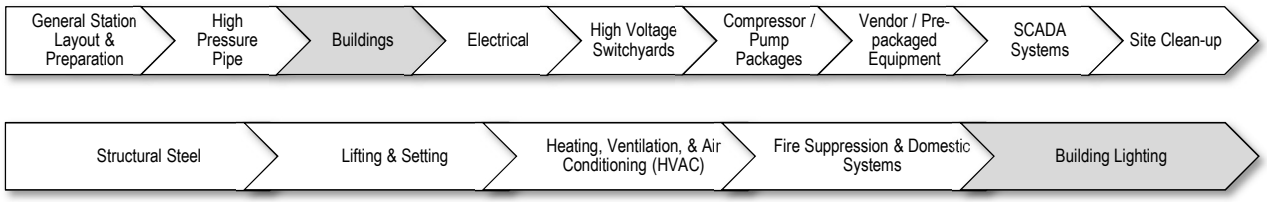
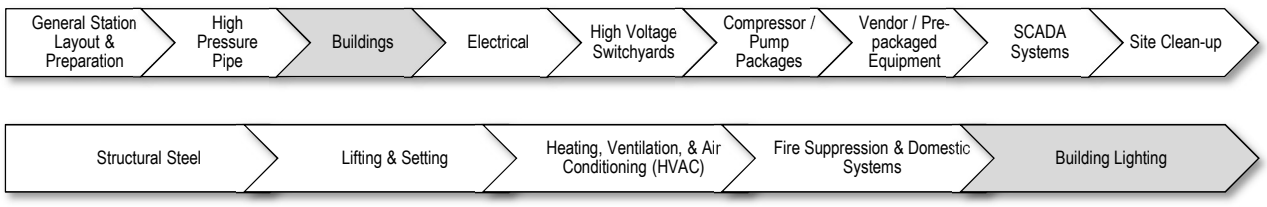


Table 176: List of References – Building Lighting

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		



10.0 ELECTRICAL

10.1 Overview

Low voltage electrical systems and controls are typically installed as part of the construction stage after the erection of buildings and their components.

Electrical installation consists of the following major items during the construction of a facility:

- Alternating Current (AC) Electrical Systems
- Electrical Controls and Instrumentation
- Grounding

Alternating Current (AC) Electrical Systems

AC electrical systems (e.g., utility power) include but are not limited to the following main components:

- Distribution Panels
- Transformers
- Motor Control Centers (MCCs)
- Automatic Transfer Switches
- Uninterruptible Power Supply (UPS)
- Motors
- Standby Generators
- Lighting

Electrical Controls and Instrumentation

All facilities have varying levels of electrical controls and instrumentation. Most controls are electrical in nature, both AC and DC, and may also include pneumatics such as compressed air or natural gas. Electrical controls and instrumentation are vital components used in Supervisory Control and Data Acquisition (SCADA) and / or Human-Machine Interface (HMI) systems.

Grounding

Grounding is a safety measure where electrically operated equipment is connected to the earth as a means of reducing electrical hazards to workers due to potentially dangerous conditions (e.g., short circuits). The station grounding system consists of the existing station grounding and any additional grounding loops.

10.2 Alternating Current (AC) Electrical Systems

10.2.1 Inputs

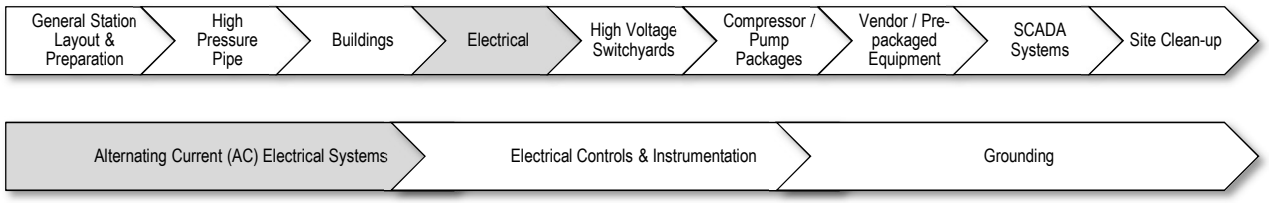
As part of preparing for inspection during the AC electrical systems installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 178.

10.2.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the AC electrical systems installation process are identified in a series of checklists as detailed in Table 177.

Table 177: Monitoring Requirements for AC Electrical Systems – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 179
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 180
Distribution Panels	• Monitoring requirements associated with distribution panels, ensuring the installation conforms to the design	Table 181
Transformers	• Monitoring requirements associated with transformers, ensuring the installation conforms to the design	Table 182
Motor Control Centers (MCCs)	• Monitoring requirements associated with MCCs, ensuring the installation conforms to the design	Table 183
Automatic Transfer Switches	• Monitoring requirements associated with automatic transfer switches, ensuring the installation conforms to the design	Table 184
Uninterruptible Power Supply (UPS)	• Monitoring requirements associated with UPS, ensuring the installation conforms to the design	Table 185
Motors	• Monitoring requirements associated with motors, ensuring the installation conforms to the design	Table 186
Standby Generators	• Monitoring requirements associated with standby generators, ensuring the installation conforms to the design	Table 187
Lighting	• Monitoring requirements associated with lighting, ensuring the installation conforms to the design	Table 188
Utility Power	• Monitoring requirements associated with utility power, ensuring the installation conforms to the design	Table 189



10.2.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for AC electrical systems inspection appear in Table 190.

Detailed Checklists – AC Electrical Systems

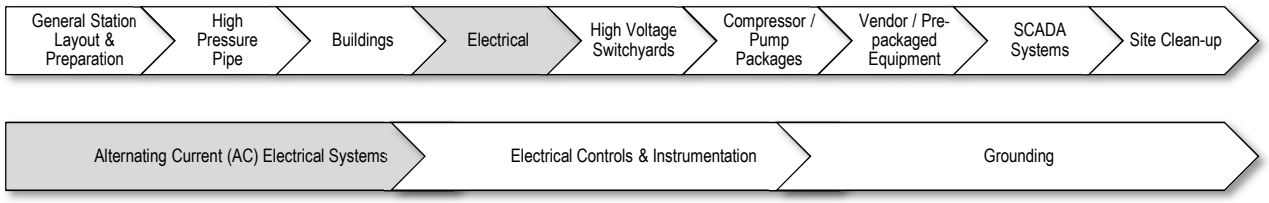
10.2.4 Typical Input Requirements for AC Electrical Systems Inspection

Table 178: Information Requirements for AC Electrical Systems Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to AC electrical systems, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Electrical Details and Wiring
	  ○ Network Wiring Diagrams
	  ○ Equipment Arrangement Plans
	  ○ Single Line Diagrams
	  ○ Lighting Plans, Sections, and Details
	  ○ Panel Assemblies
	  ○ Panel Schedules
	  ○ Conduit / Cable Schedules
	  ○ Conduit / Cable Routing Plans
	  ○ Loop Drawings
	  ○ Termination Schedules
	  ○ Wiring Diagrams
	  ○ Hazardous Area Classification Plans and Details
	• Electrical Specifications
	• Electrical Manufacturer Drawings and Specifications
	• Conduit / Cable / Cable Tray Placements

	Contracts and agreements related to: • Electrical Work ○ All Electricians' qualifications records to specific applicable processes • Technical Advisors / Vendor Representatives • Municipal / County Permits and Inspection (if applicable) • Electric Utility Company Specifications and Requirements



✓	Description
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Working at Elevations • Ladder Safety

10.2.5 Best Practice Items for Inspecting Typical AC Electrical Systems Installation

Table 179: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all material markings and tag numbers are in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and Manufacturer's name
	Ensure procedures are available for all instrumentation requiring field calibrations

Table 180: Safety Concerns for AC Electrical Systems Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed

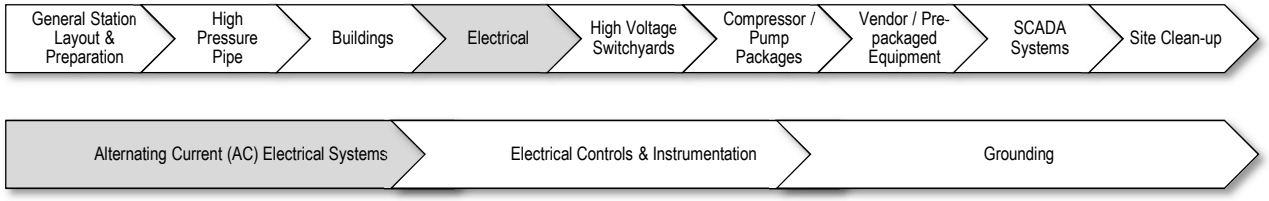


Table 181: Typical Monitoring Requirements for Distribution Panels

✓	Description
	Ensure assembly is checked for any missing parts
	Ensure panelboard circuit schedule is filled out
	Ensure correct circuit breaker, fuse size, and location
	Ensure distribution panel is grounded, installed, and connected, and test record is completed
	Ensure mounting and supports are secure
	Ensure nameplate, number of circuits, and panelboard locations are correct
	Ensure panel load balance is checked once all loads are energized
	Ensure all trash is removed from panel enclosure
	Ensure all panels are properly labelled and identified (e.g., Lamacoids)

Table 182: Typical Monitoring Requirements for Transformers

✓	Description
	Check nameplate for agreement with application
	Ensure bushings are checked for chips or cracks
	Ensure cooling fan mountings are checked and in good condition
	Ensure no-load tap changer is checked for proper movement
	Ensure cooling fan relay and circuit is checked
	Ensure operation of temperature indicators and alarm relays is checked
	Ensure all gaskets and fittings are checked for oil leakage
	Ensure oil fill is conducted per Manufacturer specifications
	Ensure correct phase rotation and polarity is checked before energizing
	Monitor performance of polarity and phase relation tests on rated voltage connection
	Monitor insulation resistance testing winding to winding
	Monitor insulation resistance testing winding to ground
	Verify that winding polarities are in accordance with the nameplate
	Ensure resistance of each high voltage winding is checked in the as found no-load tap changer position
	Ensure resistance of each high voltage winding is checked in the as found load tap changer position, if required
	Ensure external cooling fan is operational and runs automatically on high temperature
	Monitor transformer oil dielectric test
	Verify proper transformer neutral connection
	Ensure transformer tap setting matches Owner Company or project specifications and Issued for Construction (IFC) Drawings
	Verify proper operation of transformer protective relays and metering circuits

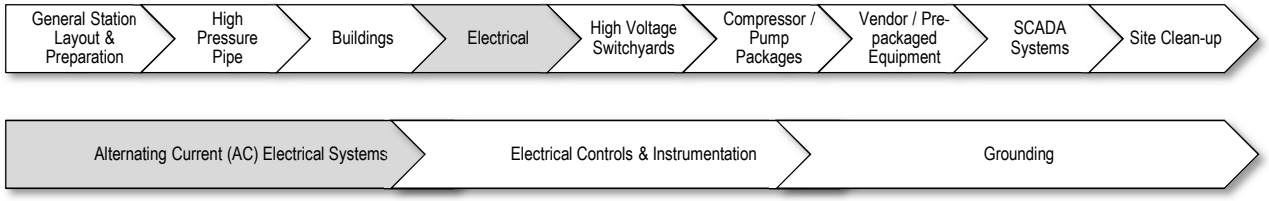


Table 183: Typical Monitoring Requirements for Motor Control Centers (MCCs)

✓	Description
	Ensure all circuit breakers and disconnects are operating normally
	Ensure bus sections are visually checked for unusual sparks / noise when energized
	Ensure communication with Programmable Logic Controller (PLC) system is confirmed, as applicable
	Ensure Human-Machine Interface (HMI) display and data pop-up sub-screen are verified
	Confirm remote operations from HMI, as applicable
	Ensure internal bus bars and power connection undergo a short-time Megger test before connection cable leads to MCC terminals
	Ensure all motor overload relays are checked electrically for correct operation
	Ensure current rating is checked for conformance with actual motor nameplate and service factor
	Ensure properly sized overloads are supplied
	Ensure wire terminals are checked for solid clean connections
	Ensure all debris is removed and each cubicle is cleaned
	Ensure contact alignment is checked on all contactors and circuit breakers
	Check for loose connections
	Check for dust or foreign particles on contact surfaces
	Ensure bearings and wearing surfaces are lubricated in accordance with Manufacturer specifications
	Ensure mechanical linkages are checked for proper working condition
	Ensure breakers are tested in accordance with Manufacturer specifications
	Ensure settings of all protective devices are set and tested in accordance with the system coordination study

Table 184: Typical Monitoring Requirements for Automatic Transfer Switches

✓	Description
	Confirm incoming voltage is correct and ensure unit is energized
	Ensure communication with Programmable Logic Controller (PLC) system is confirmed, as applicable
	Confirm serial data read / write to operator and engineering workstations, as applicable
	Confirm input / output to operator and engineering workstations
	Ensure “remote” start to generator is verified
	Ensure “switch over” to emergency power is verified
	Ensure “switch over” to primary power is verified
	Verify correct operation of automatic transfer switch control system
	Confirm all time delay settings

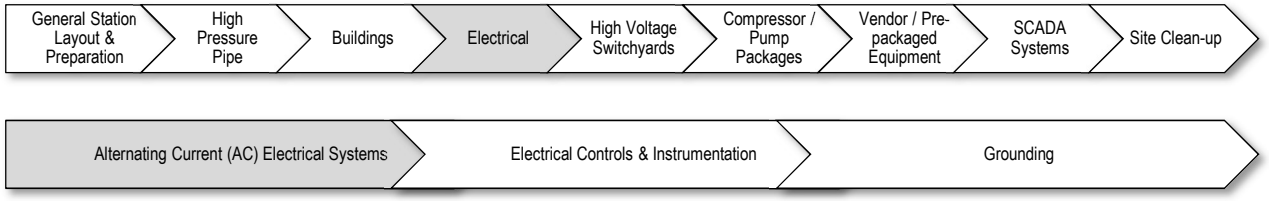


Table 185: Typical Monitoring Requirements for Uninterruptible Power Supply (UPS)

✓	Description
	Confirm incoming voltage is correct and ensure unit is energized
	Confirm proper connection with external devices on loss of power as well as restoration
	Ensure ventilation requirements are functional prior to charging any batteries, if required

Table 186: Typical Monitoring Requirements for Motors

✓	Description
	Confirm correct mounting orientation (i.e., horizontal versus vertical) for the motor
	Ensure voltage is checked
	Ensure correct rotation is validated
	Ensure inrush and nominal current are checked
	Ensure motor trip setting is adjusted
	Monitor insulation resistance testing winding to winding
	Monitor insulation resistance testing winding to ground
	Verify that winding polarities are in accordance with the nameplate
	Ensure voltage is recorded for each phase
	Monitor test of motor winding temperature detectors (if installed)
	Monitor vibration test
	Verify operation of motor space heater (if installed)

Table 187: Typical Monitoring Requirements for Standby Generators

✓	Description
	Ensure that the standby generator is properly fueled and checked for oil
	Ensure communication with Programmable Logic Controller (PLC) system is confirmed, as applicable
	Ensure Human-Machine Interface (HMI) display and data pop-up sub-screen are verified
	Ensure remote operations from HMI are confirmed, as applicable
	Check cooling system for proper installation
	Check exhaust system for proper installation
	Check start battery and battery charger for proper installation
	Verify generator circuit breaker settings and ensure breaker is operating correctly
	Verify generator voltage
	Confirm proper installation of emissions controls per the air quality permit
	Confirm safe egress points and platforms are properly installed for larger generators

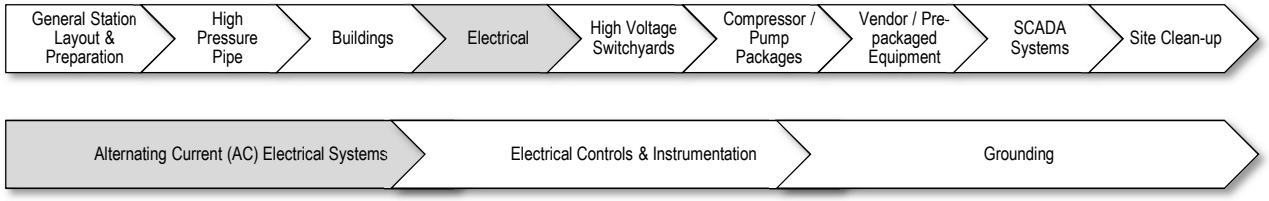


Table 188: Typical Monitoring Requirements for Lighting

✓	Description
	Ensure lighting transformers and panel boards are properly installed
	Ensure all interior and exterior lighting fixtures are properly installed and circuited
	Ensure all fixtures are connected between proper phase conductors
	Ensure all fixtures, including lamps and floodlights, are level, plumb, and in proper working order
	Ensure voltage is checked
	Ensure nominal current is checked
	Ensure photocell trip setting is adjusted
	Monitor testing operation of photocell with starter
	Ensure HMI display is verified, as applicable
	Ensure lighting and lighting circuits are complete
	Ensure emergency lighting systems are operable
	Verify automated lighting schemes, as applicable
	Verify lighting intensity levels meet Owner Company or project specifications
	Check for proper orientation of floodlights
	Check for proper orientation of photocell and ensure correct operation of photocell

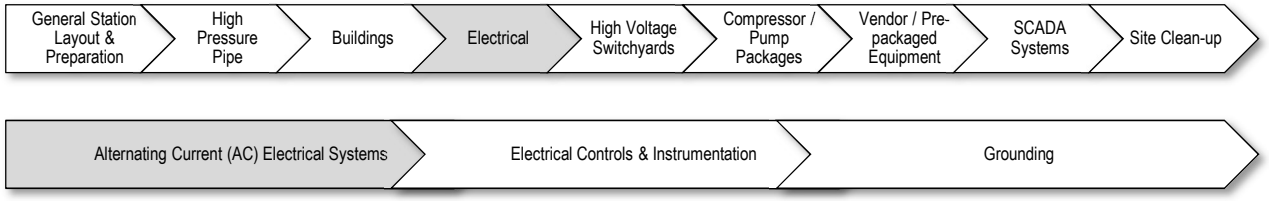
Table 189: Typical Monitoring Requirements for Utility Power

✓	Description
	Verify installation meets Electric Utility Company specifications and Owner Company or project specifications and Issued for Construction (IFC) Drawings
	Verify grounding and bonding requirements for service entrance are met
	Coordinate work with Electric Utility Company for incoming power line location, utility transformer location, etc.
	Verify all utility inspection requirements are met

10.2.6 Typical Outputs for AC Electrical Systems Inspection

Table 190: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete AC electrical systems test reports, including: • Instrument Calibration Record Forms • Megger Test Records



✓	Description
Daily	

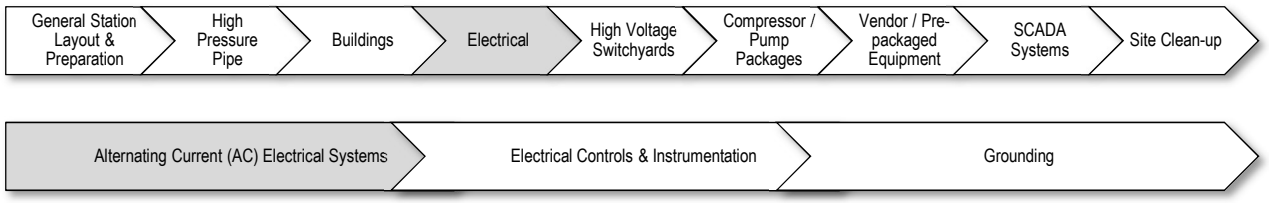
	Complete AC electrical systems progress reports, including:
	• Work completed to date, including:
	  ○ Length and Locations of Conduits / Cables Installed
	  ○ Conduits / Cables Installed by Conduit / Cable Number
	  ○ Progress of Specific Activities
	• Document punch list items, as required

10.2.7 References – AC Electrical Systems

Note to user: The reference information provided in Table 191 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 191: List of References – AC Electrical Systems

Document No.	Type	Title
American Gas Association (AGA)		
AGA XL1001	Recommended Practice	Classifications of Locations for Electrical Installations in Gas Utility Areas
American Petroleum Institute (API)		
API RP 500	Recommended Practice	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Canadian Standards Association (CSA)		
CSA C22.1	Standard	Canadian Electrical Code, Part I
CSA C22.2	Standard	Canadian Electrical Code, Part II
CSA C22.3	Standard	Canadian Electrical Code, Part III
CSA C22.1HB	Handbook	Canadian Electrical Code Handbook
National Fire Protection Association (NFPA)		
NFPA 70	Standard	National Electrical Code (NEC)
NFPA 70E	Standard	Standard for Electrical Safety in the Workplace
N/A	Handbook	National Electrical Code (NEC) Handbook



10.3 Electrical Controls and Instrumentation

10.3.1 Inputs

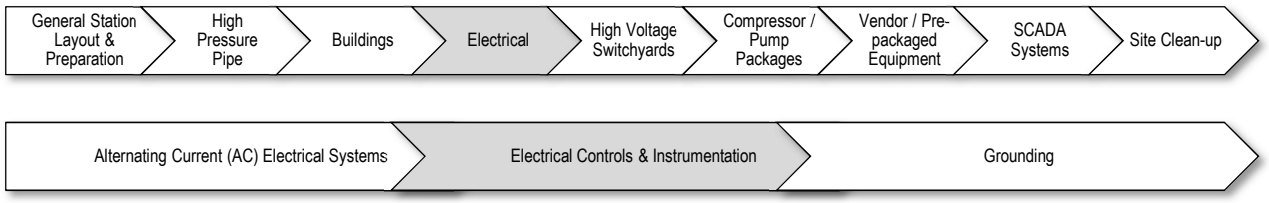
As part of preparing for inspection during the electrical controls and instrumentation installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 193.

10.3.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the electrical controls and instrumentation installation process are identified in a series of checklists as detailed in Table 192.

Table 192: Monitoring Requirements for Electrical Controls and Instrumentation – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 194
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 195
General Electrical Controls and Instrumentation Installation	• Monitoring requirements associated with electrical controls and instrumentation, ensuring the installation conforms to the design	Table 196
Tubing	• Monitoring requirements associated with tubing, ensuring the installation conforms to the design	Table 197
Conduits / Cables	• Monitoring requirements associated with conduits / cables, ensuring the installation conforms to the design	Table 198
Boxes and Fittings	• Monitoring requirements associated with boxes and fittings, ensuring the installation conforms to the design	Table 199
Wiring	• Monitoring requirements associated with wiring, ensuring the installation conforms to the design	Table 200
Connections and Terminations 600 Volts and Less	• Monitoring requirements associated with connections and terminations 600 Volts and less, ensuring the installation conforms to the design	Table 201
Conduit / Cable Trays	• Monitoring requirements associated with cable trays, ensuring the installation conforms to the design	Table 202
Relays and Protective Devices	• Monitoring requirements associated with relays and protective devices, ensuring the installation conforms to the design	Table 203



10.3.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for electrical controls and instrumentation inspection appear in Table 204.

Detailed Checklists – Electrical Controls and Instrumentation

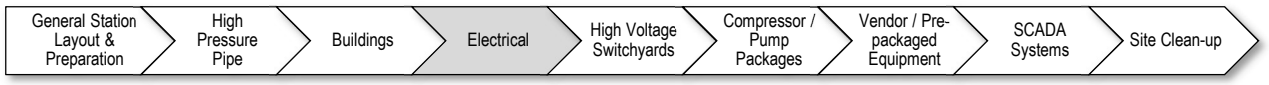
10.3.4 Typical Input Requirements for Electrical Controls and Instrumentation Inspection

Table 193: Information Requirements for Electrical Controls and Instrumentation Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to electrical controls and instrumentation, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Electrical Details and Wiring
	  ○ Network Wiring Diagrams
	  ○ Equipment Arrangement Plans
	  ○ Single Line Diagrams
	  ○ Lighting Plans, Sections, and Details
	  ○ Panel Assemblies
	  ○ Panel Schedules
	  ○ Conduit / Cable Schedules
	  ○ Termination Schedules
	  ○ Interconnect Listings
	  ○ Wiring Diagrams
	  ○ Routing Plans
	  ○ Loop Diagrams
	  ○ Cause and Effect Diagrams
	• Electrical Specifications, including Operations Philosophy
	• Electrical Manufacturer Drawings and Specifications

	Contracts and agreements related to: • Electrical Work ○ All Electricians' qualifications records to specific applicable processes • Technical Advisors / Vendor Representatives
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures



✓	Description
	• Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

10.3.5 Best Practice Items for Inspecting Typical Electrical Controls and Instrumentation Installation

Table 194: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all material markings and tag numbers are in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and Manufacturer's name
	Ensure procedures are available for all instrumentation requiring field calibrations

Table 195: Safety Concerns for Electrical Controls and Instrumentation Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed

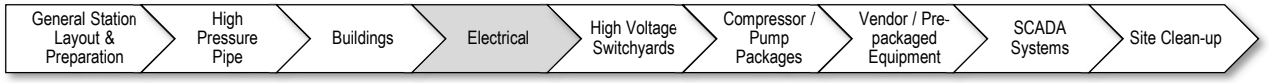
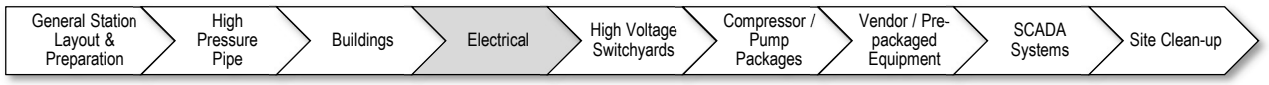


Table 196: Typical Monitoring Requirements for General Electrical Controls and Instrumentation Installation

✓	Description
	Ensure all panels are properly labelled and identified (e.g., Lamacoids)
	Monitor calibration of test equipment in accordance with calibration procedures
	Ensure correct installation of conduit / cable, wiring, terminations, and interconnections, including mounting, pulling wire, and tubing
	Monitor calibration of end devices and instruments and verify software functionality
	Ensure correct installation of instrumentation wiring loops
	Monitor calibration of instrumentation wiring loops
	Ensure all conduits / cables, wires, and / or equipment provided by the Contractor are checked for correct ratings
	Ensure seals and insulators are properly installed
	Ensure isolation points between grounded and cathodic protected equipment are properly installed
	Ensure all electrical circuits and devices are tested before they are energized
	Ensure continuity check is performed on instrument, control, and alarm wiring
	Ensure electrical transmission and control wiring is tested for continuity, proper termination, and grounding
	Ensure entire electrical installation is tested for circuit continuity, short circuits, and improper grounding
	Ensure each control circuit is checked for resistance, continuity, and grounds with instrumentation leads disconnected from main control instruments
	Ensure continuity of connecting conduit / cable from internal plant system to the main ground grid is tested
	Ensure any rerouting or relocating of raceways, grounding, and equipment, where new work conflicts with existing facilities, is performed as agreed to by the Owner Company
	Ensure that electrical equipment is free of dust, moisture, oil, chemicals, or other harmful matter, such as airborne particles, trimmings, and other construction debris
	Ensure proper color coding of insulated conductors
	Ensure all power panel and lighting panel directory cards are completed with legible printing and permanent ink
	Ensure all bus bolts are torqued to the Manufacturer's recommended values
	Ensure all external power and control connections are properly installed, with all control wiring grouped, strapped, and supported to prevent strain at terminal blocks
	Ensure that there are no grounds on equipment, and insulation resistance is tested (where applicable) and results documented
	Ensure all control circuits are tested for proper operation prior to connecting power leads to motors and equipment
	Verify motor rotation prior to coupling motors to driven equipment
	Ensure all connections to circuit breakers are installed in accordance with panel board schedules
	Ensure complete power distribution and control systems for HVAC systems are installed and connected
	Ensure raceway is cleaned until entirely free of all water and dirt, immediately prior to pulling the conductors with approved conduit / cable pulling devices



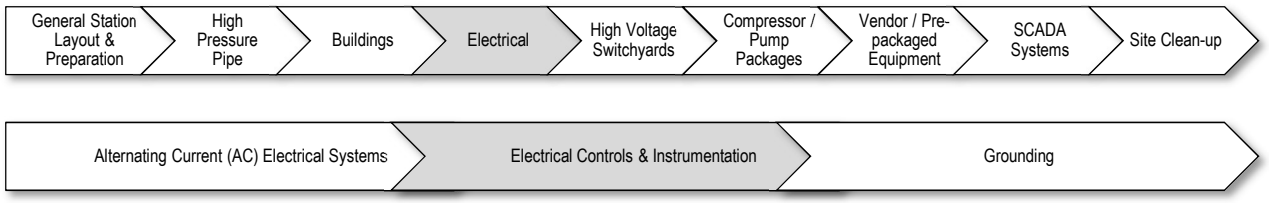
✓	Description
	Ensure all splices are covered with insulation
	Ensure spare conduits / cables and spare conductors are provided
	Ensure all conductors are labelled at each end and at pull boxes

Table 197: Typical Monitoring Requirements for Tubing

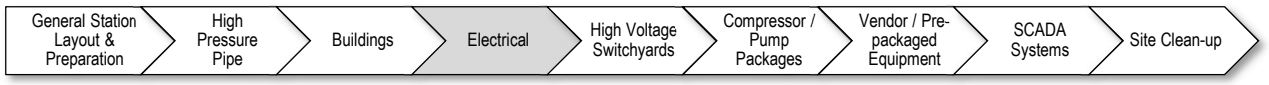
✓	Description
	Ensure tubing is installed with proper size and location
	Ensure all tubing connected to instruments contains a gradual slope down toward the source of the monitoring element with the higher end connected to the instrument to prevent any possible freezing of the sensed gas
	Ensure insulating devices are properly installed
	Ensure all tubing, fittings, clamps, clips, and support material are properly installed
	Ensure tubing is arranged in an orderly manner, firmly secured and rigidly supported, and routed, including loops to account for vibration or thermal differentials
	Ensure tubing numbers are attached to the tubing on equipment and device ends, as well as the bulkhead
	Ensure cutting or bending of tubing is performed in accordance with Manufacturer specifications
	Ensure no offset bends (or kick outs) are made to compensate for errors in measurement
	Ensure all instrument lines are pneumatically blown free of moisture, loose scale, and foreign matter with clean, dry air prior to connecting to the instrument
	Ensure all instruments, including electrical devices such as solenoid valves and pressure switches, are properly mounted and supported
	Ensure pneumatic tubing and / or electrical conduits / cables are not used for support of instruments or accessories
	Ensure pneumatic tubing is not used for support of electrical conduits / cables and electrical conduits / cables are not used for support of pneumatic tubing
	Ensure field mounted instruments are properly mounted on instrument racks, structural steel, or masonry structures
	Ensure instruments are not mounted on handrails or vibrating equipment

Table 198: Typical Monitoring Requirements for Conduits / Cables

✓	Description
	Verify conduits / cables are properly identified and labelled
	Ensure conduit / cable size, number of conductors, and general conduit / cable routing is correct
	Ensure grade beam trenches are not used as pathways for conduits / cables
	Ensure factory dust covers are removed from all unused conduit / cable entrances and replaced with suitable conduit / cable plugs
	Ensure conduit / cable joints and fittings are mechanically secure and water tight
	Ensure that a protective bushing is installed on all conduit / cable ends before any wire or conduit / cable is pulled



✓	Description
	Ensure all insulation and sealing material is installed where sleeves or openings are installed in walls, floors, roofs, or ceilings to accommodate raceways, conduits / cables, or bus ducts
	Ensure conduit / cable system will not interfere with the removal of any valve, instrument, or other device that is subject to removal for service
	Ensure tubing is thoroughly cleaned and checked prior to wire installation
	Ensure any damaged conduit / cable coating is repaired in accordance with Manufacturer specifications
	Ensure caution tape is placed above the buried conduit / cable systems when required
	Ensure conduit / cable supports are not hung from pipe nor immediately near engine exhaust components
	Ensure conduits / cables are spaced far enough apart so that fittings are accessible
	Ensure all field-made conduit / cable bends are of proper radius and free of wrinkles
	Verify proper bend radius is used for conduits / cables during installation
	Ensure all spare conduits / cables are capped and with a pulling wire or rope in place, if required
	Ensure conduit / cable is received and stored on suitable wooden or metal racks to protect from physical damage and corrosion, and that thread protectors remain in place until conduit / cable is installed
	Ensure exposed conduit / cable is plumb, level, and rigid
	Ensure exposed conduit / cable and fittings are securely fastened to suitable supports by using approved clamps, straps, fittings, hangers, etc.
	Ensure all conduits / cables are installed and maintained free of obstructions and ready for pulling of wire
	Ensure all threaded conduits / cables are plugged with recessed head plugs after conduit / cable is in place, until conductor is to be installed
	Ensure flexible conduit / cable and conduit / cable hubs are properly installed
	Ensure all conduit / cable terminations at junction boxes, transducers, motors, instruments, switches, valves, and other devices are properly installed
	Ensure all conduits crossing station roads or parking areas, or containing high voltage wires, are adequately encased
Conduits / Cables – Underground	
	Verify proper depth of burial of conduits / cables
	Verify proper spacing between conduits / cables in ductbanks
	Ensure minimum clearance of buried conduits / cables in any direction from all buried pipe
	Ensure underground and embedded conduit / cable is labelled at pull points and equipment, using proper conduit / cable designations
	Ensure conduits / cables run either parallel or perpendicular to buildings, walkways, streets, and piping facilities
	Ensure conduits / cables that enter a building below grade are sealed off to prevent water and moisture from entering the building
	Ensure conduit / cable runs to buildings slope away from the building
	Ensure minimum slack is provided on both ends of conduits / cables when transitioning from below grade to above grade to allow for future settlement



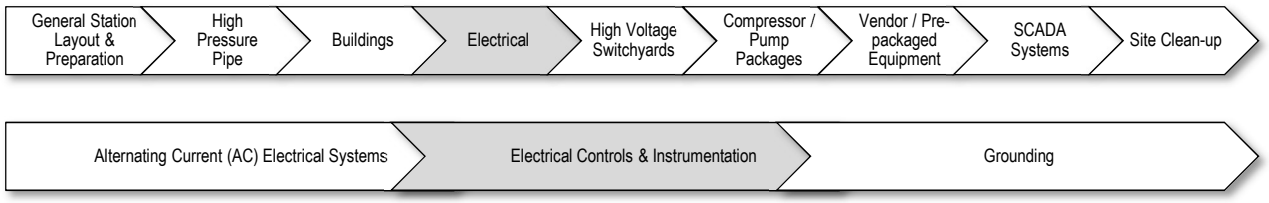
✓	Description
	Ensure installed components are not damaged or subject to faulty work, including concrete and excavation for underground conduit / cable runs
	Ensure underground conduit / cable systems are identified at the point of transition from grade
	Ensure conduit / cable systems in manholes are identified
	Ensure concrete is mixed with red dye prior to placement where buried conduit / cable is specified to have concrete coverage
Conduit / Cable Seals	
	Verify conduit seals are installed, where required
	Ensure seal devices are accessible for filling and maintenance
	Ensure conduit / cable ends are sealed to Manufacturer's specification after pulling and final terminations are completed
	Ensure all changes in area classifications where power and control wires are entering or leaving classified areas contain a conduit / cable seal

Table 199: Typical Monitoring Requirements for Boxes and Fittings

✓	Description
	Ensure pull boxes are properly installed where necessary to avoid excessive pulling stress, such that pulling faces are accessible and Manufacturer's pull tension requirements are met
	Ensure terminal boxes are properly installed; when installed outdoors, ensure terminal boxes are equipped with approved breathers and drains, and approved corrosion inhibitor devices, as necessary
	Ensure the number of tapped openings and / or hubs in explosion-proof boxes are correct
	Ensure spare openings in junction boxes for future connections are provided and plugged
	Ensure threads of all threaded covers, plugs, and openings are clean, and conducting lubricant is used on all threads to prevent binding
	Ensure O-ring gaskets are used where junction or terminal boxes are located outdoors or below grade
	Ensure all conduit / cable boxes, sealing condulets, fittings, and unions are properly installed

Table 200: Typical Monitoring Requirements for Wiring

✓	Description
	Monitor all wiring pulling activities to ensure that proper pulling techniques are used
	Ensure termination and wire runs inside equipment and panels are securely fastened
	Ensure each wire is properly secured and supported at each terminal block connection or splice so that any strain on the wire does not transmit to the connection
	Ensure each neutral wire is properly marked
	Ensure all wires placed in terminals use a ferrule to eliminate frayed wires from failing to be terminated properly
	Ensure barrier strips, not wire nuts, are used when connecting two or more wires together in one junction point



✓	Description
	Ensure all wires are marked at their termination points
	Ensure all wire connections are well tightened to provide a good low resistance connection
	Ensure proper bend radius is maintained on wires

Table 201: Typical Monitoring Requirements for Connections and Terminations 600 Volts and Less

✓	Description
	Ensure all connections are clean and tight for a low resistance joint without the use of wire nuts
	Ensure power cable lugs are the proper size for the wire size and connector bolts used
	Ensure conductor strands are not trimmed
	Ensure taps and splices in power wiring are made in approved boxes with suitable connectors and properly protected
	Ensure length of insulation stripped and removed for termination is in accordance with Manufacturer specifications for terminating device
	Ensure stripped wire is not folded over the insulation or doubled to compensate for incorrect terminal sizing
	Ensure integrity of insulation of shielded pair, triad, or quad wires in all instrumentation conduits / cables is maintained by leaving all foil on until the point of termination
	Ensure heat-shrink tubing is used on each shielded pair, triad, or quad wire in all instrumentation conduits / cables between the conduit / cable connector and the termination point in all boxes and control panels
	Ensure proper thermocouple lugs, terminals, and screws are used to match the wire type for thermocouples

Table 202: Typical Monitoring Requirements for Conduit / Cable Trays

✓	Description
	Ensure all turns, bends, and other deviations in conduit / cable trays, busways, wireways, etc. are made with approved fittings suited to that purpose
	Ensure all conduit / cable trays are properly installed with expansion joints, adequately supported (e.g., at bends, elbows, elevation changes), and grounded
	Ensure all conduits / cables in trays are arranged and securely fastened to the tray on all horizontal and vertical runs
	Ensure conduits / cables are not hung from the bottom or side of the conduit / cable trays
	Ensure conduits / cables extending from trays are properly supported
	Ensure minimum vertical separation is maintained from top of electrical equipment to bottom of conduit / cable tray
	Ensure conduit / cable trays are not installed over equipment that must be accessed on a regular basis (e.g., maintenance to motors, large valves, pumps)
	Ensure conduit / cable tray covers are adequately fastened to conduit / cable trays and properly installed
	Ensure conduit / cable trays slope down and away from building penetrations
	Ensure proper separation of electrical conduits / cables from instrumentation wiring in conduit / cable trays
	Verify conduit / cable tray barriers are installed, where required, for separation of power and signal cables

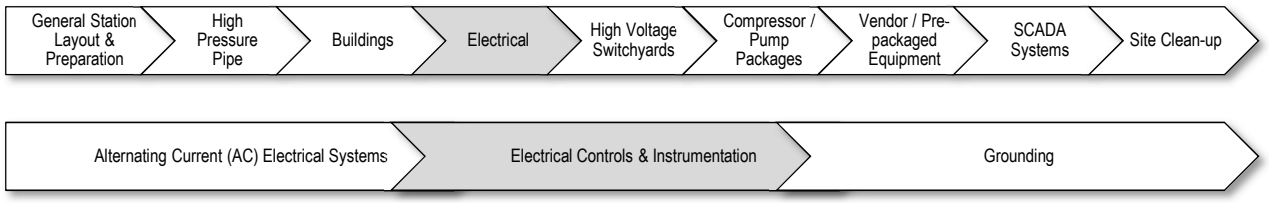


Table 203: Typical Monitoring Requirements for Relays and Protective Devices

✓	Description
	Ensure all relays are checked for loose terminals; holding lock screws; damage to coil, resistors, wiring, indicator targets, and holding devices; foreign material in magnet gaps; any cause for sluggish action
	Ensure protective relays are set, adjusted, and calibrated in accordance with Manufacturer specifications
	Ensure fuse size and rating correspond to Manufacturer's published data
	Ensure relay operation is checked and that they operate the circuit breakers (i.e., ensure the source of tripping power and all wiring between the relay and breaker are tested)

10.3.6 Typical Outputs for Electrical Controls and Instrumentation Inspection

Table 204: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete electrical controls and instrumentation test reports, including: • Instrument Calibration Record Forms • Instrument Check Sheets • Loop Test Record Forms
Daily	

	Complete electrical controls and instrumentation progress reports, including:
	• Work completed to date, including:
	  ○ Length and Locations of Conduits / Cables Installed
	  ○ Conduits / Cables Installed by Conduit / Cable Number
	  ○ Instrumentation Installed by Instrument Number
	• Document punch list items, as required

10.3.7 References – Electrical Controls and Instrumentation

Note to user: The reference information provided in Table 205 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 ensure that the correct, and most current, documents are referenced as appropriate.

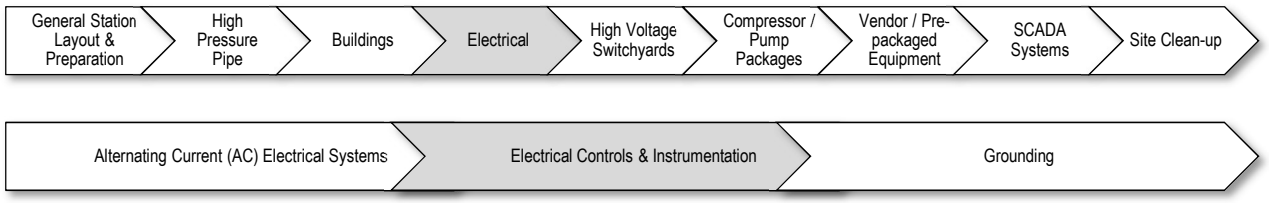
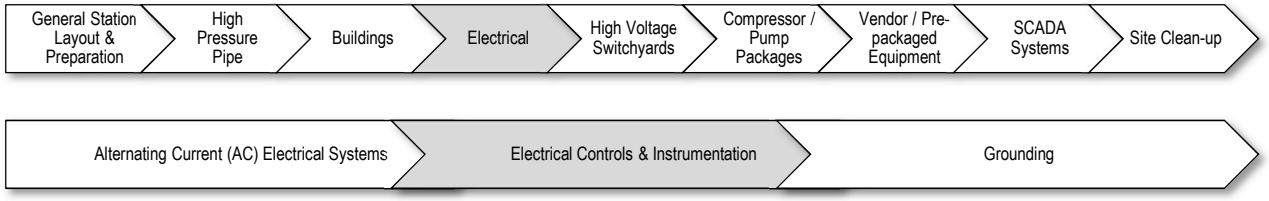


Table 205: List of References – Electrical Controls and Instrumentation

Document No.	Type	Title
American Gas Association (AGA)		
AGA XL1001	Recommended Practice	Classifications of Locations for Electrical Installations in Gas Utility Areas
American Petroleum Institute (API)		
API RP 500	Recommended Practice	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Canadian Standards Association (CSA)		
CSA C22.1	Standard	Canadian Electrical Code, Part I
CSA C22.2	Standard	Canadian Electrical Code, Part II
CSA C22.3	Standard	Canadian Electrical Code, Part III
CSA C22.1HB	Handbook	Canadian Electrical Code Handbook
National Fire Protection Association (NFPA)		
NFPA 70	Standard	National Electrical Code (NEC)
NFPA 70E	Standard	Standard for Electrical Safety in the Workplace
N/A	Handbook	National Electrical Code (NEC) Handbook



10.4 Grounding

10.4.1 Inputs

As part of preparing for inspection during the grounding process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 207.

10.4.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the grounding process are identified in a series of checklists as detailed in Table 206.

Table 206: Monitoring Requirements for Grounding – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 208
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 209
Grounding Installation	• Monitoring requirements associated with grounding, ensuring the installation conforms to the design	Table 210

10.4.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for grounding inspection appear in Table 211.

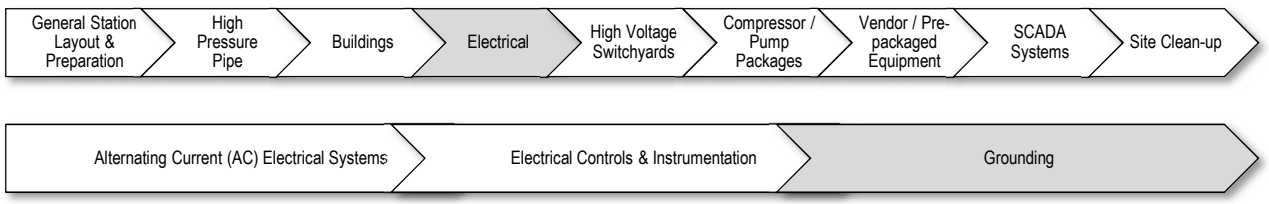
Detailed Checklists – Grounding

10.4.4 Typical Input Requirements for Grounding Inspection

Table 207: Information Requirements for Grounding Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to grounding, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Electrical Details and Wiring



✓	Description
	○ Network Wiring Diagrams ○ Equipment Arrangement Plans ○ Single Line Diagrams ○ Lighting Plans, Sections, and Details ○ Panel Assemblies ○ Panel Schedules ○ Conduit / Cable Schedules ○ Wiring Diagrams ○ Grounding Drawings ○ Routing Plans • Electrical Specifications, including Grounding Specifications • Electrical Manufacturer Drawings and Specifications
	Contracts and agreements related to: • Electrical Work ○ All Electricians' qualifications records to specific applicable processes • Technical Advisors / Vendor Representatives
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Site Security

10.4.5 Best Practice Items for Inspecting Typical Grounding Installation

Table 208: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all material markings and tag numbers are in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling

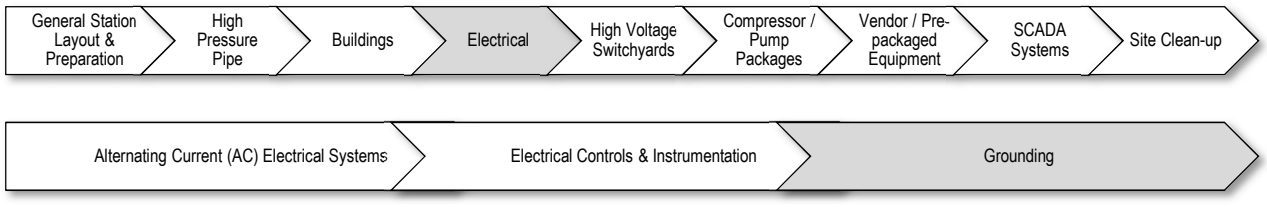
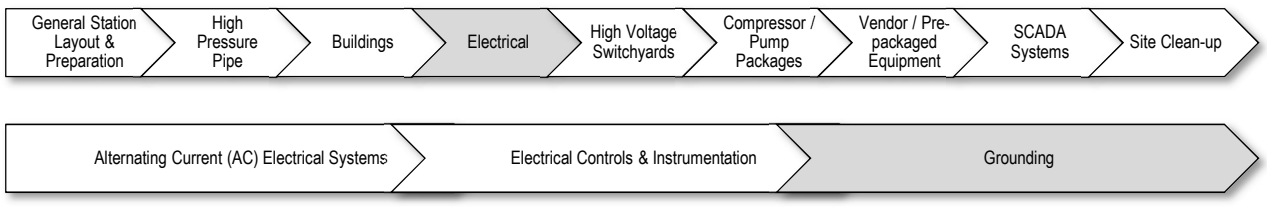


Table 209: Safety Concerns for Grounding Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed
	Ensure conduit / cable spools are safeguarded and the site regularly inspected to ensure that grounding components have not been removed, as theft of copper at industrial sites is a common concern

Table 210: Typical Monitoring Requirements for Grounding Installation

✓	Description
	Ensure all conduit / cable systems, raceway systems, switchgear / motor control centers, power and lighting panels, foundations, fabricated steel buildings, steel building columns, substation structures, motor frames, fencing, and all non-current carrying metal parts, in buildings, adjacent equipment, and other locations, are permanently and effectively grounded, including all materials, fittings, and equipment
	Ensure instrumentation shields and drain wires are isolated / insulated from ground at the field device and properly grounded
	Ensure enclosures are not relied upon to complete a ground path such that jumpers and / or ground buses are installed between grounding lugs
	Ensure ground grid is continuous without splices, where practical, and buried
	Ensure all buried joints, splices, and connections are made and insulated
	Ensure grounding conductors are slack between points of underground connection
	Ensure grounding risers are properly installed, with provisions for future connections (if required)
	Ensure joint surfaces are cleaned to bright, bare metal prior to making grounding connection to above ground equipment and structures
	Ensure grounding conductors and associated connections are properly installed
	Ensure exposed grounding cables are run tight against buildings, parallel to building lines, adequately strapped and installed in conduits, where required, to protect from potential damage
	Ensure all above ground equipment and all segments of perimeter fencing are connected to the station grounding grid
	Ensure jumper cables are installed at all fencing corners
	Ensure that emergency generator neutral is grounded through ground resistor in switchgear, if applicable
	Ensure correct quantity, location, and installation of tie rods and grounding
	Ensure ground resistance of all ground rods within battery limits of plant is tested
	Verify ground resistance of entire grounding system is in accordance with Owner Company or project specifications
	Ensure lightning protection is properly installed



10.4.6 Typical Outputs for Grounding Inspection

Table 211: Typical Reporting Requirements

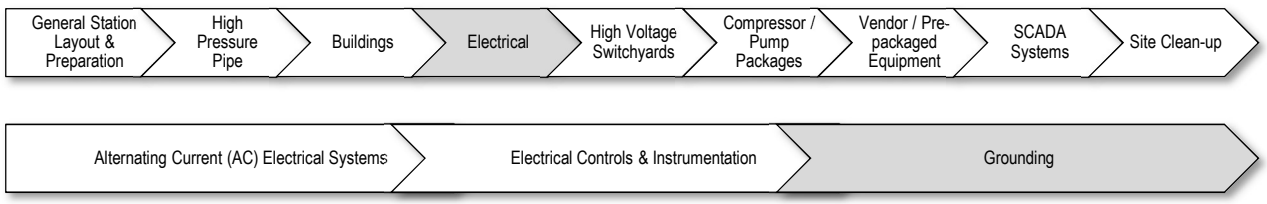
✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete grounding test reports, including: • Grounding / Bonding Resistance Reading Reports
Daily	
	Complete grounding progress reports, including: • Work completed to date • Document punch list items, as required

10.4.7 References – Grounding

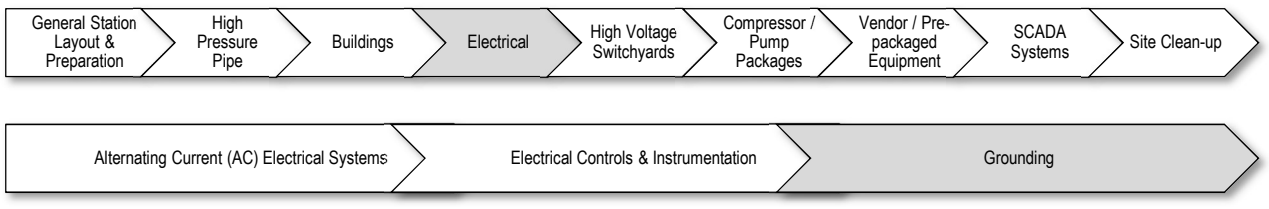
Note to user: The reference information provided in Table 212 is intended as a guide only (i.e., the list is not exhaustive); documents of this nature are updated frequently and it remains the responsibility of the user to ensure that the correct, and most current, documents are referenced as appropriate.

Table 212: List of References – Grounding

Document No.	Type	Title
American Gas Association (AGA)		
AGA XL1001	Recommended Practice	Classifications of Locations for Electrical Installations in Gas Utility Areas
American Petroleum Institute (API)		
API RP 500	Recommended Practice	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Canadian Standards Association (CSA)		
CSA C22.1	Standard	Canadian Electrical Code, Part I
CSA C22.2	Standard	Canadian Electrical Code, Part II
CSA C22.3	Standard	Canadian Electrical Code, Part III
CSA C22.1HB	Handbook	Canadian Electrical Code Handbook
National Fire Protection Association (NFPA)		



Document No.	Type	Title
NFPA 70	Standard	National Electrical Code (NEC)
NFPA 70E	Standard	Standard for Electrical Safety in the Workplace
N/A	Handbook	National Electrical Code (NEC) Handbook



11.0 HIGH VOLTAGE SWITCHYARDS

11.1 Overview

High voltage switchyards are used to step down high voltage power to an appropriate voltage for use within the facility.

Construction of high voltage switchyards consists of the following major items during the construction of a facility:

- Foundations and Reinforced Concrete (refer to Section 7.7)
- Structural Steel
- Welding and Joining (refer to Section 8.4)
- Coating / Painting (refer to Section 8.5)
- Lifting and Setting
- Switchgear

These items are presented within this section, roughly in sequence of construction.

Structural Steel

Depending on the nature of the facility, high voltage switchyards may use equipment that requires structural support. Structural steel is typically installed as part of the construction stage prior to lifting and setting of equipment. At this point, associated joints and connections of structural steel are also inspected.

Lifting and Setting

Lifting and setting involves the placement of equipment onto foundations or into excavations. This activity requires specialized lifting equipment, trained Operators, and pre-planning.

Switchgear

Switchgear is a generic term for the combination of electrical components (e.g., fuses, circuit breakers, switches, control panels, relays, transformers) that are used to control, protect, and isolate electrical equipment.

11.2 Structural Steel

11.2.1 Inputs

As part of preparing for inspection during the structural steel construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 214.

11.2.2 Execution

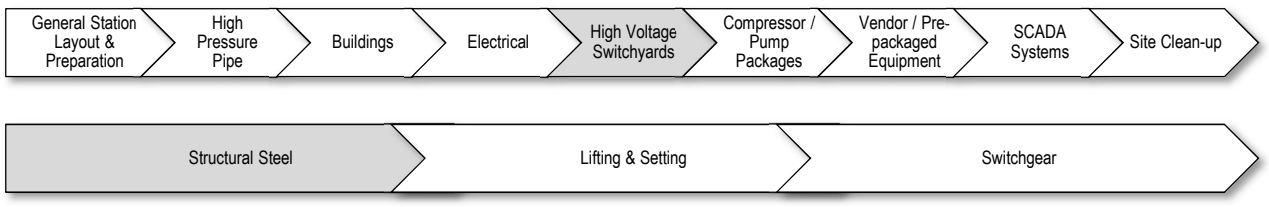
While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the structural steel construction process are identified in a series of checklists as detailed in Table 213.

Table 213: Monitoring Requirements for Structural Steel

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 215
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 216
Civil		
Foundations and Reinforced Concrete Construction	• Previously discussed monitoring requirements associated with foundations and reinforced concrete construction	Section 7.7
Structural Steel Construction	• Monitoring requirements associated with structural steel, ensuring the installation conforms to the design	Table 217
Civil, Mechanical, Electrical (All Disciplines)		
Welding and Joining Operations	• Previously discussed monitoring requirements associated with welding and joining operations	Section 8.4
Coating / Painting Operations	• Previously discussed monitoring requirements associated with coating / painting operations	Section 8.5

11.2.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for structural steel inspection appear in Table 218.



Detailed Checklists – Structural Steel

11.2.4 Typical Input Requirements for Structural Steel Inspection

Table 214: Information Requirements for Structural Steel Inspection

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to structural steel, such as: • Issued for Construction (IFC) Drawings • Fabrication Shop Drawings • Structural Steel Specifications • Construction Specifications • Manufacturer Specifications and Drawings
	Contracts and agreements related to: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information
	Owner Company specific Safety Plan, including (but not limited to): • Working at Elevations • Lift Plan
	Other project specific Plans, which may include: • Traffic Management Plan

11.2.5 Best Practice Items for Inspecting Typical Structural Steel Construction

Table 215: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all structural steel members are piece marked in accordance with Fabrication Shop Drawings

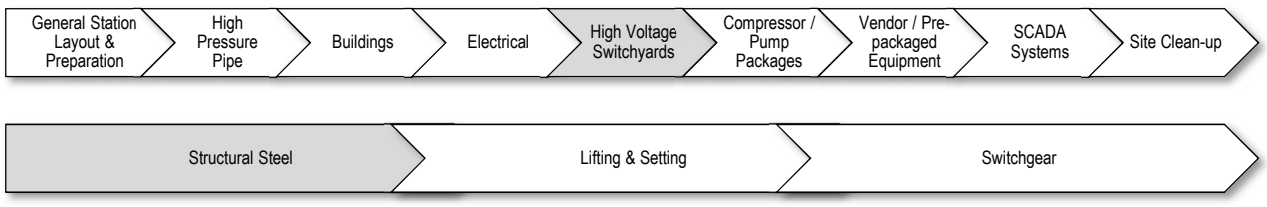


Table 216: Safety Concerns for Structural Steel Construction

✓	Description
	Ensure structures are not loaded with weight that endangers design integrity
	Ensure erection steel is adequately braced until permanently connected and self-supporting

Table 217: Typical Monitoring Requirements for Structural Steel Construction

✓	Description
	Ensure that joint surfaces are free from loose mill scale, dirt, oil, burrs, pits, or other defects that prevent solid seating
	Ensure structural steel is installed in accordance with Owner Company or project specifications and Issued for Constructino (IFC) Drawings
	Confirm that erection bolts are removed and replaced with specified bolts and nuts
	Ensure bolts and nuts are adequately torqued / tensioned and documented
	Ensure all structural steel members are thoroughly cleaned and shop coated
	Ensure all pre-painted surfaces damaged during construction are repaired
	Ensure all galvanized surfaces damaged during construction are coated
	Ensure platforms and elevated structures are properly installed
	Ensure welding is completed in accordance with Section 8.4 Welding and Joini

11.2.6 Typical Outputs for Structural Steel Inspection

Table 218: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

	Complete structural steel progress reports, including:
	• Work completed to date, including:
	  o Number and location of structural steel members erected
	  o Description and location of placed structural steel
	• Document punch list items, as required

11.2.7 References – Structural Steel

Note to user: The reference information provided in Table 219 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 ensure that the correct, and most current, documents are referenced as appropriate.

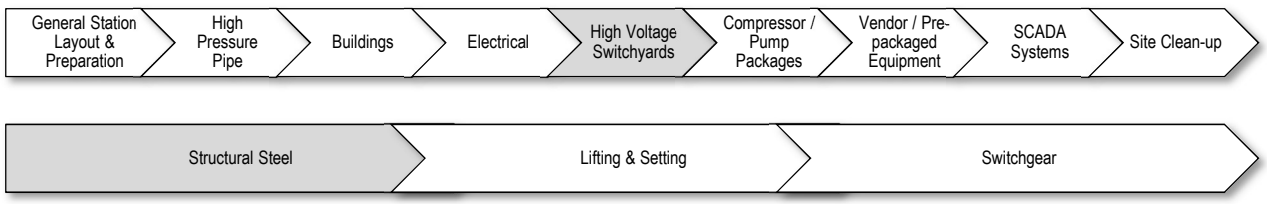
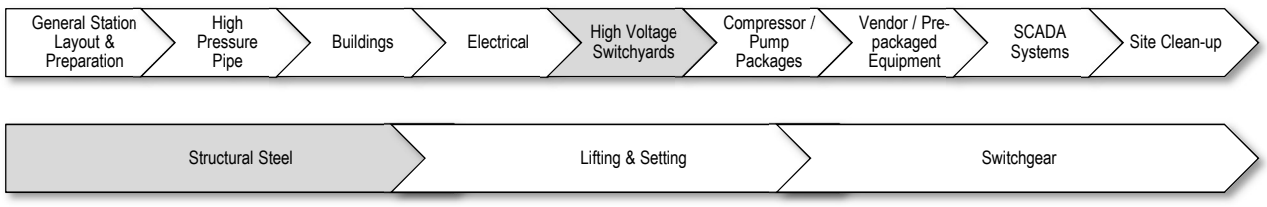


Table 219: List of References – Structural Steel

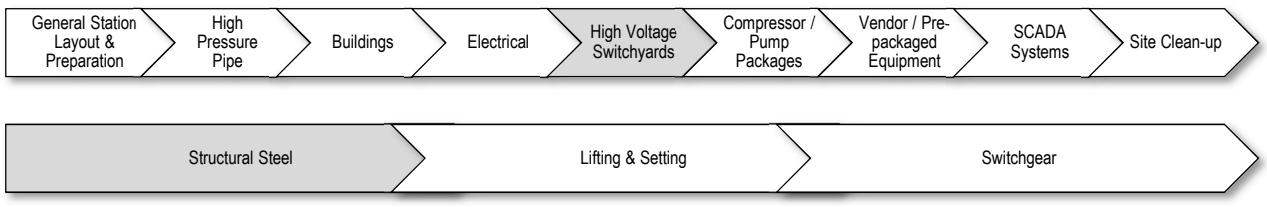
Document No.	Type	Title
American Institute of Steel Construction (AISC)		
AISC 206	Standard	Certification Program for Structural Steel Erectors
AISC 207	Standard	Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 325	Handbook	Steel Construction Manual
American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)		
ANSI / AISC 303	Standard	Code of Standard Practice for Steel Buildings and Bridges
ANSI / AISC 360	Specification	Specification for Structural Steel Buildings
American Society for Testing and Materials (ASTM)		
ASTM A36	Specification	Standard Specification for Carbon Structural Steel
ASTM A123	Specification	Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	Specification	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	Specification	Standard Specification for Carbon and Alloy Steel Nuts
ASTM F3125	Specification	Standard Specification for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength
N/A	Standard	Selected ASTM Standards for Structural Steel Fabrication
American Society of Civil Engineers (ASCE)		
ASCE 7	Standard	Minimum Design Loads for Buildings and Other Structures
Canadian Institute of Steel Construction (CISC)		
N/A	Recommended Practice	Code of Standard Practice
N/A	Handbook	Handbook of Steel Construction
Canadian Standards Association (CSA)		
CSA G40.20 / G40.21	Standard	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
CSA G164	Standard	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA S16	Standard	Design of Steel Structures
CSA S136	Specification	North American Specification for the Design of Cold-Formed Steel Structural Members
International Code Council (ICC)		



Document No.	Type	Title
N/A	Standard	The International Building Code (IBC) [1]
National Research Council Canada (NRC)		
N/A	Standard	The National Building Code of Canada (NBC) [1]
Research Council on Structural Connections (RCSC)		
N/A	Specification	Specification for Structural Joints Using High-Strength Bolts

Note(s):

1) Provincial / Territorial and / or State Building Codes govern, where applicable



11.3 Lifting and Setting

11.3.1 Inputs

As part of preparing for inspection during the lifting and setting process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 221.

11.3.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the lifting and setting process are identified in a series of checklists as detailed in Table 220.

Table 220: Monitoring Requirements for Lifting and Setting – Mechanical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 222
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 223
Lifting and Setting	• Monitor lifting and setting operations for safety and ensure that no damage occurs to the equipment	Table 224

11.3.3 Outputs

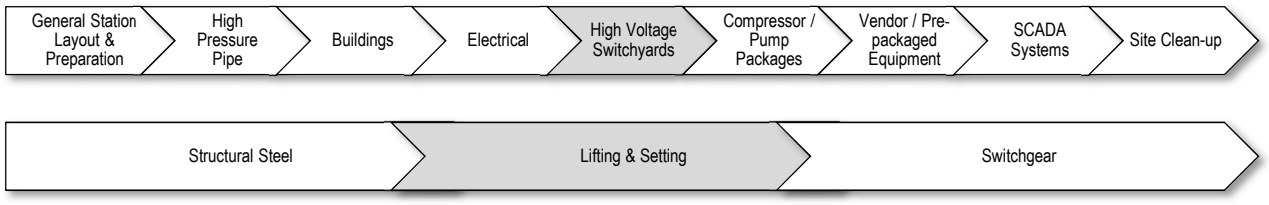
The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for lifting and setting inspection appear in Table 225.

Detailed Checklists – Lifting and Setting

11.3.4 Typical Input Requirements for Lifting and Setting Inspection

Table 221: Information Requirements for Lifting and Setting

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to lifting and setting, such as: • Issued for Construction (IFC) Drawings • Equipment Manufacturer Specifications and Drawings • Lifting Equipment Specifications and Drawings

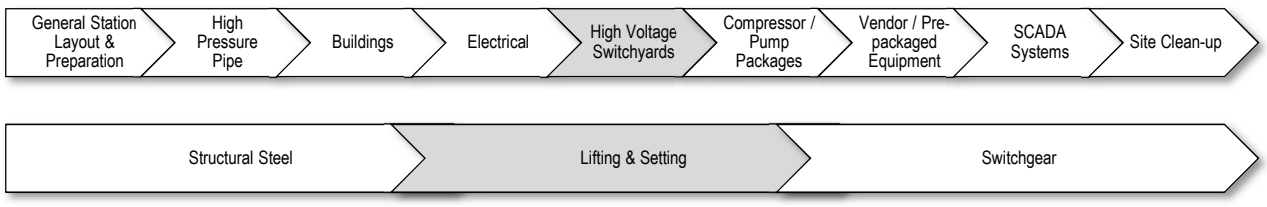


✓	Description
	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Heavy Lift Plan • Lock-out / Tag-out Procedures
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Relevant Contingency Plans • Loading, Securing, and Rigging Practices

11.3.5 Best Practice Items for Inspecting Typical Lifting and Setting Operations

Table 222: 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) • Facility 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 lifting and setting to make sure all personnel involved are aware of: • Lifting sequence • Critical lift circumstances • Equipment size and numbers • Individual roles and responsibilities • Weather restrictions (e.g., wind, lightning)
	Verify qualifications and training certificates of all Crane Operators and Riggers to ensure they are competent and trained
	Verify the weight of the load, confirm equipment is certified (e.g., cranes, forklifts), and lifting components can withstand load limits / weight requirements
	Confirm spreader bars, slings, belts, cradles, etc. have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and ensure their suitability for lifting to avoid equipment damage



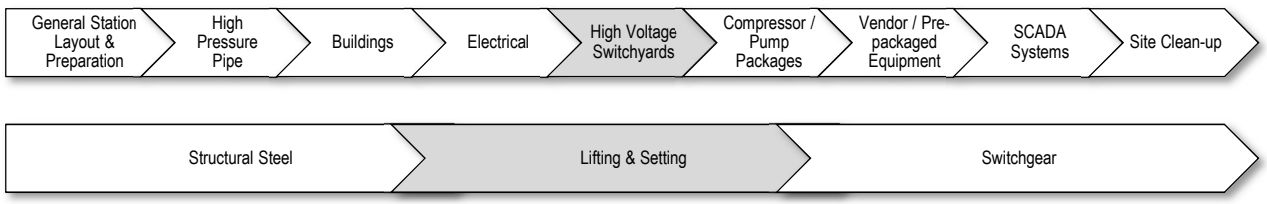
✓	Description
	Inspect spreader bars, slings, belts, cradles, etc. visually for damage
	Ensure concrete foundations for equipment and skids have been prepared as per equipment setting requirements

Table 223: Safety Concerns for Lifting and Setting

✓	Description
	Ensure a job safety analysis (JSA) is conducted and strictly adhered to throughout lifting and setting operations
	Ensure that the JSA is updated as required
	Ensure Equipment Operators use spotters while backing up and traversing near or under powerlines and overhead hazards
	Ensure that personnel are never allowed between the suspended load and an obstacle, which could result in a pinch point safety hazard
	Ensure loads are not suspended over workers
	Ensure barricades, fencing, etc. are in place prior to lifting and setting to properly rope off the swing radius
	Ensure lighting is adequate for the entire period of the lift (light kits and generators may be required)
	Ensure the entire lift sequence can be undertaken in safe weather conditions (i.e., no lightning or high winds)

Table 224: Typical Monitoring Requirements for Lifting and Setting

✓	Description
	Ensure lifting is secured from specified lifting points
	Review and amend the job safety analysis (JSA), tailgate documents, and Lift Plan if there has been any deviation
	Ensure that lifting equipment is labelled for maximum capacity
	Ensure the use of approved safety latches on all lifting hooks
	Ensure the use of tag lines when required
	Confirm presence of designated signal person using proper hand signals
	Ensure the Contractor has a rigging control in place and removes and destroys all defective rigging
	Ensure lifting equipment is placed on level ground
	Ensure 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 distributes load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes
	Ensure suspended load never swings or rubs against any obstacles or equipment, and is not dropped or subjected to jarring or sudden impacts
	Ensure skid-mounted equipment is leveled and properly secured to the foundation



11.3.6 Typical Outputs for Lifting and Setting Inspection

Table 225: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

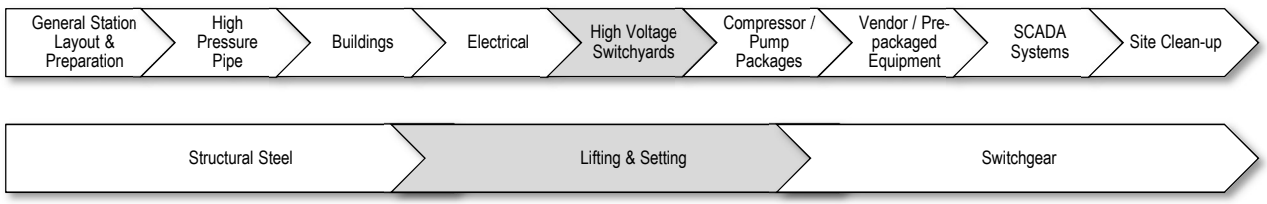
	Complete lifting and setting progress reports, including:
	• Work completed to date, including:
	  ○ Description and location of placed equipment or structural steel
	  ○ Any damage incurred during lifting and setting
	• Document punch list items, as required

11.3.7 References – Lifting and Setting

Note to user: The reference information provided in Table 226 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 226: List of References – Lifting and Setting

Document No.	Type	Title
American Petroleum Institute (API)		
API RP 686	Recommended Practice	Recommended Practice for Machinery Installation and Installation Design
American Society of Mechanical Engineers (ASME)		
ASME B30.05	Standard	Mobile Cranes
ASME B30.14	Standard	Sideboom Cranes
ASME B30.2	Standard	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
Canadian Standards Association (CSA)		
CSA B167	Standard	Overhead Cranes, Gantry Cranes, Monorails, Hoists, and Jib Cranes



11.4 Switchgear

11.4.1 Inputs

As part of preparing for inspection during the switchgear installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 228.

11.4.2 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the switchgear installation process are identified in a series of checklists as detailed in Table 227.

Table 227: Monitoring Requirements for Switchgear – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 229
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 230
Switchgear Installation	• Monitoring requirements associated with switchgear, ensuring the installation conforms to the design	Table 231

11.4.3 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for switchgear inspection appear in Table 232.

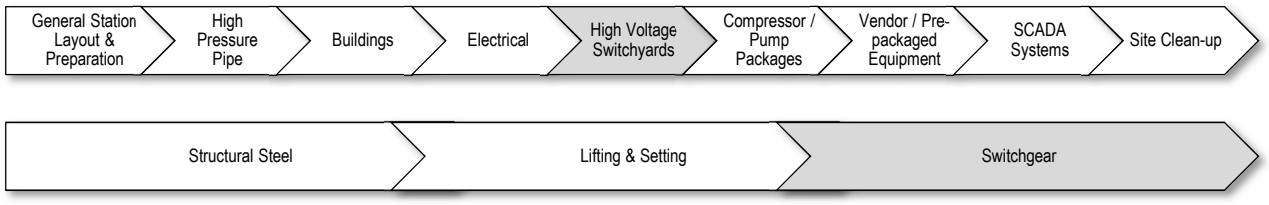
Detailed Checklists – Switchgear

11.4.4 Typical Input Requirements for Switchgear Inspection

Table 228: Information Requirements for Switchgear

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to switchgear, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Electrical Details and Wiring
	  ○ Network Wiring Diagrams



✓	Description
	○ Equipment Arrangement Plans ○ Single Line Diagrams ○ Lighting Plans, Sections, and Details ○ Panel Assemblies ○ Panel Schedules ○ Conduit / Cable Schedules ○ Wiring Diagrams ○ Routing Plans • Electrical Specifications • Electrical Manufacturer Drawings and Specifications
	Contracts and agreements related to: • Electrical Work ○ All Electricians' qualifications records to specific applicable processes • Technical Advisors / Vendor Representatives • Electric Utility Company Specifications and Requirements
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

11.4.5 Best Practice Items for Inspecting Typical Switchgear Installation

Table 229: 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) • Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all material markings and tag numbers are in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and Manufacturer's name
	Ensure procedures are available for all instrumentation requiring field calibrations

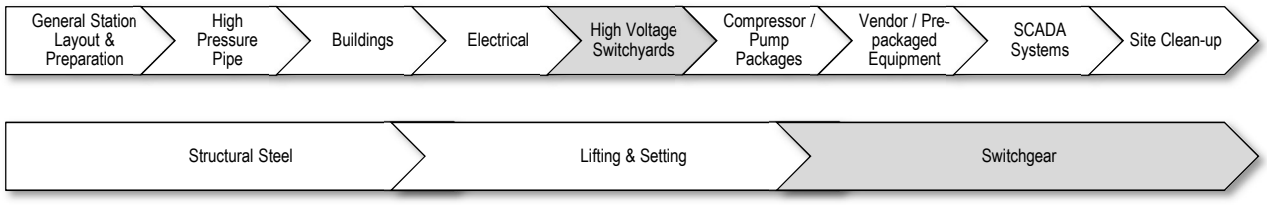


Table 230: Safety Concerns for Switchgear Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment (e.g., to prevent arc flash)
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed

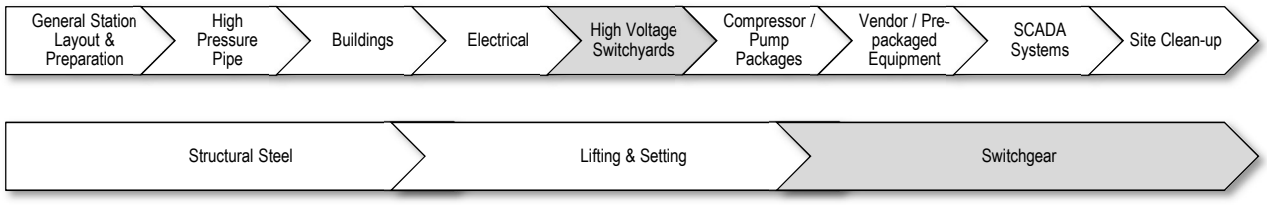
Table 231: Typical Monitoring Requirements for Switchgear Installation

✓	Description
	Ensure individual circuit breakers are checked for damage, loss of parts, alignment, and contact pressure
	Ensure clearance and tightness of all moving parts is checked and ensure wedges, ties, and blocks installed by Manufacturer are removed
	Ensure electrical continuity of all current, potential, and control circuits is checked
	Verify that all fuse holders, fuses, and other protective devices are not damaged and are of proper type, size, and rating
	Verify that instrument transformers are the proper type and rating
	Verify ratio and polarity of transformers in accordance with nameplate data
	Ensure setting and calibration of all relays is performed in accordance with Manufacturer specifications
	Ensure switchgear undergoes a short-time Megger test before incoming and outgoing conduits / cables are connected
	Ensure proper phase rotation
	Ensure tightness of all wire / cable connections is checked
	Ensure automatic transfer on secondary selective systems is tested by simulated power failure under voltage conditions
	Ensure all other auxiliary devices are checked, tested, and operational
	Ensure all untapped bolted bus connections are checked for proper torque ratings
	Check all mechanical interlocks for proper installation

11.4.6 Typical Outputs for Switchgear Inspection

Table 232: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Complete switchgear test reports, including: • Instrument Calibration Record Forms



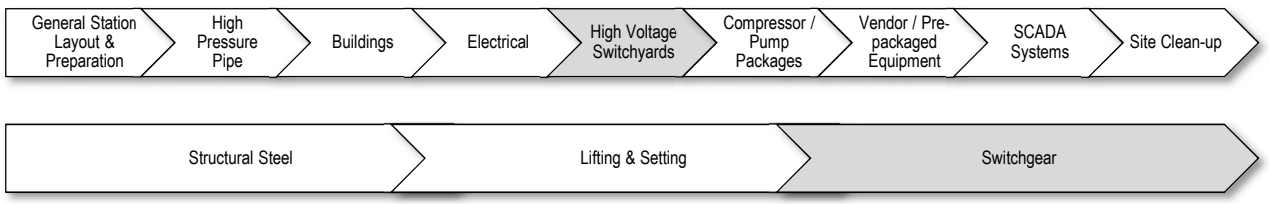
✓	Description
	• Megger Test Records • Ground Bus Resistance Values • Insulation Resistance Test Record Forms • Distribution Panel Test Records • Bus Connection Verification Reports
Daily	
	Complete switchgear progress reports, including: • Work completed to date • Document punch list items, as required

11.4.7 References – Switchgear

Note to user: The reference information provided in Table 233 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 233: List of References – Switchgear

Document No.	Type	Title
American Gas Association (AGA)		
AGA XL1001	Recommended Practice	Classifications of Locations for Electrical Installations in Gas Utility Areas
American Petroleum Institute (API)		
API RP 500	Recommended Practice	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Canadian Standards Association (CSA)		
CSA C22.1	Standard	Canadian Electrical Code, Part I
CSA C22.2	Standard	Canadian Electrical Code, Part II
CSA C22.3	Standard	Canadian Electrical Code, Part III
CSA C22.1HB	Handbook	Canadian Electrical Code Handbook
National Fire Protection Association (NFPA)		
NFPA 70	Standard	National Electrical Code (NEC)
NFPA 70E	Standard	Standard for Electrical Safety in the Workplace
N/A	Handbook	National Electrical Code (NEC) Handbook



12.0 COMPRESSOR / PUMP PACKAGES

12.1 Overview

Compressors (for gaseous products) and pumps (for liquid products) are devices that are used to increase the pressure of the product so that it flows down the pipe.

Installation of compressor and pump packages consists of the following major items during the construction of a facility:

- Foundations and Reinforced Concrete (refer to Section 7.7)
- High Pressure Pipe (refer to Section 8.0)
- Structural Steel (refer to Section 9.2)
- Lifting and Setting
- Electrical Controls and Instrumentation (refer to Section 10.3)

Note that connections to compressor / pump packages are within the scope of this document; however, connections for components within these packages are typically inspected by the Vendor and therefore outside the scope of this document.

Lifting and Setting

Lifting and setting involves the placement of compressor / pump packages onto foundations and leveling equipment, including all package connections. This activity requires specialized lifting equipment, trained Operators, and pre-planning.

Compressor and pump packages are specialized items with long lead times. Proper attention and care must be given during the lifting and setting phase to ensure that the equipment is not damaged, which may cause delays to the project.

12.2 Inputs

As part of preparing for inspection during the compressor / pump packages installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 235.

12.3 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the compressor / pump packages installation process are identified in a series of checklists as detailed in Table 234.

Table 234: Monitoring Requirements for Compressor / Pump Packages

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 236
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 237
Civil, Mechanical, Electrical (All Disciplines)		
High Pressure Pipe Construction	• Previously discussed monitoring requirements associated with high pressure pipe construction	Section 8.0
Civil		
Foundations and Reinforced Concrete Construction	• Previously discussed monitoring requirements associated with foundations and reinforced concrete construction	Section 7.7
Structural Steel Construction	• Previously discussed monitoring requirements associated with structural steel construction	Section 9.2
Mechanical		
Lifting and Setting	• Monitoring requirements associated with lifting and setting, ensuring the installation conforms to the design	Table 238
Electrical		
Electrical Controls and Instrumentation Installation	• Previously discussed monitoring requirements associated with electrical controls and instrumentation installation	Section 10.3

12.4 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for compressor / pump packages installation inspection appear in Table 239.

Detailed Checklists – Compressor / Pump Packages

12.5 Typical Input Requirements for Compressor / Pump Packages Inspection

Table 235: Information Requirements for Compressor / Pump Packages Inspection

✓	Description
	All designs, drawings, and specifications developed by the Owner Company and Contractors related to compressor / pump packages, such as: • Issued for Construction (IFC) Drawings • Equipment Manufacturer Specifications and Drawings • Lifting Equipment Specifications and Drawings • Leveling and Alignment Procedures • Long-Term Storage Procedures (i.e., to prevent corrosion)
	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey
	Owner Company specific Safety Plan, including (but not limited to): • Traffic Control Plan • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Heavy Lift Plan (including Equipment Manufacturer information on weights, center of gravity, dimensions, lift points, spreader bars, slings, etc.) • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Relevant Contingency Plans • Loading, Securing, and Rigging Practices

12.6 Best Practice Items for Inspecting Typical Compressor / Pump Packages Installation

Table 236: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility 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 lifting and setting to make sure all personnel involved are aware of: • Lifting sequence

✓	Description
	• Critical lift circumstances • Equipment size and numbers • Individual roles and responsibilities • Weather restrictions (e.g., wind, lightning)
	Verify qualifications and training certificates of all Crane Operators and Riggers to ensure they are competent and trained
	Verify the weight of the load, confirm equipment is certified (e.g., cranes, forklifts), and lifting components can withstand load limits / weight requirements
	Confirm spreader bars, slings, belts, cradles, etc. have labels clearly indicating lift capacities (the rated maximum tensile strength of straps used for lifting purposes) and ensure their suitability for lifting to avoid equipment damage
	Inspect spreader bars, slings, belts, cradles, etc. visually for damage
	Ensure concrete foundations for equipment and skids have been prepared as per equipment setting requirements
	Confirm that floor slabs on which the crane may sit have cured adequately†
	Confirm that machinery foundations have cured and grout preparations have been completed†
	Ensure the lifting plan is reviewed and approved by the structural engineer responsible for the design of the structure (including temporary shoring, bracing, or supports) if the machinery will be set in a partially completed structure, or if structural members must be removed to lower the machinery into the structure†
	Confirm the setup location for the lifting equipment in relationship to the initial pick point of the load and its final installation point†
	Check for damage to package / enclosure internals during shipment (e.g., damage to equipment-removal beams due to vibration during transport)
	Check for water damage and / or corrosion to packing and components
	Inspect all electrical panels and ensure all panels are tightly closed after inspection
	Check for impact damage, removing access panels for internal inspection (components such as battery chargers and variable-frequency drives (VFDs) can have internal damage while showing no external damage)
	Confirm all vessels and tanks are closed and / or sealed
	Confirm couplings and shaft ends are protected from dirt and corrosion
	Confirm support structures, inlet and exhaust systems, and other large, drop-shipped components include hardware installation kits
	Ensure that any removal of packing material does not damage the equipment and specific unpacking and uncrating instructions are followed

† From API RP 686 Recommended Practice for Machinery Installation and Installation Design. Copyright © 2009 American Petroleum Institute. Used with permission.

Table 237: Safety Concerns for Compressor / Pump Packages Installation

✓	Description
	Ensure a job safety analysis (JSA) is conducted and strictly adhered to throughout lifting and setting operations
	Ensure that the JSA is updated as required
	Ensure Equipment Operators use spotters while backing up and traversing near or under powerlines and overhead hazards
	Ensure that personnel are never allowed between the suspended load and an obstacle, which could result in a pinch point safety hazard

✓	Description
	Ensure loads are not suspended over workers
	Ensure barricades, fencing, etc. are in place prior to lifting and setting to properly rope off the swing radius
	Ensure lighting is adequate for the entire period of the lift (light kits and generators may be required)
	Ensure the entire lift sequence can be undertaken in safe weather conditions (i.e., no lightning or high winds)

Table 238: Typical Monitoring Requirements for Lifting and Setting

✓	Description
	Ensure lifting is secured from specified lifting points
	Review and amend the JSA, tailgate documents, and Lift Plan if there has been any deviation
	Ensure that lifting equipment is labelled for maximum capacity
	Ensure the use of approved safety latches on all lifting hooks
	Ensure the use of tag lines when required
	Confirm presence of designated signal person using proper hand signals
	Ensure the Contractor has a rigging control in place and removes and destroys all defective rigging
	Ensure lifting equipment is placed on level ground
	Ensure 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 distributes load over a larger area) supplemented by a larger wooden or composite float to reduce high bearing loads on soil created by the cranes
	Ensure suspended load never swings or rubs against any obstacles or equipment, and is not dropped or subjected to jarring or sudden impacts
	Verify that the cables and slings are bearing only on the intended lift points and are not transmitting any loads onto auxiliary piping, instruments, chain guards, etc.†
	Ensure lift points for individual machinery pieces are not used for lifting machinery skids or packages (e.g., lifting lugs on motors, gearboxes, casings, inspection covers)†
	Ensure equipment shafts are not used for lifting equipment†
	Ensure use of lift points on the baseplate or skid for baseplate or skid-mounted machinery†
	Ensure machinery is not used as a lift point unless approved by the Manufacturer†
	Ensure care is exercised in lifting skid-mounted equipment where part of the machinery or its auxiliaries have been removed for shipment, thus changing the center of gravity†
	Ensure special-purpose machinery rotors are restrained in an externally obvious manner to restrict axial travel prior to the lift†
	Ensure ancillary equipment is not lifted as assemblies
	Ensure package is properly placed on foundation, including correct vertical elevation and level package
	Ensure machinery is pre-lubricated prior to rotation to prevent possible bearing or gear damage
	Ensure skid-mounted equipment is leveled and properly secured to the foundation

† From API RP 686 Recommended Practice for Machinery Installation and Installation Design. Copyright © 2009 American Petroleum Institute. Used with permission.

12.7 Typical Outputs for Compressor / Pump Packages Inspection

Table 239: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

	Complete compressor / pump packages progress reports, including:
	• Work completed to date, including:
	  ○ Description and location of placed equipment
	  ○ Any damage incurred during lifting and setting
	• Document punch list items, as required

12.8 References – Compressor / Pump Packages

Note to user: The reference information provided in Table 240 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 240: List of References – Compressor / Pump Packages

Document No.	Type	Title
American Petroleum Institute (API)		
API 610	Standard	Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries
API 618	Standard	Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services
API RP 686	Recommended Practice	Recommended Practice for Machinery Installation and Installation Design
American Society of Mechanical Engineers (ASME)		
ASME B30.05	Standard	Mobile Cranes
ASME B30.14	Standard	Sideboom Cranes
ASME B30.2	Standard	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
Canadian Standards Association (CSA)		
CSA B167	Standard	Overhead Cranes, Gantry Cranes, Monorails, Hoists, and Jib Cranes

13.0 VENDOR / PRE-PACKAGED EQUIPMENT

13.1 Overview

Vendor / pre-packaged equipment is installed to support the primary compressor or pump package. Installation of vendor / pre-packaged equipment consists of the following major items during the construction of a facility:

- Foundations and Reinforced Concrete (refer to Section 7.7)
- Lifting and Setting (refer to Sections 12.2, 12.3, 12.4)
- Due to the nature of vendor and pre-packaged systems, the inspection is driven primarily by discipline; therefore, the content in this section is broken out by discipline (as opposed to individual systems)

These packages may include the following: air filter, exhaust, air cooling, compressed air, lubricating oil, fire water pumps, auxiliary power units (APU), and control piping systems.

- Air Filter Systems: These systems pre-treat the air used in combustion in the primary driver (e.g., gas turbine or reciprocating engine) to remove particulate matter and / or liquids.
- Exhaust Systems: These systems are used to silence the exhaust on compression equipment and may also be used to treat (e.g., removal of carbon dioxide) or monitor the exhaust gases for composition (Continuous Emission Monitoring System, or CEMS).
- Air Cooling Systems: Air coolers are used to reduce the temperature of natural gas that has been heated in the compression process.
- Compressed Air Systems: Compressed air systems are used for instrumentation control systems or cooling. These systems include but are not limited to the air compressors, air dryer, and compressed air treatment, including associated equipment and piping.
- Lubricating Oil Systems: These systems are used for lubrication and cooling of rotating equipment and commonly used in gas turbine and compressor applications.
- Fire Water Pumps: Fire water pumps are required at industrial locations, in accordance with the relevant code requirements. Tankage may be required to store fire water and fuel to be able to operate without utility power.
- Auxiliary Power Units (APU): These systems are automated power systems that will automatically start to provide power to critical systems for a specified amount of time in the event of the loss of utility power.
- Valves and Actuators: Valves are used to assist with the isolation of pipe sections or to control product flow in a pipe or within a facility. Actuators are used to control the position of these valves (typically required for large diameter valves). The focus of this document is on the large diameter valves and associated actuators used to manage product flow.

- Control Piping: These systems are usually a specialized form of a compressed air system or a natural gas system that are used to operate valve actuators remotely.

13.2 Inputs

As part of preparing for inspection during the vendor / pre-packaged equipment installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 242.

13.3 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the vendor / pre-packaged equipment installation process are identified in a series of checklists as detailed in Table 241.

Table 241: Monitoring Requirements for Vendor / Pre-packaged Equipment

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 243
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 244
Civil		
Foundations and Reinforced Concrete Construction	• Previously discussed monitoring requirements associated with foundations and reinforced concrete construction	Section 7.7
Vendor / Pre-packaged Equipment Installation	• Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design	Table 245
Mechanical		
Lifting and Setting Operations	• Previously discussed monitoring requirements associated with lifting and setting operations	Sections 12.2, 12.3, 12.4
Vendor / Pre-packaged Equipment Installation	• Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design	Table 246
Electrical		
Vendor / Pre-packaged Equipment Installation	• Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design	Table 247

13.4 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for vendor / pre-packaged equipment installation inspection appear in Table 248.

Detailed Checklists – Vendor / Pre-packaged Equipment

13.5 Typical Input Requirements for Vendor / Pre-packaged Equipment Inspection

Table 242: Information Requirements for Vendor / Pre-packaged Equipment Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to vendor / pre-packaged equipment, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs)
	  ○ Process Flow Diagrams (PFDs)
	  ○ Isometric Drawings
	  ○ Electrical Line Lists and Drawings
	• Equipment Vendor Drawings and Specifications
	• Long-Term Storage Procedures (i.e., to prevent corrosion)

	Contracts and agreements related to: • Procurement of Equipment (e.g., Purchase Orders) • Technical Advisors / Vendor Representatives • Utility Power • First Fill
	Owner Company specific Safety Plan, including (but not limited to): • Requirements for Personal Protective Equipment (PPE) • Emergency Medical Services (EMS) • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash) • Working at Elevations • Working with Medium Voltage Devices • Physical Containment of Leaks
	Other project specific Plans, which may include: • Fire Prevention / Firefighting Plan • Relevant Contingency Plans

13.6 Best Practice Items for Inspecting Typical Vendor / Pre-packaged Equipment Installation

Table 243: Prior to Commencing Work

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

✓	Description
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and Issued for Construction (IFC) Drawings per Section 7.5 Stockpiling and Material Handling
	Ensure tag numbers are in accordance with IFC Drawings
	Verify nameplate data against IFC Drawings

Table 244: Safety Concerns for Vendor / Pre-packaged Equipment Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed
	Ensure pneumatic pressure sources are handled with care as they may cause serious injury or harm
	Ensure air compressors are safe guarded from accidental contact as they may use rotating components
	Ensure lubricating oil systems are handled with care as they are pressurized and there is potential for serious injury or harm from leaks under pressure
	Ensure appropriate precautions are taken as lubricating oil may be flammable

Table 245: Typical Monitoring Requirements for Vendor / Pre-packaged Equipment Installation – Civil

✓	Description
	Ensure elevations of foundations have been verified prior to setting equipment
	Ensure the installation is undertaken in accordance with Equipment Vendor procedures and requirements

Table 246: Typical Monitoring Requirements for Vendor / Pre-packaged Equipment Installation – Mechanical

✓	Description
	Ensure the installation is undertaken in accordance with Equipment Vendor procedures and requirements
	Inspect equipment for damage and ensure preservation is removed, including temporary shipping brackets and temporary blinds
	Verify that proper gaskets are installed at flanged connections, and flanges are tightened to specified torque / tension and sequence
	Verify that the removal of shipping protection has not caused damage to the equipment
	Witness Vendor Site Acceptance Tests
	Ensure that all bolting is tight and pipe is supported and not causing any nozzle loading of the filter housing
	Verify that all vessels have an ASME code stamp, as required
	Verify leak testing / hydrostatic testing (in accordance with Section 8.6 Hydrostatic Testing) of the pipe is completed

✓	Description
	Verify pipe installation against P&IDs
	Ensure correct installation and placement of all filters, valves, regulators, and drains
	Confirm air compressor, pump, and fan motors have proper safety shielding on rotating parts
	Verify correct level of lubricant in compressor
	Monitor cleaning of pipe to remove all contaminants, swabbing to remove all dirt, deposits, and loose objects from inside pipe before joints are connected
	Ensure equipment is clean and free of debris

Table 247: Typical Monitoring Requirements for Vendor / Pre-packaged Equipment Installation – Electrical

✓	Description
	Ensure the installation is undertaken in accordance with Equipment Vendor procedures and requirements
	Ensure vessels, skids, and equipment are securely grounded to ground loop per Section 10.4 Grounding
	Ensure correct electrical terminations, including polarity and workmanship
	Check sequencing of control panel with power to motors turned off, as applicable
	Ensure proper separation of electrical conduits / cables from instrumentation wiring in conduit / cable trays
	Verify proper bend radius is used for conduits / cables during installation
	Confirm conduit / cable penetrations through concrete or soil are sealed around the conduit / cable to prevent water ingress
	Confirm conduits / cables are sealed in hazard areas
	Witness Vendor Site Acceptance Tests
	Verify equipment is properly identified for its jurisdiction (e.g., Canadian Standards Association (CSA), Underwriters Laboratories (UL), Underwriters Laboratories of Canada (ULC))
	Verify instrumentation installation against IFC Drawings
	Ensure all tubing, fittings, clamps, clips, and support material are properly installed
	Ensure tubing is arranged in an orderly manner, firmly secured and rigidly supported, and routed, including loops to account for vibration or thermal differentials
	Ensure process gas tubing in the horizontal plane is installed with a downward sloping grade toward the source connection to provide liquid drainage; where a downward sloping grade cannot be achieved, ensure low point drains are installed
	Ensure tubing numbers are attached to the tubing on equipment and device ends, as well as the bulkhead
	Ensure cutting or bending of tubing is performed in accordance with Manufacturer specifications
	Ensure no offset bends (or kick outs) are made to compensate for errors in measurement
	Ensure all instrument lines are pneumatically blown free of moisture, loose scale, and foreign matter with clean, dry air prior to connecting to the instrument
	Ensure all instruments, including electrical devices such as solenoid valves and pressure switches, are properly mounted and supported
	Ensure pneumatic tubing and / or electrical conduits / cables are not used for support of instruments or accessories
	Ensure pneumatic tubing is not used for support of electrical conduits / cables and electrical conduits / cables are not used for support of pneumatic tubing

✓	Description
	Ensure the installation is undertaken in accordance with Equipment Vendor procedures and requirements
	Ensure field mounted instruments are properly mounted on instrument racks, structural steel, or masonry structures
	Ensure instruments are not mounted on handrails or vibrating equipment

13.7 Typical Outputs for Vendor / Pre-packaged Equipment Inspection

Table 248: Typical Reporting Requirements

✓	Description
General	
	Complete vendor / pre-packaged equipment test reports, including: • Vendor Checklists
Daily	

	Complete vendor / pre-packaged equipment progress reports, including:
	• Work completed to date, including:
	  ○ Vendor equipment mounted
	  ○ Description and location of pipe or tubing installed
	  ○ Identification of instrumentation terminated
	• Document punch list items, as required

13.8 References – Vendor / Pre-packaged Equipment

Note to user: The reference information provided in Table 249 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 249: List of References – Vendor / Pre-packaged Equipment

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		

14.0 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS

14.1 Overview

SCADA systems include emergency shutdown systems, security systems, station controls, Human-Machine Interface (HMI) systems, and all related components, including the Programmable Logic Controller (PLC) System, associated panels, networking, communication, and interface to other systems, as applicable. In most cases, this may also involve a backup control center.

Note that oversight of the installation of SCADA systems is typically undertaken by Operations personnel and is therefore outside of the scope of this document; however, emergency shutdown systems are within the scope of this document.

Emergency shutdown systems include emergency shutdown piping and all of the associated equipment such as panels.

14.2 Inputs

As part of preparing for inspection during the SCADA systems installation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 251.

14.3 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the SCADA systems installation process are identified in a series of checklists as detailed in Table 250.

Table 250: Monitoring Requirements for SCADA Systems – Electrical

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 252
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 253
Emergency Shutdown Systems Installation	• Monitoring requirements associated with emergency shutdown systems, ensuring the installation conforms to the design	Table 254

14.4 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for SCADA systems inspection appear in Table 255.

Detailed Checklists – SCADA Systems

14.5 Typical Input Requirements for SCADA Systems Inspection

Table 251: Information Requirements for SCADA Systems Inspection

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to SCADA systems, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Piping and Instrumentation Diagrams (P&IDs) including Instrument Index
	  ○ Panel Assemblies
	  ○ Wiring Diagrams
	  ○ Network Wiring Diagrams
	  ○ Schematic Diagrams
	  ○ Lighting Details
	  ○ Fire and Gas Plans and Details
	  ○ Electrical Details
	  ○ Power Distribution Drawings
	  ○ Nameplate Schedules
	  ○ Input / Output List (including Calibration Range, Alarms, and Set Points)
	• Vendor Drawings and Specifications, including
	  ○ Operating and Maintenance Manuals and Test Procedures)
	  ○ SCADA Test Documentation
	  ○ Telecommunication Test Documentation
	  ○ System Software Design Documentation
	  ○ Factory Acceptance Test Procedures
	  ○ Site Acceptance Test Procedures

	Contracts and agreements related to: • Third Party Support for Installation (may be included in commissioning support contract) • Interconnect Agreements
	Owner Company specific Safety Plan, including (but not limited to): • Lock-out / Tag-out Procedures • Electrical Safety (e.g., arc flash)
	Other project specific Plans, which may include: • Operations Philosophy

14.6 Best Practice Items for Inspecting Typical SCADA Systems Installation

Table 252: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s)

✓	Description
	• Facility Contractor's tailgate meetings (as required) • Ad-hoc meetings with Contractors to discuss and clarify questions or concerns
	Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Owner Company or project specifications and IFC Drawings per Section 7.5 Stockpiling and Material Handling

Table 253: Safety Concerns for SCADA Systems Installation

✓	Description
	Ensure adequate working clearances are maintained when working near power lines / energized electrical equipment
	Ensure proper personal protective equipment (PPE) is used when working on energized electrical equipment
	Ensure proper Lock-out / Tag-out Procedures are followed when working at existing facilities
	Ensure all electrical tools are properly grounded
	Ensure proper grounding installation (e.g., proper separation to facility piping and cathodic protection installations)
	Ensure all equipment warning labels, required by code, are installed
	Ensure systems cannot be accidentally activated by the SCADA system during installation

Table 254: Typical Monitoring Requirements for Emergency Shutdown Systems Installation

✓	Description
	Ensure correct instrument installation
	Monitor calibration of instruments and verify operability of software
	Ensure correct installation of instrumentation wiring loops
	Monitor calibration of instrumentation wiring loops
	Ensure proper operation of emergency shutdown panel

14.7 Typical Outputs for SCADA Systems Inspection

Table 255: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
Daily	

	Complete SCADA systems progress reports, including:
	• Work completed to date, including:
	  ○ Instrument Calibration Record Forms
	  ○ Instrument Check Sheets
	  ○ Loop Test Record Forms
	• Document punch list items, as required

14.8 References – SCADA Systems

Note to user: The reference information provided in Table 256 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 256: List of References – SCADA Systems

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		

15.0 SITE CLEAN-UP

15.1 Overview

Construction site clean-up is the final cleaning and removal of construction materials and equipment from the facility site. This also involves establishing the final grade, detailing of the surface (e.g., yard gravel, curbs, sidewalks), and completion of any outstanding construction deficiencies.

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

However, during summer construction, the Contractor will do both machine and final clean-up immediately after the end of construction and return to the site at a later date for additional restoration work (e.g., repairing a sunken trench).

15.2 Inputs

As part of preparing for inspection during the site clean-up process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Owner Company technical specifications as identified in Table 258.

15.3 Execution

While the work is being executed, the Inspector is required to monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the site clean-up process are identified in a series of checklists as detailed in Table 257.

Table 257: Monitoring Requirements for Site Clean-up – Civil

Item	Description	Reference
Prior to Commencing Work	• On a daily basis, ensure key issues that have been identified are detailed and addressed	Table 259
Safety	• Monitor the operations for adherence to relevant Owner Company and project specific safety requirements	Table 260
General Site Clean-up	• Monitor to ensure that condition of the facility site and construction area is left in the state identified in the Issued for Construction (IFC) Drawings	Table 261
Fencing	• Confirm that fencing has been installed as per Owner Company specifications and Land Owner agreements	Table 262

15.4 Outputs

The Inspector is required to report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each work day and end of week. Report requirements and reporting processes are Owner Company and project specific; however, best practices for reporting requirements for site clean-up inspection appear in Table 263.

Detailed Checklists – Site Clean-up

15.5 Typical Input Requirements for Site Clean-up Inspection

Table 258: Information Requirements for Site Clean-up

✓	Description

	All designs, drawings, and specifications developed by the Owner Company and Contractors related to site clean-up, such as:
	• Issued for Construction (IFC) Drawings, including
	  ○ Access Road Drawings
	  ○ Grading Drawings
	  ○ Line List (e.g., special concerns for each Land Owner)
	  ○ Surface Treatment Drawings (e.g., surface gravel placement)
	  ○ Fencing Drawings

	Contracts and agreements related to: • Road Use • Crossing for Buried Facilities • Construction Survey • Municipal / County Codes and Requirements (e.g., for road repair in rural areas)
	Owner Company 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)
	Other project specific Plans, which may include: • Approved Grading Plan

15.6 Best Practice Items for Inspecting Typical Site Clean-up Operations

Table 259: Prior to Commencing Work

✓	Description
	Participate in daily meetings to address: • Job safety and / or hazard identification issues • Environmental concerns • Duties of Inspector(s) • Facility Contractor's tailgate meetings (as required)

✓	Description
	• Ad-hoc meetings with Contractors to discuss and clarify questions or concerns

Table 260: Safety Concerns for Site Clean-up

✓	Description
	Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information

Table 261: Typical Monitoring Requirements for General Site Clean-up

✓	Description
	Liaise with Land Agent on any special restoration requirements of Land Owners
	Ensure complete removal of debris (e.g., general construction debris, rocks, boulders)
	Check placement of erosion control measures for compliance with Owner Company specifications
	Ensure no surplus construction materials are left on the facility site (refer to contract documents to determine which materials will be stored and which will be scrapped)
	Confirm that reusable materials (e.g., pipe sections, valves, coating material) were returned to Owner Company after being prepared for return
	Confirm that the Contractor will conduct final clean-up when soils are dry and unfrozen
	Ensure cathodic protection test leads at all test stations are installed at specified heights on supporting poles
	Ensure final continuity check of cathodic protection test leads is completed
	Ensure rock material from construction or excavation that was not reused is removed from the facility site and hauled to an Owner Company approved dump site or distributed within a specific portion of the facility site
	Ensure all damages to facility site have been identified and repaired
	Ensure all required signage, including facility identification, pipe warning signs, and safety signage, are installed
	Confirm all erosion prone slopes are re-vegetated by seeding with approved mixes, erosion control matting, hydro-seeding and / or hydro-mulching in accordance with Owner Company specifications and Land Owner agreements
	Verify final grade and drainage requirements are met

Table 262: Typical Monitoring Requirements for Fencing

✓	Description
	Ensure all temporary fences and barricades have been removed
	Ensure that fence grounding systems are installed, as applicable
	Ensure that portable fence panels rest on the ground and are adequately supported
	Ensure that portable fence panels are securely linked
	Ensure permanent fencing support posts are securely cemented into the ground
	Ensure permanent fencing support posts are installed vertically and in line
	Ensure permanent fencing fabric is securely fastened to the support posts
	Ensure gates have full movement without hitting the ground and have sufficient clearance for snow or ice build up, as required

15.7 Typical Outputs for Site Clean-up Inspection

Table 263: Typical Reporting Requirements

✓	Description
General	
	Ensure completion of as-built red-lined drawings
	Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress
Daily	
	Complete site clean-up progress reports, including: • Daily progress of the Contractor's clean-up activities • Temporary / permanent repairs performed • Location and type of sediment control measures installed • Installation of additional warning signs • Document punch list items, as required

15.8 References – Site Clean-up

Note to user: The reference information provided in Table 264 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 ensure that the correct, and most current, documents are referenced as appropriate.

Table 264: List of References – Site Clean-up

Document No.	Type	Title
Refer to Owner Company specific plans, procedures, and specifications for additional requirements beyond those identified in Section 6.0 Facilities Construction Inspector – Foundational Information		

ENDNOTE

This Guide was developed by the INGAA Foundation and CEPA Foundation for the use of Facilities Construction Inspectors in North America. This is the original version and is subject to future revision.

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